ISPRA
Istituto Superiore per la Protezione
e la Ricerca Ambientale

A.M.B.
Associazione Micologica Bresadola

c.s.m.
A.M.B. - Fondazione
Centro Studi Micologici

MANUALI E LINEE GUIDA

History of italian mycology and first contribution to the correct nomenclature of fungi

104 bis / 2013

ISPRA
Istituto Superiore per la Protezione
e la Ricerca Ambientale

A.M.B.
Associazione Micologica Bresadola

c.s.m.
A.M.B. - Fondazione
Centro Studi Micologici

History of italian mycology and first contribution to the correct nomenclature of fungi

Manuali e Linee Guida 104 bis/2013

ISPRA - Institute for Environmental Protection and Research
Via Vitaliano Brancati, 48 – 00144 Roma
http://www.isprambiente.gov.it/en

ISPRA, Handbooks and guidelines n. 104 bis/2013
ISBN: 978-88-448-0656-9

Graphics processing: ISPRA

Cover art: Franco Iozzoli

Cover photos:
G. Bresadola: AMB archive, photo by G. Visentin from *Mycological notes* – Mycological Library of the Bresadola Mycological Association (AMB) - Mycological Study Centre (CSM).
Panel of *Amanita caesarea*: photo by G. Visentin from *Iconographia Mycologica* - Mycological Library of AMB-CSM.
Fomes fomentarius: AMB archive, photo by F. Galbiati.
Amanita muscaria: AMB archive, Mycological Group Etruria Meridionale - Bresadola Mycological Association (GMEM-AMB), photo by G. Moccia.

Editorial coordination: Daria Mazzella

I went to the woods because I wanted to live deliberately;

I wanted to live deep and suck out all the marrow of life;

To put to rout all that was not life and not when I had come to die,

discover that I had not lived.

Henry David Thoreau (1854)

INDEX

AUTHORS

The handbook has been edited by:

Carmine Siniscalco (Nature Defence Department - "*Wild Fungi Special Project*"; President of the Scientific Committee of "*Wild Fungi Special Project*"; Bresadola Mycological Association – Mycological Group Etruria Meridionale).

Francesco Doveri (Bresadola Mycological Association – Group of P. L. Morando di Livorno).

Gino Bellato (Bresadola Mycological Association – Group of Vicenza).

Luca Campana (Nature Defence Department - Parks and protected areas; Member of the Technical Secretariat of "*Wild Fungi Special Project*"; Bresadola Mycological Association – Mycological Group Etruria Meridionale).

Francesca Floccia (Nature Defence Department - Protection of biodiversity - Bioindicators and Ecotoxicology).

Carlo Jacomini (Nature Defence Department - Protection of biodiversity - Bioindicators and Ecotoxicology; Member of the Technical Secretariat of "*Wild Fungi Special Project*"; Bresadola Mycological Association – Mycological Group Etruria Meridionale).

Cristina Luperi (Bresadola Mycological Association – Mycological Group Etruria Meridionale).

Christine Marciasini (Bresadola Mycological Association - Mycological Group Etruria Meridionale).

Gianfranco Visentin (Bresadola Mycological Association – Group of Rovigo; Member of the Technical Secretariat of "*Wild Fungi Special Project*").

Collaborators

A. Bianchin (Bresadola Mycological Association - Group "Villa Franchi" of Faenza-Lugo)
R. Brotzu (Bresadola Mycological Association - Group of Belluno)
R. Carletti (Bresadola Mycological Association - Mycological Group Etruria Meridionale)
M. Chiari (Bresadola Mycological Association - Mycological Group "G. Carini" of Brescia)
G. Consiglio (Bresadola Mycological Association - Local Group A.V.I.S. of Bologna)
M. Floriani (Bresadola Mycological Association - Group "E. Bettini" of Pergine Valsugana)
F. Galbiati (Bresadola Mycological Association - Group of Varese)
C. Lavorato (Bresadola Mycological Association - Group "Sila Greca" of Acri)
M. Lombardo (Nature Defence Department - Genetically Modified Organisms)
E. Marchina (Bresadola Mycological Association - Mycological Group "G. Carini" of Brescia)
G. Medardi (Bresadola Mycological Association - Mycological Group "G. Carini" of Brescia)
G. Moccia (Provincial Administration of Rome - Operating Unit of "*Wild Fungi Special Project*")
A. Montecchi (Bresadola Mycological Association - Group "R. Franchi" of Reggio Emilia)
E. Munari (Bresadola Mycological Association - Group "Villa Franchi" of Faenza-Lugo)
C. Papetti (Bresadola Mycological Association - Mycological Group "G. Carini" of Brescia)
L. Plebani (Bresadola Mycological Association - Mycological Group "G. Carini" of Brescia)
M. Sarasini (Bresadola Mycological Association - Group "C. Vittadini" of Monza)
S. Scandurra (Bresadola Mycological Association - Mycological Association Trinacria of Torretta)
C. Zovadelli (Bresadola Mycological Association - Group of Cremona)

PREFACE TO THE HANDBOOK

The "*Wild Fungi Special Project*" was launched in 2007 by the Nature Defence Department of the Italian Agency for Environmental Protection and Technical Services. Currently, it is performed by ISPRA, to provide unconventional operational tools for environmental quality evaluation using fungi as biological indicators. The Project is divided into sixteen topics, including fungi field collection, its identification and conservation for accomplishing a National mycological flora inventory.

Concern emerged on the lack of terminology consistency, resulting from several different taxonomic classifications. Based on this need, ISPRA found necessary to carry out this handbook **History of Italian mycology and first contribution to the correct nomenclature of fungi**.

The handbook is organised into three parts.
The first one is a historical overview of Mycology from prehistoric times to the early Twentieth Century, which saw the birth of modern mycology, and is designed to provide the correct temporal framework of the species authors.
The second part is the mycological collection of more than seven thousand names, accompanied by detailed explanatory notes.
The third part is a list of correct name abbreviations of authors of fungal taxa.
Propose of this handbook, developed on the basis of the Melbourne Code rules in force since 2012 as defined in the International Code of Nomenclature for algae, fungi and plants (ICN), is to offer a basis for solving the current terminology problems.

We hope that this first contribution, result of the authors' commitment and of the collaboration with Bresadola Mycological Association, might be a reliable reference for mycologists and those who contribute in various ways to the "*Wild Fungi Special Project*" realisation.

Emi Morroni
Ad interim Nature Defence Department Director

PREAMBLE TO THE HANDBOOK

Knowledge of a living organism proceeds in successive stages: first is the simple visual perception, followed by identification of a species in comparison to similar bodies, then the discovery of those properties useful to mankind, and finally an understanding of its vital processes. In this manner we arrive, at a systematization of the whole, so that the living organism can be understood as a component of the world around us. It is through these stages, with, of course, variations, that knowledge of plants, animals and even fungi, the organism discussed here, has developed.

Fungi have always been well known to the higher animals; they eat them and can distinguish a non-poisonous mushroom from a poisonous mushroom. Human use of fungi began when we lived as hunter-gatherers. Fungi were an important food, but they were also used as medicine, hallucinogens, and poisons. However, while knowledge of plants and animals rapidly progressed, and their qualities , which even during in the Greco-Roman civilization, at least in their essential characteristics, were well known, fungi were still a mystery and remained so for a long time. They contained some plant properties and some animal properties, but yet seemed to be distinct from both groups. It was not until the eighteenth century with the fundamental work of P. A. Micheli that we find a scientific approach to the study of fungi. A century later, with the improvement of the microscope, it finally became possible to clarify the nature of the fruitbodies produced by the mycelium, a body without a definite shape and extension which cannot be perceived directly by the human eye. From that moment on the new word of reference became: "fungi" (miceti in Italian from the Greek “mykes”). The complicated reproductive processes of the mycelium only became clear a few decades ago. Today this group is the focus of scientific study that has shifted from the world of macroscopic fungi to yeasts, which are of great importance due to their particular biochemical characteristics.

In recent decades the place of Fungi within the complex of living organisms has been clarified, at least in general outlines: they form a group, and due to their molecular and genetic characteristics they are more closely connected to animals than to plants. In ecosystems (at least in countries with temperate or cold climates, like ours), fungi play a vital role in the recycling of organic matter produced by green plants through photosynthesis and without fungi the balance of the biosphere would be seriously impaired.

At this point, new questions arise. First, the need to have an overview of this group of living organisms. Federico Cesi’s excellent plates already (designed between 1610 and 1630, still unpublished today) illustrated several hundred species of fungi seen in Central Italy. At the end of the nineteenth century to describe fungi P.A. Saccardo began "*Sylloge fungorum omnium hucusque cognitorum*", a work that was published in 25 volumes without arriving at a complete picture of fungi. Subsequent to, as well as contemporaneously, with the work of Saccardo, Giacomo Bresadola completed the splendid “*Iconographia Mycologica*”, which contained over 1000 original plates. Today we know that Fungi form one of the great groups of living organisms, the number of entities of fungi (species, subspecies, varieties) known in our country is much larger than that of green plants.

Binomial nomenclature was introduced by Linnaeus to identify living species, which for Fungi was developed mainly by C.H. Persoon and E. M. Fries in the early decades of the nineteenth century. Thus, all known fungi present in Italy are also "labeled" with a Latin binomial, followed by the name (often abbreviated) of the first person to describe the species. It should be no surprise that over the course of the next two centuries there have been numerous name changes, different interpretations, and at times simply mistakes. These reasons explain an interest in the work that is presented here. It seeks to provide a nomenclatural standard for the species of Fungi in our country and surrounding areas. An update of classic works, which have not been broadly diffused and are difficult to consult now seems necessary.

In its general structure, this volume could be interpreted as a catalog of Italian Fungi. Today, in many fields of biogeography catalogs of names are published (in general with the more modern title of Check List or Checklist), providing a biological inventory of a certain area. This is not the purpose of this list of Italian Fungi. Such an approach may make sense for vascular plants, which are fixed to the substrate, while Fungi, which, at least in most cases, are spread by means of spores, are not closely related to a given territory. The authors have undertaken extensive efforts to review and unify the

nomenclature of fungus species, which anyone dealing with Italian mycology may use as a reference. In other words, it is not simply a package of knowledge of which one must simply make note, but rather a working tool available to scholars. This is the reason that we used a deliberately limiting term above where we stated that this work "*seeks to provide a standard*". Knowledge of living organisms is constantly evolving, and as a consequence nomenclature must adapt to a constantly developing reality.

In conclusion, we return to what we were originally indicated as the ultimate goal of knowledge and, namely the completeness of information, such as to achieve a synthesis in a unitary system. With respect to Fungi there has been significant progress in recent decades, but nevertheless many issues remain unresolved. This also includes the mycological component of our country. One can therefore hope that the work presented here can provide a basis for a better understanding of Fungi as a whole, and the role they play in the ecological balance of Italy.

Sandro Pignatti
Professor Emeritus of the
University of Rome "La Sapienza"

INTRODUCTION TO THE HANDBOOK

The ISPRA Project "*Wild Fungi Special Project*" promotes and provides studies on fungal species to evaluate their use as biological indicators in environmental quality assessment. To this end, it participates in the national technical committee set up by ISPRA on soil biodiversity and land degradation monitoring network. This contribution in 2012 led to the creation of eight national "Centres of Excellence" and the publication of a Booklet ISPRA "Nature and Biodiversity" (QNB 4/2012), which shows the feasibility and the historical and cultural background.

In 2010, International Year of Biological Diversity, Italy has established the National Strategy for Biodiversity (SNBD) as provided by Law 124 of 14/02/94. It foresees the launch of a national program of soil biodiversity monitoring as a priority intervention needed to achieve its specific objectives (Ministry of Environment, 2010). The urgent need to adopt programs for soil biodiversity monitoring is caused both by the ever-increasing pressures on soil, and by the current limited amount of acquired information (Gardi *et al*. 2009) when compared to the actual amount available.

This is especially true for fungi, of which we know only a small part, evaluated at 4.5% of the total mycological biodiversity.

One of the main research themes of "*Wild Fungi Special Project*" is the field sampling of fungal material, its determination and drying, resulting in a national census of the mycological flora. This to assemble data for a checklist of Italian macro-mycetes and eventually to draw a mycological map at the National scale. This process needs a historical and geographical analysis of all available sources, including those stored in museums and in private and public mycological collections. Therefore, it is crucial to find among all these sources a correct classification key and a universal nomenclature in order to avoid both taxa duplication or synonymy and confusion among researchers.

These problems emerged in some National scale studies - such as the European Report "Chemical Elements in Higher Fungi" (JRC, 2011) and the drafting of our next handbook on the association of mycological species with vegetation habitats. They also highlighted the need to provide the public and specialists with a useful reference text.

The first part of this handbook summarizes the history of Italian mycology, from prehistory to modern science. While in the ancient times information on plants and animals progressed rapidly - well known already at the time of Greek and Roman civilizations, Fungi remained mysterious for long time. Only the Eighteenth Century gives birth to a scientific approach to Fungi, and no sooner than the Nineteenth Century, with the microscope achievement, the analysis of sporophores began, resulting in reliable taxonomic keys.

The second and third parts of this handbook represent a basic guide for mycologists who want to map and monitor fungi throughout the country.

The second part contains more than 7,000 correct names of Macromycetes, with a useful set of explanatory notes on the correct name pronunciation.

The third part contains the correct abbreviation form for the fungal taxa authors' names in the version widely recognised and made mandatory by the most important magazines of international mycology, as proposed by CABI.

Carmine Siniscalco
"Wild Fungi Special Project" Leader

PART ONE:

HISTORY OF MYCOLOGY

Introduction

The first part of this handbook summarizes, with brief remarks and bibliographical notes, the history of italian mycology in the international context from prehistoric times to the early twentieth century with the works of Giacomo Bresadola.

Before describing the current knowledge of the historical course of Fungi from prehistory to the modern science of mycology, we want to point out that "only in this chapter" will be proposed the classification made by CAB International (formerly the Commonwealth Agricultural Bureau[1]) for the words "genus" and "species" for each fungus cited.

In this historical phase, comprised of continuous systematic and taxonomic turmoil, only partially alleviated by the International Code of Botanical Nomenclature, the choice of "using" a system and a taxonomy is, often, purely arbitrary.

Like in the work "*Wild Fungi Special Project*" (Cenci *et al*., 2010), a "non ideological", but essentially practical and operational choice has been made. To enable everyone to speak a common language we preferred using the system and taxonomy used in "'Index Fungorum"[2] for the ease of access to the site by anyone, and the assurance of its continuous updating as well as progresses made by phylogenetic analysis.

Carmine Siniscalco

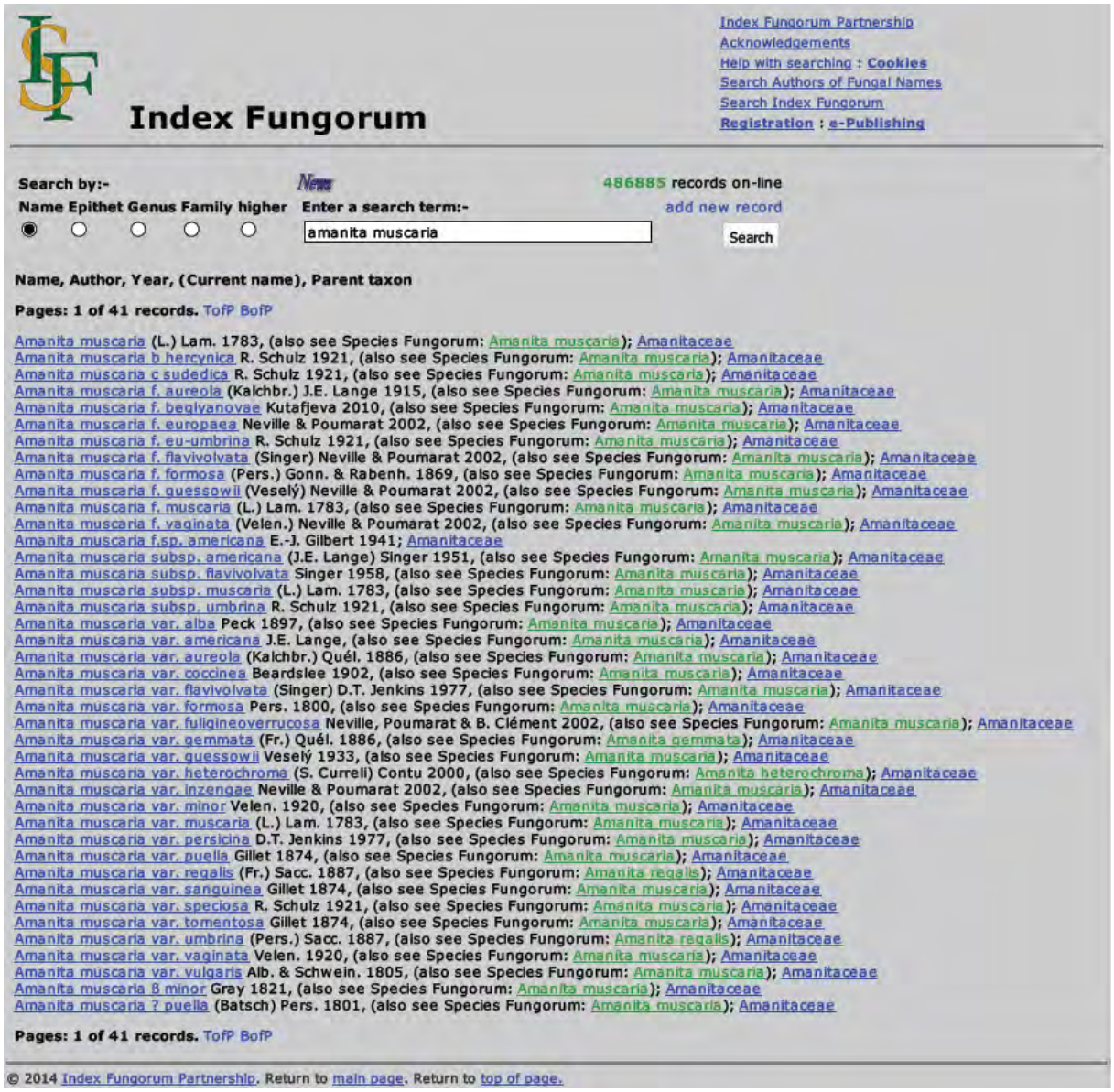
CAB International logo

Index Fungorum logo

[1] http://www.cabi.org/

[2] The Index Fungorum, the global fungal nomenclator coordinated and supported by the Index Fungorum Partnership (Landcare Research-NZ and RBG Kew : Mycology), contains names of fungi (including yeasts, lichens, chromistan fungal analogues, protozoan fungal analogues and fossil forms) at all ranks. Available at http://www.indexfungorum.org/Index.htm.

Searching the Index Fungorum database



Index Fungorum

Index Fungorum Partnership
Acknowledgements
Help with searching : Cookies
Search Authors of Fungal Names
Search Index Fungorum
Registration : e-Publishing

Search by:- Name Epithet Genus Family higher

News

486885 records on-line

Enter a search term:- amanita muscaria

add new record

Search

Name, Author, Year, (Current name), Parent taxon

Pages: 1 of 41 records. TofP BofP

Amanita muscaria (L.) Lam. 1783, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria b hercynica R. Schulz 1921, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria c sudedica R. Schulz 1921, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. aureola (Kalchbr.) J.E. Lange 1915, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. beglyanovae Kutafjeva 2010, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. europaea Neville & Poumarat 2002, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. eu-umbrina R. Schulz 1921, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. flavivolvata (Singer) Neville & Poumarat 2002, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. formosa (Pers.) Gonn. & Rabenh. 1869, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. guessowii (Veselý) Neville & Poumarat 2002, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. muscaria (L.) Lam. 1783, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f. vaginata (Velen.) Neville & Poumarat 2002, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria f.sp. americana E.-J. Gilbert 1941; Amanitaceae
Amanita muscaria subsp. americana (J.E. Lange) Singer 1951, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria subsp. flavivolvata Singer 1958, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria subsp. muscaria (L.) Lam. 1783, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria subsp. umbrina R. Schulz 1921, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. alba Peck 1897, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. americana J.E. Lange, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. aureola (Kalchbr.) Quél. 1886, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. coccinea Beardslee 1902, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. flavivolvata (Singer) D.T. Jenkins 1977, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. formosa Pers. 1800, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. fuligineoverrucosa Neville, Poumarat & B. Clément 2002, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. gemmata (Fr.) Quél. 1886, (also see Species Fungorum: Amanita gemmata); Amanitaceae
Amanita muscaria var. guessowii Veselý 1933, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. heterochroma (S. Curreli) Contu 2000, (also see Species Fungorum: Amanita heterochroma); Amanitaceae
Amanita muscaria var. inzengae Neville & Poumarat 2002, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. minor Velen. 1920, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. muscaria (L.) Lam. 1783, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. persicina D.T. Jenkins 1977, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. puella Gillet 1874, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. regalis (Fr.) Sacc. 1887, (also see Species Fungorum: Amanita regalis); Amanitaceae
Amanita muscaria var. sanguinea Gillet 1874, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. speciosa R. Schulz 1921, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. tomentosa Gillet 1874, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. umbrina (Pers.) Sacc. 1887, (also see Species Fungorum: Amanita regalis); Amanitaceae
Amanita muscaria var. vaginata Velen. 1920, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria var. vulgaris Alb. & Schwein. 1805, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria ß minor Gray 1821, (also see Species Fungorum: Amanita muscaria); Amanitaceae
Amanita muscaria ? puella (Batsch) Pers. 1801, (also see Species Fungorum: Amanita muscaria); Amanitaceae

Pages: 1 of 41 records. TofP BofP

Species synonymy

Search Species Fungorum : **Cookies**
Search Bibliography of Systematic Mycology
Search Dictionary of the Fungi Hierarchy

Species Fungorum

Synonymy See Note

Current Name:
Amanita muscaria (L.) Lam., *Encycl. Méth. Bot.* (Paris) **1**(1): 111 (1783)

Synonymy:
Agaricus aureolus Kalchbr., *Icon. Sel. Hymenomyc. Hung.*: 9 (1873)
Agaricus imperialis Batsch, *Elench. fung.*, cont. prim. (Halle): 59 (1783)
Agaricus muscarius L., *Sp. pl.* **2**: 1172 (1753)
Agaricus muscarius var. formosus (Gonn. & Rabenh.) Peck, *Ann. Rep. N.Y. St. Mus. nat. Hist.* **33**: 44 (1883) [1880]
Agaricus muscarius var. formosus (Pers.) J. Kickx f., *Fl. crypt. Louvain* (Bruxelles): 185 (1835)
Agaricus muscarius L., *Sp. pl.* **2**: 1172 (1753) **var. muscarius**
Agaricus muscarius var. puella J. Kickx f., *Fl. crypt. Louvain* (Bruxelles): 185 (1835)
Agaricus muscarius var. puella Sw., *K. Vetensk-Acad. Nya Handl.* **30**: 87 (1809)
Agaricus muscarius var. sanguineus J. Kickx f., *Fl. Crypt. Flandres* (Paris) **2**: 128 (1867)
Agaricus nobilis Bolton, *Hist. fung. Halifax* (Huddersfield) **2**: 46, tab. 46 (1788)
Agaricus pseudoaurantiacus Bull., *Hist. Champ. Fr.* (Paris) **3**: 673, tab. 122 (1812)
Agaricus puellus Batsch, *Elench. fung.*, cont. prim. (Halle): 59 (1786)
Amanita aureola (Kalchbr.) Sacc., *Syll. fung.* (Abellini) **5**: 12 (1887)
Amanita circinnata Gray, *Nat. Arr. Brit. Pl.* (London) **1**: 600 (1821)
Amanita formosa Gonn. & Rabenh., *Myc. Europ.* (Dresden): tab. 10, fig. 2 (1869)
Amanita muscaria b hercynica R. Schulz, (1921)
Amanita muscaria c sudedica R. Schulz, (1921)
Amanita muscaria f. aureola (Kalchbr.) J.E. Lange, *Dansk bot. Ark.* **2**(no. 3): 9 (1915)
Amanita muscaria f. beglyanovae Kutafjeva, *Nov. sist. Niz. Rast.* **44**: 138 (2010)
Amanita muscaria f. europaea Neville & Poumarat, *Bull. Soc. mycol. Fr.* **117**(4): 301 (2002) [2001]
Amanita muscaria f. eu-umbrina R. Schulz [as '*a eu-umbrina*'], *Pilz- u. Kräuterfreund* **4**: 227 (1921)
Amanita muscaria f. flavivolvata (Singer) Neville & Poumarat, *Bull. Soc. mycol. Fr.* **117**(4): 314 (2002) [2001]
Amanita muscaria f. formosa (Pers.) Gonn. & Rabenh., *Myc. Europ.* (Dresden) **31**(4): 5 (1869)
Amanita muscaria f. guessowii (Veselý) Neville & Poumarat [as '*gussowii*'], *Bull. Soc. mycol. Fr.* **117**(4): 305 (2002) [2001]
Amanita muscaria (L.) Lam., *Encycl. Méth. Bot.* (Paris) **1**(1): 111 (1783) **f. muscaria**
Amanita muscaria f. vaginata (Velen.) Neville & Poumarat, *Bull. Soc. mycol. Fr.* **117**(4): 318 (2002) [2001]
Amanita muscaria subsp. americana (J.E. Lange) Singer, *Lilloa* **22**: 386 (1951) [1949]
Amanita muscaria subsp. flavivolvata Singer, *Sydowia* **11**(1-6): 374 (1958) [1957]
Amanita muscaria (L.) Lam., *Encycl. Méth. Bot.* (Paris) **1**(1): 111 (1783) **subsp. muscaria**
Amanita muscaria subsp. umbrina R. Schulz, *Pilz- u. Kräuterfreund* **4**: 228 (1921)
Amanita muscaria var. alba Peck, *Ann. Rep. N.Y. St. Mus.* **48**: 313 (1897) [1895]
Amanita muscaria var. americana J.E. Lange
Amanita muscaria var. aureola (Kalchbr.) Quél., *Enchir. fung.* (Paris): 3 (1886)
Amanita muscaria var. coccinea Beardslee, *Notes on the amanitas of the southern Appalachians*, Part I. Sub-genus Amanitopsis: 8 (1902)
Amanita muscaria var. flavivolvata (Singer) D.T. Jenkins, *Biblthca Mycol.* **57**: 56 (1977)
Amanita muscaria var. formosa Pers., *Observ. mycol.* (Lipsiae) **2**: 37 (1800) [1799]
Amanita muscaria var. fulgineoverrucosa Neville, Poumarat & B. Clément, in Neville & Poumarat, *Bull. Soc. mycol. Fr.* **117**(4): 306 (2002) [2001]
Amanita muscaria var. guessowii Veselý [as '*güssowii*'], *Annls mycol.* **31**(4): 254 (1933)
Amanita muscaria var. inzengae Neville & Poumarat, *Bull. Soc. mycol. Fr.* **117**(4): 310 (2002) [2001]
Amanita muscaria var. minor Velen., *České Houby* **1**: 197 (1920)
Amanita muscaria (L.) Lam., *Encycl. Méth. Bot.* (Paris) **1**(1): 111 (1783) **var. muscaria**
Amanita muscaria var. persicina D.T. Jenkins, *Biblthca Mycol.* **57**: 59 (1977)
Amanita muscaria var. puella Gillet, *Hyménomycètes* (Alençon): 39 (1874) [1878]
Amanita muscaria var. sanguinea Gillet, *Hyménomycètes* (Alençon): 39 (1874) [1878]
Amanita muscaria var. speciosa R. Schulz, *Pilz- u. Kräuterfreund* **4**: 228 (1921)
Amanita muscaria var. tomentosa Gillet, *Hyménomycètes* (Alençon): 39 (1874) [1878]
Amanita muscaria var. vaginata Velen., *České Houby* **1**: 197 (1920)
Amanita muscaria var. vulgaris Alb. & Schwein., *Consp. fung.* (Leipzig): 143 (1805)
Amanita muscaria ß minor Gray, *Nat. Arr. Brit. Pl.* (London) **1**: 600 (1821)
Amanita muscaria ? puella (Batsch) Pers., *Syn. meth. fung.* (Göttingen) **2**: 253 (1801)
Amanitaria muscaria (L.) E.-J. Gilbert, in Bresadola, *Iconogr. Mycol.* **27**(Suppl. 1): 76 (1941)
Amanitaria muscaria (L.) E.-J. Gilbert, in Bresadola, *Iconogr. Mycol.* **27**(Suppl. 1): 76 (1941) **var. muscaria**
Venenarius muscarius (L.) Earle ex Murrill, *Mycologia* **7**(3): 152 (1915)

Synonymy Contributor(s):
Kew Mycology (2013)

Click on an entry to see Index Fungorum data. Please contact Paul Kirk if you have any additions or errors to report.

back to previous page

1. THE ORIGIN

Fungi have ancient origins, postulated to date back about three billion years. The documentation of their existence, inferred from recently discovered fossils, dates back to several hundreds of millions of years.

Some mycorrhizal fossils similar to the Glomales found in Ordovician rocks indicate the presence of these fungi when the only land plants were represented by bryophytes (Redecker *et al*., 2000). The first known oribatal mites, organisms which today live in association with fungi and organic matter in the soil, upon which they feed, can be traced to this period (Bernini *et al*., 2002).

Molecular studies have confirmed the estimate for the origin and diversity of arbuscular mycorrhizal fungi (AMF) in 353000000-462000000 years (*Nature*, 1993) and the presence of a single genus, *Glomus*, and the coincidence with the presence of the first land plants, 415 million years.

Glomus

Source: http://tolweb.org/Glomeromycota

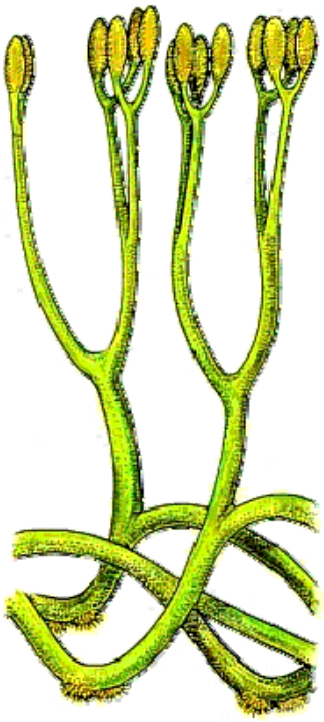
Though we have no evidence that these fungi already had symbiotic relationship with bryophytes, fossil evidence of terrestrial plants from the Devonian era and the well-documented ability of present day bryophytes to form arbuscular vascular symbiosis with mycorrhizal fungi suggests this possibility (Redecker *et al*., 2000).

Studies of fossil plants from the Devonian era indicate that primitive plants as *Aglaophyton*, *Rhynia* and *Asteroxylon* contained in their root system structures, such as vesicles and spores, similar to those formed today by Fungi of the genus *Glomus* Tul. & C. Tul.

This fossil evidence confirms the estimates of the origin of major groups of soil fungi to approximately 600 million years ago. Among 300 million year old carboniferous remains are several types of still vegetating fungi (Goidanich *et al*., 1982).

There is very little information on Fungi in antiquity and the few references that can be found in literature are almost always related to practices and customs of daily life, such as the lighting of the fire, food, medical care and religious rituals.

Aglaophyton



Source: http://www.uni-muenster.de/GeoPalaeontologie/Palaeo/Palbot_2011/Rhynie/2.html

The findings of fungus remains at the Neolithic archaeological excavations and there is evidence of their use in lighting fires[3]. Fossils found by pile dwellings near Swiss lakes, are evidence of how their prehistoric inhabitants gathered them for use as food and decoration.

Etchings from as early as the Upper Paleolithic (35,000 BC) period, with the presence of the so-called Cro-Magnon man[4], have been found in Europe showing anthropomorphized hybrids of humans with deer, wolves and birds have been interpreted by scholars as shamans engaged in rituals. These primitive healers learned how to splint, but not how to mend fractures, and skulls showing drill marks with slices of cranial bone removed using stone tools are frequently found. Researchers explain this practice as the liberation of evil spirits which had possessed the patient, or as treatment of skull fractures. The significant percentage of individuals that survived these "surgical" interventions suggests that the shamans had knowledge of anesthesia and antiseptics with the use of specific plants and/or fungi. Moreover, the shaman healing practices were not related only to the use of herbs and/or fungi, but were accompanied by many rituals that included spells, prayers and amulets.

The spiritual and magical use of fungi linked to the medicine, has been handed down for millennia to the present day and in some cultures the medicinal properties of polypores[5] in general is frequently associated with strength and wisdom. For example, the polypore *Haploporus odorus* (Sommerf.)

[3] Beginning in the Paleolithic Era *Fomes fomentarius* (L.) Fr. Was the fungal species most commonly used to start fires.

[4] In 1868 French workers working on the Marseille-Bordeaux railway line, discovered at Cro-Magnon in the Dordogne the remains of five human skeletons placed over hearths containing work tools and animal bones. The scientists were able to quickly compare those with other skeletons which were unearthed in the meantime: all were attributed to a type to the most advanced type of Neanderthal man, who was called Cro-Magnon. Following the classification routinely adopted today by paleoanthropologists, these men belong to the subspecies *Homo sapiens sapiens*, that is, in other words they are not any different from modern man except with respect to some negligible morphological details.

[5] In many cases, the generic term Fungi polypores, is not indicated only species belonging to the family of former *Polyporaceae* Fr. ex Corda, but also other fungal species with poroid hymenium.

Bondartsev & Singer is revered by the Native American *Blackfoot* and *Cree* tribes, as well as other tribes. Religious vestments and other sacred objects used by shamans, all symbols of spiritual power, were made with this fungus. Furthermore, *H. odorus* was used for protection and to ward off disease, either by wearing it around the neck or burning it. Among the *Cree* it was used as incense, vaporizing it to "*open the doors to the spirit world to be able to see and hear spirits*" and it would often also have a medicinal use.

From the time of Hippocrates[6], burning tinder fungi were used for cauterization and this practice has survived to this day among Laplanders, the Chinese and Japanese. Tinder fungi were also used to stop blood flow by surgeons, barbers and dentists, hence the name "Surgeons'Agaric". While a sort of absorbent cotton prepared with this mushroom was applied externally on wounds and burns, or as a heating compress. In Europe it was used for dysmenorrhea, hemorrhoids and bladder problems; in India as a diuretic, laxative and nerve tonic; and in China for esophagus, stomach and uterine cancer . Among the **Khanty**[7] of Siberia, this species was reduced to powder with *Phellinus igniarius* (L.: Fr.) Quél. and inhaled, while the American Indian **Athapaskan**, **Eyak**, **Tanaina** tribes and some **Eskimo** tribes[8], even today, smoke the ashes, alone or mixed with tobacco. Tinder fungi were also used in fumigation rituals of the **Khanty** Siberians and the **Ainu** of Japan's Hokkaido Island, where they were burned around houses throughout the night, to drive out evil spirits that were carriers of diseases and epidemics.

Just as ancient, and still in use today is the exploitation of the medicinal and hallucinogenic qualities possessed by macromycetes in the countries of Central America.

Sculptures and etchings clearly outlining mushrooms dating back to 1300 BC have been found in Mexico and Guatemala, where they have been attributed to the Mayan civilization.

Mushrooms are also recognizable in prehistoric etchings and in some representations of the ancient Egyptian, Indian and Sumerian civilizations.

In medieval Europe, people believed that Fungi were the work of the devil who, when wandering on Earth, took on the guise of a fat toad, and ordered mushrooms to sprout from the earth for use as stools[9]. Mushrooms are found in many anecdotes during that period, which have generated false beliefs and superstitions.

There is no denying that the Fungi have always had a place in popular folklore and the ensuing legends were in all likelihood encouraged by the very nature of Fungi, mainly from their fruitbodies and their life cycle which can be condensed into: unknown origin[10], sudden appearance[11], poisonous, brief life and speedy decomposition.

In the Renaissance, Fungi were still considered plants "*without fruit and seed*" consisting of some "*disordered matter*".

It was not until the eighteenth century that the first fundamental mycological findings appear and Pier Antonio Micheli, considered, and rightly so, the founder of modern mycological science, in the nineteenth century consecrated mycology a science independent of botany.

In the twentieth century from the great works of the best known and most important Italian mycologist, Giacomo Bresadola, Italian mycology made great strides and there are countless works both on taxonomy and mycological diffusion, thanks to the scientific works of the Bresadola Mycological Association (AMB), founded in Trento in 1957 as the Mycological Group G. Bresadola.

---

[6] (Cos, 460 circa 460 BC – Larissa circa 377 BC) Ancient Greek physician considered the "father" of medicine.

[7] Khanty are seminomadic people (one of the Siberian tribes) of the Siberian taiga (the Khanty-Mansi Autonomous Okrug region) which survives by livestock-farming (their livelihoods depend mainly on reindeer).

[8] The tinder mushroom, *F. fomentarius*, has been used since ancient times to stoke fires and *P. igniarius* could have been used in Alaska for their narcotic properties, often smoked or inhaled in combination with tobacco (*Nicotiana* sp.) (Ott, 1978).

[9] "Toadstool" is a poisonous mushroom which literally means the toad's stool.

[10] Isn't it true that gnomes, fairies and Fungi have an important role in our children's fairytales?

[11] Many fungal fruiting bodies grow very quickly and often in clearings in the woods, or in the fields, growing up in a circle in the so-called "Looking for Witches", which according to tradition, it is the favorite place by fairies, goblins and witches for their collective dances during the nights of the full moon …

GEOLOGICAL ERAS		
ERAS	**GEOLOGICAL PERIODS**	**MYA (MILLIONS OF YEARS AGO)**
PRECAMBRIAN		**4600**
	PREZOIC	**4600**
	ARCHEOZOIC	**3600**
	CIANOZOIC	**2500**
	PROTEROZOIC	**1600**
PALEOZOIC ERA (= ANCIENT LIFE)		**590**
	CAMBRIAN	**590**
	ORDOVICIAN	**505**
	SILURIAN	**440**
	DEVONIAN	**410**
	CARBONIFEROUS	**360**
	PERMIAN	**285**
MESOZOIC ERA (= MIDDLE LIFE)		**250**
	TRIASSIC	**250**
	GIURASSIC	**215**
	CRETACEOUS	**145**
CENOZOIC ERA (= NEW LIFE)		**65**
	PALEOCENE	**65**
	EOCENE	**58**
	OLIGOCENE	**27**
	MIOCENE	**24**
	PLIOCENE	**5,2**
	PLEISTOCENE	**2**

2. THE PREHISTORIC PERIOD

2.1 The Paleolithic and the Neolithic

Prehistory begins with the Paleolithic period from 2,500,000 BC to 10,000 BC (Ancient stone age) and ends with the Neolithic era from 8,000 BC to 5,000 BC (News stone age) passing though the Mesolithic Era from 10,000 BC to 8,000 BC (Middle stone age)[12].

Primitive peoples at the dawn of human civilization, were undoubtedly familiar with mushrooms for domestic and nutritional purposes, as well as for their religious and artistic influences.

***Amanita muscaria* (L.) Lam.**

Source: AMB archive, photo by M. Chiari

The caveman soon discovered Fungi and first and foremost among there is the *Amanita muscaria* var. *muscaria* (L.) Lam. Certainly attractive for its appearance, found in engravings in archaeological remains dating back some 8,000 to BC in Siberia, near the Pegtymel River, and cave paintings dating between 7,000 BC and 5,000 BC in Algeria (Assisi *et al*., 2006).

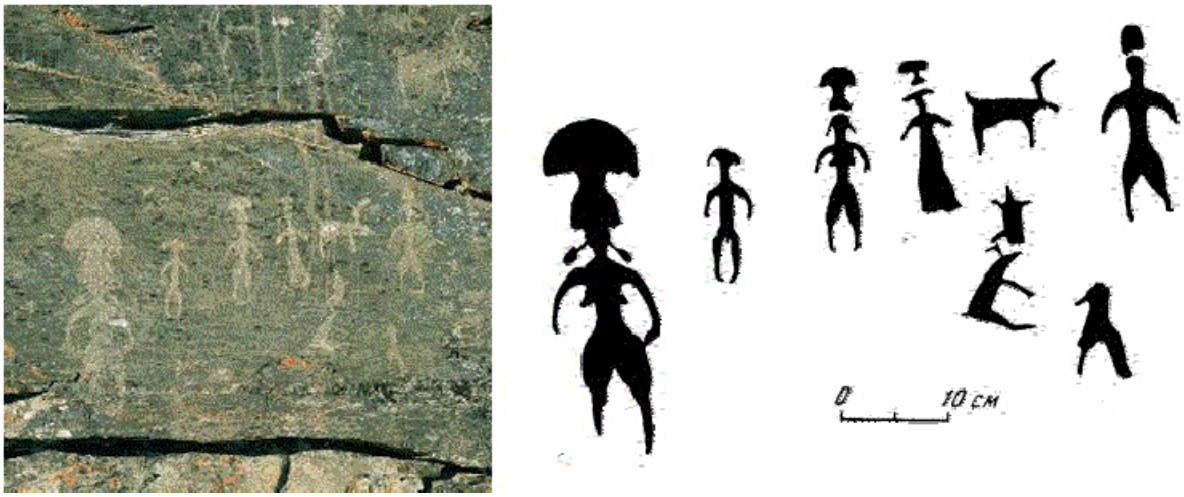
From the head of these humanoid mushroom rock engravings, protrude appendages that resemble bolts of lightning, perhaps there purpose was to represent the power and strength that consuming this

[12] The Paleolithic is divided into:

LOWER PALEOLITHIC (2,500,000 BC TO 100,000 BC)	**IN AFRICA *HOMO HABILIS*, THE FIRST HOMINID BELONGING TO THE GENUS HOMO APPEARED. AFTER CIRCA 1,000,000 YEARS *HOMO ERECTUS* APPEARED ONCE AGAIN ON THE AFRICAN CONTINENT. *HOMO ERECTUS* DISAPPEARED AROUND 100,000 BC**
MIDDLE PALEOLITHIC (100,000 BC TO 35,000 BC)	**IN EUROPE (GERMANY) NEANDERTHAL MAN (*HOMO NEANDERTHALENSIS*) APPEARS AND DISAPPEARS IN THE UPPER PALEOLITHIC PERIOD**
UPPER PALEOLITHIC (35,000 BC TO 10,000 BC)	***HOMO SAPIENS SAPIENS* APPEARS (THE PRINCIPAL RACES ARE CRO-MAGNON AND COMBE CAPELLE) SETTLING IN EUROPE, AFRICA, ASIA, AUSTRALIA AND AMERICA**

mushroom provided, or, according to some authors, a relationship between lightning and rain and the appearance of fungi. These Roundhead paintings, which are the cultural heritage left by this ancient people, who have vanished into the mists of time, demonstrate the high degree of aggregation that these people developed and their knowledge of the mushroom used in their daily lives.

Rock engravings of the river Pegtymel, Siberia



Source: http://samorini.it/site/archeologia/asia/uomini-fungo-asia/pegtymel/

In Africa ancient ritual use of hallucinogenic Fungi was found in the heart of the Sahara desert with pictorial stages named "Round Heads" by archaeologists dated to have been made between 7000 BC and 5000 BC. The main concentrations of these paintings are at the top of mountain ranges and plateaus in the Sahara, in the Tassili (Algeria), Acacus (Libya) and nell'Ennedi (Chad).

We have no reason think that these images reflect a mystical or sacred motive; perhaps they are simply playful, but what is in fact conveyed is a message of well being and joy, often found in relation to Fungi, thus not a sporadic reference (Assisi *et al.*, 2006).

Hallucinogenic mushrooms of the "Roundheads" (Sahara Desert)

Source: http://samorini.it/site/archeologia/africa/funghi-allucinogeni-teste-rotonde/

The culture of the late Stone Age, between 9,000 and 7,000 BC which produced the artistic style of "Round Head" rock would seem to be the oldest human culture identified to date which explicitly recognized the use of Fungi.

The documentation of Saharan Africa shows that the use of hallucinogenic fungi originated in the Paleolithic and was traditionally added to a religious ritual contexts (Samorini, 2002).

Numerous findings of mushroom remains in archaeological digs, referring to this historical period, demonstrate their use as tinder (the oldest find dates back about 9,000 years BC). In Denmark the Fungus *Fomes fomentarius* (L.) Fr. belonging to the family of *Polyporaceae* Fr. ex Corda, was found associated with fragments of pyrite and silica, in an environmental context dated to at least 6,000 BC.

In Yorkshire, England at Star Carr, findings of this fungus, in some instances still attached to pieces of birch and fragments of pyrite, have an even earlier date. Other samples of *Fomes fomentarius* were found in stilt villages in Italy and Switzerland, along with *Daedalea quercina* (L.) Pers., *Ganoderma lucidum* (Curtis) P. Karst. and *Phellinus igniarius*.

It is possible that the tinder used for fire during this period was made from pieces of dried mushrooms that captured sparks generated by the contact of pyrite and flint.

In Italy in some stilt dwelling remains traces of puffballs[13] and fruitbodies of *Phellinus igniarius* have been discovered, and it has been assumed that it was used for tinder.

***Fomes fomentarius* (L.) Fr.**

Source: AMB-Sila Greca archive, photo by C. Lavorato

[13] Puffball (or snowball) is the common name used to refer to Fungi Gasteromycetes epigeal (Bonazzi, 2003) belonging to the family of *Lycoperdaceae* Chevall. (1826) (Sarasini, 2005)

***Daedalea quercina* (L.) Pers.**

Source: AMB archive, photo by F. Galbiati

***Ganoderma lucidum* (Curtis) P. Karst.**

Source: AMB archive, photo by C. Papetti

3. THE ENEOLITHIC OR COPPER AGE

The Eneolithic (5,000 BC to 3,000 BC) is a transitional period between the Stone Age (Prehistory) and the Bronze Age commonly referred to as the Copper Age.

On 19 September 1991 Erika and Helmut Simon a husband and wife from Nuremberg descended from the top of the Similuan (Ötztal Alps) [14] and mistaking the trail made a macabre discovery which would subsequently contribute to the knowledge of our ancestors of that historical period.

The mummified corpse, trapped in the ice was estimated to be between from 3,350 years BC to 3,150 years BC. It was also given various names: "the Iceman", "the Similaun Man" and a very familiar name of "Ötzi".

Among "Otzi's" implements of particular interest was a small pocket of skin within which were the remains of dried mushrooms identified as *Fomes fomentarius*, splinters of flint, arrowheads and a few other remains.

Additionally, most likely tied to his wrist, were other remains of Fungi belonging to *Piptoporus betulinus* (Bull.) P. Karst species. The first was confirmed as tinder while doubts remain as to use of the second, which was found wrapped in strips of leather.

Equipment Ötzi

Source: http://www.iceman.it/it/node/326

Some suppositions have been made which range from the hallucinogenic properties of the fungus and therefore that "Otzi" was a shaman, while other theories claim that, according to ancient beliefs, *P. betulinus* had healing properties. The spiritual and magical use of *Piptoporus betulinus* can be linked the birch tree itself, which in antiquity was considered sacred. These beliefs appear to be connected to a psychoactive fungus, *A. muscaria*, which also grows associated with the birch tree. It would seem that the properties of A. muscaria were symbolically transferred to the birch polypore fungus, becoming a sort of substitute, but devoid of psychoactive effects. The tinder Fungus (*F. fomentarius*) can also grow on birch trees and could, therefore, have played a magical and spiritual role, considering the fact that physical fire could represent spiritual fire (light) reached by the ingestion of *A. muscaria*. In any case, the use as a species of hallucinogenic polypore birch (*P. betulinus*) is not reflected in the literature available to date.

[14] The pair of German hikers returned to the Simulian refuge at Giogo Basso (3,017 meters) in Val Venosta just below Giogo di Tisa (3,210 meters) near the border with Austria.

Betula pubescens

Source: AMB-Sila Greca archive, photo by C. Lavorato

4. THE ANCIENT WORLD

4.1 The Bronze Age

The Ancient Age goes from 3,500 BC to 476 AD, till the end of the Western Roman Empire.

In the pre-Columbian period in Mexico and Guatemala, Fungi appear as "mushroom-stones" depicting totemic females or animals (toads) surmounted by a large mushroom cap. Many mushroom stones have been found, initially interpreted by archaeologists as phallic symbols used as boundary stones, but the discovery of the ritual use of hallucinogenic fungi in Mexico provided the correct interpretation: these stones evoke hallucinogenic Fungi.

Maya mushroom stones

Source: http://www.mushroomstone.com/

An obvious imitation of the *Amanita muscaria* is found in the stone sculpture found in Mexico in 1997 by Guzman (Assisi *et al*., 2006). Remains of images of mushrooms have also been found in Europe, among the oldest etchings on be the oldest graffiti on Mount Bego, in the Maritime Alps and in the nearby Valley of Marvels in France dating back to 1,800 BC. In the scene depicted on the rock of the Altar "of Monte Bego, in addition to knives and lightning and a human figure called the "tribal chief", showing an engraving that looks like a mushroom, with stems and dots on the cap, reminiscent of the *Amanita muscaria*. If this were to be confirmed it would be one of the most ancient representations of this Fungus (Assisi *et al.*, 2006).

Even Ortaa-Sagol in Siberia, mushroom rock images have been identified, dating date back to the Bronze Age (1,100 BC) and from the same period are finds discovered in Scandinavia. In the Siberian finds the humanoid figures with their mushroom-shaped heads have, in addition to bows, a bag hanging from the waist, which could be a container for magic herbs, suggesting that the figures represented were shamans.

This representation of mushroom men is very similar to that of the mushroom men of Saharan Africa and pre-Columbian art, demonstrating the presence of a common denominator in the cultures of different peoples: hallucinogenic Fungi.

In Scandinavian rock art, the typical element is represented by a ship the symbolism of which, according to some authors, is related to sacral elements connected to the passage of the deceased in the afterlife, or the depiction of the journey of the sun from east to west[15].

Reliefs of petroglyphs in Aby, Bohuslän, Svezia

Source: http://samorini.it/site/archeologia/europa/funghi-arte-preistorica-scandinava/

The clear fungal elements present in these etchings, may represent the Fungus *Amanita muscaria* widely used in the Scandinavian regions; in a second vessel an enormous mushroom is held by a human figure in a pose that suggests the role of leader of the expedition: most likely a shaman. It is possible that the use of magic mushrooms, aside from moving closer to various "Odins"[16], through shamanic rituals, could have had more human uses such as not feeling fatigue on long trips and simultaneously the strength to face the unknown. It is precisely in relation to travel, that an explanation can be provided as to why these findings are present mainly on the coast. In all these archaeological finds from the Bronze Age, the common theme is an almost magical sacredness of mushrooms represented by symbolic iconography, sometimes very explicit, with a "divine mushroom" that somehow plays an important role in the life of primitive societies on every continent (Assisi *et al.*, 2006).

4.2 The Iron Age

In the Indian state of Kerala between 1,000 BC and 100 AD Megalithic culture flourished marked, as was that of Northern Europe, by dolmens, menhirs and other stone structures.

A megalithic monument common to Kerala is the "Kuda Kallu" (umbrella stone) the most important concentrations of which are found in the inner region of Trichur (Samorini, 2002). "Kuda-Kallu" are 1.5-2 meters high and consist of four stones that form the pyramidal base on which rests a fifth stone, the larger-shaped extended cap.

[15] It is possible that this means of transportation would have been pictured in these incisions because, for these populations, it was the most used means; it probably represented the innate tendency to proceed beyond the horizon to continue the voyage, to discover new worlds, both metaphysically as well as in actual fact. In fact it would seem that the discovery of America was made by the ancestors of these Northern people: the paleo-Siberian nomads in 28,000 BC, after having crossed the Bering Strait, would have brought the culture of magic Fungi to Latin America (Assisi *et al.*, 2006).

[16] Wuoton; perhaps heir to a pre-Germanic religious tradition. The etymology is connected to the term "furor", which is also the basis for divine inspiration and poetry. Although Odin occupied and dominant position in the Germanic pantheon, as the "universal father", "ruler of heaven and Earth" and "creator" does not have Olympian characteristics of the supreme deities of other populations of the indo-European languages such as the Greeks' Zeus or the Romans' Jupiter. The German god, whose name's etymological origin corresponds to these two and another (Tyr or Zio), which nevertheless is subordinated to Odin. In Odin his lethal characteristics abound: he is the leader of the "wild hunt", host of the souls of the dead; he is the god of war whose spear (Gungir) infallibly hits its mark and returns to him. His strength, only limited by fate (at the twilight of the gods Odin shall be devoured by Fenrir the wolf), that is derived by a supreme magical knowledge: to acquire this, which is drawn from the spring of Mimir, he gave his eye in exchange, thus becoming one-eyed like certain Cyclops demons of other mythologies. He knows the magic of runes acquired by the star suspended (hung) on the Yggdrasil (the sacred ash) for nine nights. He exercises both good and evil powers: raping women, stealing the magical mead of Skattung, but also creating along with his brothers, Vili and Vé, the world, raising the earth from water, and the first human couple from an ash and an elm tree. Wandering the world he knows all (two ravens keep him informed of distant happenings) and founds human civilization. The Romans, with reason, identified him with Mercury (connected with death and cultural inventions) whence the word Wednesday, the day of Wodan (Italian: mercoledì -- Mercury dies): Germanic mythology gives him Borr and Bestia as his parents, Frigg as his wife and first born son, Balder.

The symbolic association of Fungi, especially psychoactive fungi is evident and the visionary properties that these fungi provided are emphasized with their connection to the afterlife and underworld, which more so than edible mushrooms are associated them with the megalithic cult of the dead.

Kuda-Kallu from the archaeological site of Aryannoor

Source: http://samorini.it/site/archeologia/asia/kuda-kallu-kerala/

4.3 The Classical Antiquity

An interesting archeological mycological find is the Greek bas relief of Pharsalus (Thessaly), dating to the fifth century BC, now in the Louvre museum in Paris.

It has a representation of two goddesses of the Eleusinian mysteries, Demeter and her daughter Persephone, in the act of showing or exchanging items. Two of these objects have a very mushroom like shape.

Bas-relief of Farsalo

Source: http://samorini.it/site/archeologia/europa/misteri-eleusini/archeologia/

At the center of the sculpture, prominently displayed, is a mushroom held by Persephone while in Demeter's right hand is a similar mushroom, but that slants towards her daughter. This bas-relief supports the hypothesis that the Greeks had a profound knowledge of plants and mushrooms used in the course of their initiation rites of nature (Samorini, 2002).

The writings of the ancient Romans provided us with information on a people who were coarser and more "uncivilized" than they: the Huns. The latter, in fact, have not left much documentation on their way of life and in the popular imagination have remained "barbarians" and destroyers and their king, Attila, has passed into history for his cruelty. While they were in all likelihood a nomadic people driven out by the Chinese and constantly moving westward; a warlike people more prone to hunting and warfare than art. However, some artifacts, dating back to the first century BC suggest that the ritualistic traditions which they carried with them in their great migration had an element of continuity: "the caldron with the mushroom handle".

We cannot know its use, but the fact that they considered it important enough to reproduce a mushroom on its handle, suggests that for the Huns this implement had something to do with an important mushroom, probably found in the woods they traversed while traveling west. Inspections carried out along their migratory routes verified that their movements covered the area in which *A. muscaria* grows. It is conceivable that the use of this fungus, by a nomadic and bellicose people like the Huns, could have been with the intent to increase aggression more than for mysticism, of which they probably were not capable of experiencing (Assisi *et al.*, 2006).

Hun copper cauldron found in Hungary

Source: http://samorini.it/site/archeologia/europa/calderoni-unni/

The use of fungi in ancient times was regarded as something evil and it can be assumed with reason that they were used by wizards and professional "poisoners".

The symptoms describing the deaths of ancient personages actually lead to thinking that these deaths were caused poisoning from *Amanita phalloides* (Vaill. ex Fr.) Link.

Amanita phalloides **(Vaill. ex Fr.) Link**

Source: AMB archive, photo by C. Papetti

The Romans certainly knew and liked the taste of mushrooms. In Imperial Rome, they were elevated to the rank of "royal food", because the *Amanita caesarea* (Scop.) Pers. was so defined as it was destined for the “Caesars". At the same time, however, in imperial culture mushrooms were also considered to be "bearers of death" and proof of this is the Latin etymology of the word "Fungus": funus = death and needle=bearer.

***Amanita caesarea* (Scop.) Pers.**

Source: AMB archive, photo by G. Medardi

Probably the ancient Romans also knew that Fungi, like some plants, provided a pleasant alterations of the consciousness. However, the writings that have survived show the use of hallucinogenic substances, although not specifically mushrooms, for medical or recreational purposes, but do not seem to validate the use of hallucinogenic Fungi in the sacred rituals of imperial Rome (Assisi *et al.*, 2006).

From Ancient Greece, there are echoes of knowledge of that time through work of **Athenaeus**[17], a Greek anthologist during the Greek Alexandrian era (II-III century AD). The "*Deipnosophistae*" (Banquet of the Learned) contains passages, or fragments of passages, of ancient Greek writers[18] in which mention is made of toxic mushrooms and in one case refers to their artificial cultivation (Lazzari, 1973)[19]. Through Athenaeus we have the certainty that the cultivation of mushrooms has its origins in remote antiquity.

The Greek **Theophrastus**, a native of the island of Lesbos and disciple of Aristotle[20], is considered the father of botany and the first definitions of Fungi which are considered "*imperfect plants, without*

[17] Athenaeus of Naucratis (? - after 192) was an ancient Greek writer. Atheneaeus, lived between the II and III centuries AD, probably during Commodus' reign (180-192 AD), he is referred to as being of Naucratis has according to certain of his manuscripts he lived in the Egyptian city of Naucratis.

[18] These are poets and physicians for whom we only know their names: Dione Carystis, Nycandrus, Phanius, Diphilus, etc. (Lazzari, 1973).

[19] "*Burying horse manure under a fig tree and watering it abundantly*". Since it is useless to seek information as to the species, it is possible only to gather an approximate idea of the degree of mycological knowledge of Greek writers during the Alexandrian period (Lazzari, 1973).

[20] Theophrastus (Eresus, 31 BC -- Athens 287 BC) was an ancient Greek philosopher and botanist. He was disciple of Aristotle and succeeded him in the direction of the lyceum (Peripatos) in 332 BC.

roots, leaves, flowers and fruits" can be traced back to him. His writings present four types which today can be considered families: underground fungus "*Hydnon*", identifiable today as part of the *Tuberaceae* Dumortier family, soil-borne fungi with stem caps "Mykés", to which belong all the families of epigean stipulate pileated fungi; sessile fungi with a hollow form "Pòxos", part of the family of *Pezizaceae* Dumortier; round fungi shaped "*like a human head*", "Kraniòn", part of the large *Lycoperdaceae* family.

With **Dioscorides**[21] we enter the era after Christ. Born in Cilicia (Asia Minor), he was a military and civilian physician under the emperors Claudius and Nero, and he left us "Della Materia Medica", a treatise in five books. He left behind writings on the toxic properties of fungi and on the treatment for poisoning ("*decoctions of herbs, vinegar and salt potions, chicken dung with honey and vinegar ...*").

He was the first to describe the agaricum fungus variety, ie the Fungus *Laricifomes officinalis* (Vill.: Fr.) Kotl. & Pouz., widely used as a medicine in ancient times, and shows ist properties and use.

***Fomitopsis officinalis* (Vill.) Bondartsev & Singer**

Source: AMB archive, photo by G. Visentin

Another Greek doctor working in Rome at the time of Marcus Aurelius was **Claudius Galen**[22] who in the three works that have survived to modern times[23] classified Fungi in three genuses: the "bolités", the "boletus" in the old sense, today known as Ceasar's Mushroom, *Amanita caesarea* (Bonazzi, 2003), "Amanìtai", the" Porcini", today's *Boletus edulis* species: *Boletus edulis* Bull.; *Boletus pinophilus* Pilát & Dermek, *Boletus reticulatus* Schaeff.; *Boletus aereus* Bull. (Bonazzi, 2003) and

[21] Dioscorides Pedanius (Anazarbe in Cilicia, about 40 - about 90 AD) was an ancient physician botanist and pharmacist greek, who practiced in Rome at the time of the Emperor Nero. He had the opportunity to travel extensively in the greek-roman world.

[22] Galen (129-216 d. C.) was ancient greek physician whose views dominated European medicine for over a thousand years. Galen was born in Pergamum (now Bergama, Turkey), from a family of architects. His interests before focusing on medicine, were eclectic: agriculture, architecture, astronomy, astrology, philosophy. Galen practiced medicine in Rome, with great success, at the time of the emperors Marcus Aurelius and Lucius Verus Commodus.

[23] "*De Alimentorum facultatibus*"; "*De cibis bonis et malis*"; "*De simplicium medicamentorum*".

"Mykés", all other mushrooms with a stem and cap. He concluded only the first two to be edible, while "Mykés" are considered the most toxic. Galen considers Fungi overall as "*not-nutritious, indigestible and dangerous*". He describes the symptoms of intoxication and confirms as a remedy "chicken droppings" (Lazzari, 1973).

***Boletus edulis* Bull.**

Source: AMB archive, photo by C. Papetti

***Boletus pinophilus* Pilát & Dermek**

Source: AMB archive, photo by C. Papetti

***Boletus aereus* Bull.**

Source: AMB archive, photo by L. Plebani

Pliny the Elder[24], a native of Como, was admiral of the Roman fleet and died a victim of the eruption of Vesuvius that buried Pompeii and Herculaneum, after bringing his vessel to close to the beach to witness the phenomenon. His greatest passion were the natural sciences and he left "*Historia naturalis*" in 37 volumes, embodying the quintessential knowledge of the time, which all naturalists made generous use of until the end of the eighteenth century.

With respect to Fungi, he advises against the use of the "Boletus" (known to the ancient Romans as "ovules" [25]) as they were easily confused with another poisonous species of mushrooms. He clearly identifies what we now refer to the Fungus *A. muscaria* and precisely describes the origin of its warts as "*nothing but the remnants of the veil*". According to Pliny, these mushrooms can become poisonous if born "*in the vicinity of hobnails, rusted iron and drenched cloths*" as well as "*near snakepits, because it is their nature to absorb any type of poisonous substance*".

Thanks to the great advances of mycological science in the last fifty years, we can finally evaluate how these prejudices affected popular imagination up to modern day!

In another case Pliny exactly describes the development of ovules and is the first to use the term "*volva*" with a mycological meaning. "*Its origin*", says Pliny, "*is to be found in the silt of damp earth and its moods, where they begin to ferment, or in the roots of cupuliferum plants*". For centuries, that description negatively influenced the opinion of naturalists who continued to regard fungi as products of soil fermentation, or tree growths, but with today's knowledge it is only right to recognize that it does shine some insight into the saprophytic phenomenon and mycorrhizal symbiosis.

[24] Pliny, known as Pliny the Elder (Como, 23 - Stabia, after September 8, 79), was a Roman writer. His style was describing things live, therefore, he is for us a true chronicler of the period. He died between the sulphurous fumes of the volcanic eruption of Mount Vesuvius that destroyed Pompeii and Herculaneum, as he tried to observe the volcanic phenomenon more closely. In his honor, the term "Plinian eruption" is used to define a strong explosive eruption, precisely similar to that of Vesuvius in which the writer lost his life.

[25] Common name used to identify *Amanita caesarea* (Bonazzi, 2003).

Pliny must also be credited with the identificatio, albeit with a different name of *Fistulina hepatica* (Schaeff.) With.[26] and *Macrolepiota procera* (Scop.) Singer var. *procera*[27]. He talks a lot of "Suilli" (today's *Boletaceae* Chevall family.), Considering them "*very prone to poisoning*". Much depends, according to Pliny, on the plant on which a fungus grows: "*harmless are those under conifer, fig and fennel, toxic, instead, under those under beech, oak and cypress trees*". It is surprising that the *A. phalloides*, nonexistent under conifers, is typical of the deciduous forest. With Pliny we also discover even in ancient times that the excellent *Pleurotus fuscus* var. *ferulae* (Lanzi) Bres., which completes its cycle at the roots of the giant fennel on both the Italian peninsula and its islands, was already sought and consumed.

Given that fungi are so dangerous[28], Pliny warns against their use and generously provides tips that to us today are naïve. For those who really want to eat them he suggests using "*silver or amber plates*", "*lengthy cooking*" keeping in mind that, "*vinegar due to its nature is contrary to the poison and should always be used generously when eating mushrooms*".

Pliny also ventured to speak of truffles, considering them a "*calluses of the earth*". They are born in autumn, especially after storms accompanied by thunder and lightning[29] are found in different countries as in Elis (Greece), at Lampsacus (Asia Minor), the island of Mytilene[30], where "*floods carry the seeds to the plains*".

Pliny relates an interesting story about truffles that abounded in North Africa. He tells of a Roman praetor, Lartius Licinius, who on a mission to Carthage broke his teeth biting into a truffle which during its growth had incorporated a coin; it all probability was the *Terfezia arenaria* (Moris) Trappe, a truffle well known from antiquity with the name of "*terfez*" from North African Mediterranean populations.

Other species of Fungi were named by Pliny in the fourteenth chapter of Book XIX. The "*pezizaceae* ("cup mushrooms") *so named because they have no stem*". Today it is difficult to determine to which family sessile mushrooms may belong, as they could encompass both the *Pezizaceae* Dumort family as well as the *Lycoperdaceae* family.

In the thirteenth chapter of volume XVI Pliny describes the'"Agaricum" (*L. officinalis*) as an "*odorous white fungus, used in medicine, that sprouted on roots of cupuliferum trees in Gaul and also had luminescent properties*". In this case, the Roman writer highlights the faulty information of his Greek sources, this fact poliporacea fungus grows exclusively on larch, in alpine areas, and has no luminescent phenomena. The explanation for this erroneous information may reside in the fact that this fungus can be stored indefinitely and be sent even from very distant regions, and for which the origin of the region may not have been known; further gatherers, earned large profits, and had a vested interest in not revealing their origin, hence the cause of uncertainties and erroneous information (Lazzari, 1973).

[26] "*...Other fungi have a firmer consistency. Infinite genera of these exist, but they all have a common origin: tree sap. Those that are a darker red in color than the boletus are very safe to eat...*". Most likely these are linicolus polyporaceae. The edible species according to some is *F. hepatica*, whose edible qualities have been known since ancient times (Lazzari, 1973).

[27] "*... there are species white in color, with very well developed stems and caps which look like Flamens...*". Flamens, were ancient Roman priests, wore a strange skull cap that ended in an olive wood point wrapped in wool with a point that was round like a ball of wool. It had the appearance of a young *M. procera* whose cap had not yet unfurled. In fact all mycologists identified this species with Pliny's description (Lazzari, 1973).

[28] According to Pliny the greatest risk of poisoning, was always represented by toxic boletus, which wiped out entire families and which caused the death of Aneus Serenus, a tribune of the praetorian court of Nero, at a banquet along with the other guests (Lazzari, 1973).

[29] A common theme with other Latin writers as well (Lazzari, 1973).

[30] Mytilene is the capital of Lesbos, Greek island in the Aegean Sea. The most illustrious citizen of Mytilene is the poetess Sappho, who lived in the VI century BC.

***Fistulina hepatica* (Schaeff.) With.**

Source: AMB archive, photo by G. Consiglio

***Macrolepiota procera* (Scop.) Singer**

Source: AMB archive, photo by E. Marchina

Terfezia arenaria **(Moris) Trappe**

Source: AMB archive, photo by A. Montecchi

Tuber magnatum **Picco**

Source: AMB archive, photo by E. Munari

5. THE MIDDLE AGE

5.1 The Early Christian and Medieval Art

The Middle Ages goes from 476 to 1492 d. C., the year of the discovery of America.

Recent studies by Giorgio Samorini on ancient Christian culture have brought to the fore how the mycological tradition of various peoples was expressed in an esoteric form in church frescoes. These studies are based primarily on iconographic documents, with particular attention to the so-called "tree-mushrooms" of primitive Christian and medieval art. Called "pilzbaum" by German scholars of Christian art, their main feature is that they resemble fungi more than trees (Samorini, 1998).

Until now no one had any idea that these representations intended to actually represent the fungus plant, with a hidden esoteric message. With the exception of the tree-mushroom found in the Plaincourault chapel, for which a French mycologist at the beginning of the 1900s suggested that this strange tree in the Garden of Eden around which is coiled a snake and is placed between Adam and Eve, was meant to represent *A. muscaria*. The esoteric meaning was clear: the forbidden fruit and the Tree of Knowledge of Good and Evil are identified with a hallucinogenic mushroom, a fungus that gives heavenly visions. The Plaincourault fresco of belongs to Romanesque art of the twelfth century and was painted by the Knights of Malta on their return from the Crusades (Samorini, 1997).

Plaincourault Fresco

Source: http://www.egodeath.com/christianmushroomtrees.htm

In the great abbey of Saint-Savin sur Gartempe, a different model of tree-mushroom can be seen, consisting of three mushrooms characterized by striations on their caps, which is a morphological characteristic peculiar to pileated mushrooms.

The majority of the tree-msuhrooms studied by Samorini are divided into the two types: Plaincourault and Saint-Savin. The first group resembles *A. muscaria*, while the second group resembles psilocybin mushrooms, and for this author it is difficult to think that it is a coincidence that the two main types of hallucinogenic mushrooms in nature correspond to the two main types of mushroom trees in Christian art (Samorini, 2002).

Other examples of both types of tree-mushrooms (III and IV century AC) can be found in the Tunisian mosaics of the late Roman and paleo-Christian eras in Messaouda and Ounaissia (Samorini, 2002).

A stunning depiction of tree-type Plaincourault mushroom is present in a page of English alchemist wiritngs of the sixteenth century. The shape of tree significantly resembles *A. muscaria*, with its conspicuously dappled cap. The man next to the tree-mushroom holds a mushroom in his left hand and with his right hand covers his face, in a typical gesture of someone in a mental state of intoxication or dizziness. This drawing shows a new detail of notable interest in that tree-mushroom is associated with a salamander, and a second salamander is drawn on a fire.

For Samorini this is the first confirmation of one of his old hypotheses. In certain parts of the medieval alchemical world the salamander was a secret symbol of *A. muscaria*, while the alchemical symbol of the salamander on a fire represents an allegory of the operation of drying the cap of this mushroom. It is known that, to achieve the full effects from this mushroom, it is necessary it must be dried (Samorini, 2002).

Samorini found other tree-mushrooms in capitals of the famous abbey of Vezelay, also in central France, which are dated circa 1150 AC. In one of these the biblical scene of the fight between David and Goliath is carved and next to it is sculpted a Saint-Savin like tree-mushroom.

A type of mushroom tree unlike the two previously described was found in the church of Vic, also in central France. On one wall is painted the scene of Christ's entry into Jerusalem, riding a mule. Some people are depicted as they climb trees to remove flowers to offer to Jesus, but one of these trees has "leaves" that clearly have a mushroom like formation.

Fresco in the church of St-Martin, in the village of Vic

Source: http://www.egodeath.com/christianmushroomtrees.htm

The scene continues onto the other wall with the painted walls of Jerusalem, on which can be seen a mushroom tree similar to the above, on which a few individuals have perched intent on cutting the

mushrooms with knives. It is difficult in this case to doubt the artist's intention to truly represent mushrooms (Samorini, 2002).

The documents of this type of identified to date by Samorini are far more numerous than those cited here, and while open to possibilities, the contemporary scholar is inclined to see in all these works of art documenting a context that goes beyond Christian culture. A "mycological tradition" of religious and esoteric, which carries within it the knowledge and use of hallucinogenic mushrooms, differentiated by cultural currents and species of fungi. A knowledge that originated in antiquity and has survived through the centuries. At certain times the followers of mycological traditions were persecuted and had to confess in secret, as in the case of certain witches or some Christian sects deemed heretical by the central power of the Church. Before and after Christ, internal and external to Christianity, the tradition has been preserved by opening more than one route in the chaos of Eurasian cultures. A tenacious tradition, as in the case of Mexico, where the worship of hallucinogenic mushrooms, believed for centuries to have become extinct under the blows of the colonial Inquisition, has actually persevered to this day. It is within this context that we can look for explanations and references to knowledge of psychoactive mushrooms within the broad Christian cultures: which should not be seen as an unshakable cultural monolith, but as a "cultural form" which frequently merged locally or marginally with traditional religions and arts such as alchemy, where devout Christians could encounter mycological traditions, expressing them in an esoteric form in frescoes in churches. Mycological traditions have been preserved for centuries and millennia following cross-cultural pathways, while the necessary faith was constantly enlivened by experiences made with sacramental mushrooms. Many cults, religions, beliefs, rites in all periods with a single visionary sacrament: the sacred mushroom (Samorini, 2002).

Contrary to conventional wisdom which considers the middle ages a period of obscurantism, both culture and science, had remarkable development, even this was limited to the monasteries (the true savior of classical culture through the work of scribes) and to the Arab world. A major impetus for culture, which was a prelude to the splendid era of the Renaissance, came after the year one thousand, with the birth of communes, national languages and universities.

In terms of natural science the famous Arabian physician Avicenna[31] and the German theologian and philosopher St. Albertus Magnus (thirteenth century) should be remembered. As for mushrooms, with the exception of the artistic and esoteric depictions discussed above, there is almost complete silence on their use and study. Sporadic but interesting information is provided by Albertus Magnus, who in his book "On Plants" mentioned for the first time *A. muscaria* and mentions its use as fly repellent by northern populations.

5.2 The Renaissance at the End of the Middle Ages

The end of 1300 A.D. marks the beginning of a profound cultural renewal placed between the late Middle Ages and the early period of the Modern Era. During the Renaissance, thanks to changing socioeconomic conditions, and the invention of printing with movable type, ancient literary, philosophical, and artistic are re-discovered and disseminated.

The Renaissance also ushers in a new era for botany, which was elevated to the dignity of a science. Many works were translated from Greek into Latin, commented and embellished beautiful *Herbarii*.

A meritorious scholar of the natural sciences during the Renaissance was **Ermolao Barbaro** (1454-1492), a Venetian nobleman and politician, commentator on Pliny, translator and commentator of Dioscorides. Barbaro was the first during the Renaissance to treat Fungi with several references to his direct observations. From his commentary on Dioscorides we learn that the Greeks considered Fungi a "*food of the gods*" or even "*children of the gods*", as it appeared that they were born without the assistance of seeds.

[31] Ibn Sinā, alias Abū ʿAlī al-Ḥusayn ibn ʿAbd Allāh ibn Sīnā o Pur-Sina, commonly known in the West as Avicenna.

***Clitopilus prunulus* (Scop.) P. Kumm.**

Source: AMB archive, photo by A. Bianchin

***Calocybe gambosa* (Fr.) Donk**

Source: AMB archive, photo by G. Medardi

***Pleurotus eryngii* (DC.) Quél. – [*Pleurotus eryngii* var. *eryngii* (DC.) Quél.]**

Source: AMB archive, photo by S. Scandurra

In his observations Barbaro discusses some types of Fungi, whose names are close enough to present-day names, for example:

"*There are Aegiritae fungi, which can be grown on the trunks of poplar trees, by spraying them with water and yeast*". Pioppini or piopparelli are the current Italian common names (Bonazzi, 2003) for the *Agrocybe cylindracea* (DC.) Maire.

"*Fungi which sprout from thorns and thistles are absolutely harmless, have a cylindrical form when they are still closed, what we call Spinulosi, Prunuli and Cardeoli*". According to a modern author (Lazzari, 1973) in the latter of these Fungi can be recognized the *Clitopilus prunulus* (Scop.) P. Kumm., the *Calocybe gambosa* (Fr.) Donk and the *Pleurotus eryngii* (DC.) Quél.

Barbaro introduces us to the "Lapis lyncurius" or "Lynx stone" or "mushroom rock"; following the popular opinions of the time, Barbaro believed it was born from a stone fossilized with Lynx urine.

In later periods this fungus will so excite the imagination of naturalists as to consume reams of paper. This Fungus is actually the *Polyporus tuberaster* (Jacq. ex Pers.) Fr., which forms the bulbous underground sclerotia that can weigh several pounds and look like a stone.

His notions of the "Ignarii", i.e., the “tinder” polypore were original; *F. fomentarius* was used in the millennia to maintain fire and to produce a cotton mass with hemostatic action.

Lynx

Source: http://bestiary.ca/beasts/beast135.ht

Agrocybe cylindracea (DC.) Maire

Source: GMEM-AMB archive, photo by C. Siniscalco

***Polyporus tuberaster* (Jacq. ex Pers.) Fr.**

Source: AMB archive, photo by C. Lavorato

***Piptoporus betulinus* (Bull.) P. Karst.**

Source: AMB archive, photo by A. Bianchin

6. THE MODERN AGE

6.1 The Renaissance

A great representative of the Renaissance is **Pier Andrea Mattioli** (1500-1577), born in Siena, he graduated from the University of Padua with a degree in medicine and settled to practice in Trento, where he is entombed in its cathedral. His fame is due to the "*Discorsi ("Commentaries") on the Materia Medica of Dioscorides*", a work printed in Venice in 1554, containing wonderful paintings, a true best-seller (60 editions in two hundred years) and an invaluable guide for doctors, pharmacists and naturalists.

His work is eclectic, a mix of medicine, pharmacology, zoology, mineralogy and, especially, botany.

Fungi are treated in several chapters. He speaks of "Prignoli", for us Blackthorn (Bonazzi, 2003) or *Calocybe gambos*a, very common in Tuscany, "*strongly scented, very pleasant taste and safe*".

Source: http://en.wikipedia.org/wiki/Pietro_Andrea_Mattioli

Mattioli has an interesting passage on a fungus, now identified as *Laetiporus sulphureus* (Bull.) Murrill, which grows on the mountains of the Val di Non (TN), which was "*so large as to weigh 25-30 pounds, bright red, and jagged*".

As for "Porcini", based on the already popular belief dating back to Pliny, he held that those with changing flesh color were poisonous. The popularity and authority of Mattioli most likely contributed to this false belief against boletus fungi with flesh that changed color being held for centuries.

His other "authoritative" error, which illustrates how old superstitions regarding the causes of fungal toxicity was still incredibly entrenched, even among the most qualified scientists of the Renaissance and that unfortunately continued until very recently, concernedt lignicolous Fungi. These were all considered to be harmless by Mattioli because they grew on trees, "*there is no danger that they will sprout on iron, or a wet cloth, or a dead snake or other venomous animal*". To disprove this belief just think the toxic *Omphalotus olearius* (DC.) Singer which grows both in sunny forests filled with broad leafed trees, where it prefers deciduous oaks (*Quercus* spp.), or in cultivated orchards where olive trees (*Olea europaea* L.) are the its favorite victims.

A chapter is devoted to truffles, having a rough and black rind with a white or sometimes black flesh, "*quarried in abundance by our farmers, being highly prized by wealthy people*". He also describes some that "*besides being small, have a smooth and pale rind, but which are tasteless and unpalatable*" these were probably the *Rhizopogon* Fr. & Nordholm sp. or the *Elaphomyces* Nees sp. (Lazzari, 1973).

***Omphalotus olearius* (DC.) Singer**

Source: AMB archive, photo by C. Lavorato

Pier Andrea Cesalpino (1525-1603), was from Arezzo, a professor at the University of Pisa and director of the famous Botanical Garden of Pisa, physician to Pope Clement VIII and of famous men such as St. Philip Neri and Torquato Tasso, and discovered the circulation of blood and blood capillaries.

He authord a specifically botanical work entitled "*De plantis libri XVI*" (Florence 1583), describing new plants and in which he attempted a classification of plants, dividing them into fifteen classes, thus anticipating by two centuries the work of De Tournefort and Linnaeus; and therefore he can be considered the "father" of Italian botany.

He is the first botanist who lingers on the topic of Fungi, completed under the influence of course, of the errors common in his day. Fungi are still considered plants "*without fruit and seed*" consisting of some "*incomplete material*".

Sorce: http://en.wikipedia.org/wiki/Andrea_Cesalpino

Its classification is not made up of genus and species (concepts introduced that were only introduced two centuries later by Linnaeus), but only by groups, eighteen to be exact, some of which deserve mention (in brackets the modern name is shown where appropriate):

1. **Tuber** (*Tuber* P. Micheli ex F.H. Wigg. sp.): "*a black rind found in Norcia, pleasing taste and odor or with whitish bark but less valuable*".

2. **Pezicae** (*Lycoperdon* Pers. sp.): "*puffballs, or smells, edible, white, as large as quinces or even the head of a man, cook them boiled or sliced and fried in oil*".

3. **Boleti** (*Amanita* Pers. sp.): "*egg-shaped when they are in the ground*".

4. **Suilli** (*Boletus* Fr. sp.): "*sprout among heather and ferns, white meat, those with meat that turns black and blue, or has a concave yellowish or greenish parts are noxious*".

5. **Lapis lyncurius** (*P. tuberaster*).

6. **Prateoli** (*Agaricus* L. sp.): "*sprout in meadows, little value as food and not free of danger*".

7. **Prateolis similes**, **iuxta stercora** (*Coprinus* Pers. sp.): similar to the above, sprout in manure, poisonous.

8. **Familiolae** (*Armillaria* (Fr.) Staude sp.): "*clumped together with long stalks, found near bushes, do not have a very refined flavor*".

9. **Scarogiae** o **Cannellae** (*M. procera*): "*not very meaty, with ring, a long stem that appears to support an umbrella*".

10. "Chanterelle Fungi" or **Gallinacei** (*Cantharellus* Fr. sp.): "*saffron-colored, fan-shaped. The peasants eat them without danger*".

11. "Latticed Stinkhorn" or **Fuoco silvestre** (*Clathrus ruber* P. Micheli ex Pers.): "*are fungi that resemble tattered rags or sponges, soft, colored bright red, not edible*". Information that was described for the first time by Cesalpino.

12. "Beefsteak tongues" or **Linguae** (*F. hepatica*): "*on the stumps of chestnuts, blood red in color inside and outside, excellent and harmless*", described for the first time by Cesalpino.

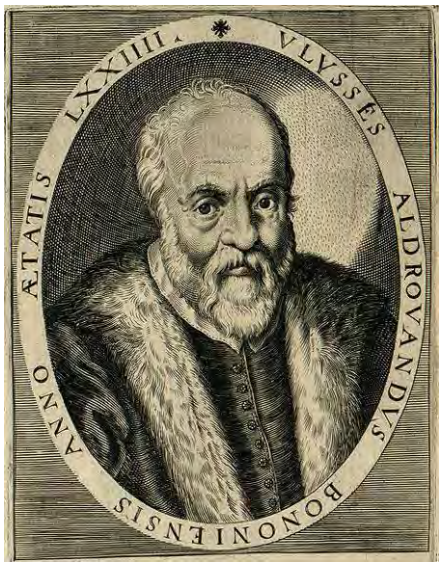
13. **Digitelli** o **Maninae** (*Ramaria* Fr. ex Bonord. sp.): "*are commonly referred in that manner*" those Fungi "*which are whitish, divided in portions that are similar to the fingers, are eaten boiled*".

14. **Igniarii** (*F. fomentarius*): "*commonly known as tinder, used to maintain fire obtained with flint, sprout on stumps, in the form of a horse's hoof. With a lower knotty portion, are used in barbershops as brushes*".

The most interesting aspect Cesalpino's work is that among the species and groups he describes he leaves little doubt as to their interpretation. Moreover, he "guessed" the edibility of certain mushrooms (*Lycoperdon* sp., *Armillaria* sp., *M. procera*, *Cantharellus* sp.) that other mycologists who would later identified them defined them mistakenly as toxic.

In conclusion, he was the first botanist to give a certain completeness to the mycology and as such was recognized by later authors.

Leo Africanus (1485-1554), the Latinized name of Al-Hasan ibn Muhammad, who was a Spanish Moorwho led an adventurous life, and ended up at the court of Pope Leo X, the great patron of the Renaissance. We are in the period of great geographical discoveries, and, urged by the Pope, Leo Africanus wrote a "*Descrittione dell'Affrica et delle cose notabili che qui sono*", where for the first time we find a clear description on the *Terfezia arenaria*, a tuber mainly common in North Africa, but also widespread throughout the Mediterranean.



Ulisse Aldrovandi (1522-1605), was a professor at the University of Bologna, and spent his long life in study, travel and research in all areas of the natural sciences. He wrote a "Historia Naturale" in fifteen volumes, of which only four were published during his lifetime. Of these, only one, "Dendrologiae" (natural history of trees), deals with botany and contains a brief discussion of tree-dwelling mushrooms. Twenty-five species of tree mushrooms are taken into account, but the illustrations and descriptions are rather poor. According to Fries, Aldrovandi has the honor of having clearly identified and depicted three species: *Pycnoporus cinnabarinus* (Jacq.) P. Karst., *Ganoderma lucidum* (Curtis) P. Karst. and *Sarcoscypha coccinea* (Gray) Boud.

Source: http://it.wikipedia.org/wiki/Ulisse_Aldrovandi

Ferrante Imperato (1550-1631), pharmacist and naturalist who lived in Naples in the sixteenth century, has left a "Historia Naturale" in which Fungi are briefly discussed. While not a real mycologist, he earned the appreciation of the Fries and has the merit of having first recognized that the "mushroom rock", "*is not a rock but an underground plant production, similar to a truffle, although its structure is tougher and more fibrous, and of much greater size*".

***Pycnoporus cinnabarinus* (Jacq.) P. Karst.**

Source: AMB archive, photo by C. Lavorato

Carolus Clusius (1526-1599), Latinized name of Charles de L'Ecluse, a native of Flanders who earned a degree in medicine in Montpellier. He was a great botanist and traveler, directed the Botanical Gardens in Vienna, spent many years in Hungary, ending his career with a coveted professorship in botany at the University of Leiden. His work in "*Fungorum in Pannonia observatorum brevis historia*" (A brief history of Fungi observed in Pannonia) is the result of research carried out in Hungary. It is important because it constitutes the first example in history of a booklet

dedicated exclusively to Fungi, describing, with an abundance of information, a hundred species, dividing them into two broad categories: "*Edules*" (edible) and "*noxii*" (toxic).

Clusius can be considered a true pioneer of mycology because, while scientific methodology, let alone mycological methodology, did not yet exist, he was able to provide numerous descriptions in German and Hungarian folk names that greatly facilitated the subsequent identification work of mycologists.

***Sarcoscypha coccinea* (Gray) Boud.**

Source: AMB archive, photo by G. Consiglio

Hadrianus Junius (1512-1575), Dutch physician and naturalist, has left us a dissertation on *Phallus* (named after him *Phallus hadriani* Vent.), the first ever mycological monograph to appear in Europe.

Alfonso Ciccarelli (1532-1585), an Umbrain physician with his "*Opusculum de tuberibus*" was the author of the first mycological monograph printed in Italy. In nineteen chapters written in elegant Latin he tackles and discusses almost all aspects of these interesting products of the earth, so at home in his region.

Marco Aurelio Severino (1580-1649), professor of anatomy and medicine at the University of Naples, wrote the monograph "*De lapide fungifero*". In it, Severino addresses the mushroom stone, for which all those who work with Fungi develop a passion. He cites and discusses all the opinions of the time before stating his opinion. First of all, he rules out that it could be fossilized lynx urine, as it "*is not even real stone but an underground fungal formation, neither more nor less than the truffles; it is like a kind of fossilized plant sponge that can soak up moisture and produce fungi*". In his study the author is not content with what is written in books but carries out his own personal and careful experiments. The slow but continuous process with which scientists detach from the tyrannical authority of the authors of classical antiquity, begins with him.

***Phallus hadriani* Vent.**

Source: AMB archive, photo by E. Munari

6.2 The period of the Counter Revolution

During the seventeenth century botany, if not precisely mycology, made significant advances with the establishment of botanical gardens and scientific academies, while we have the first use of the microscope.

Botanical gardens in which different plant species are cultivated by recreating appropriate exotic habitats, are maintained by institutions such as universities for educational and research purposes.

In modern times the first botanical garden was at the University of Pisa, which was founded in 1544 due to the insight of Luca Ghini, a famous physician and botanist from Imola. Thanks to funding from the Grand Duke of Tuscany, Cosimo I de 'Medici, Ghini, who the year before had been given a professorship in botany at the city of Pisa, created the first at the Garden "Arsenale Mediceo", on the right bank of the Arno river, the location which had provided its original name "Giardino dell'Arzinale".

In Italy the Botanical Garden of Pisa[32] was soon followed by that of Padua (1545)[33], Bologna (1568)[34] etc. Among the first Botanical Gardens outside of Italy is the one in Paris (in the seventeenth century called *Jardin du Roi*), followed by Oxford, Berlin, Uppsala etc.

[32] This is the oldest university botanical garden in the world, even if the location chosen by Ghini was different from the current one. The first garden was at the medical arsenal on the right bank of the Arno river, from which drives its original name "Giardino dell'Arzinale".
Thereafter the need to increase the defense of the defense of the Botanical Garden Ghini introduced into teaching live plants, shown and discussed and not only for their therapeutic properties, but also with respect to their identity and nomenclature. The need to always have samples plant samples available for teaching caused Ghini to undertake the drying out of plants to create a herbarium, the pages of which could be easily exchanged among scholars. To resolve the loss of certain characteristics needed for diagnosis, such as color, Ghini also used plates that illustrated great precision the most important details of the plants, along the lines proposed by the great botanists of central Europe.
Thereafter, the need to increase the military defenses of the city induced Ghini to enlarge the arsenal, extending it to part of the land that belonged to the Botanical Garden. Therefore in 1563 it was transferred to another site, in the north-west area of

The Academies of Sciences can be considered free association of scientists which , isolated from the ignorance of the masses on the one hand and conservatism of the universities of the time, tried to communicate among themselves, evaluate, and experiment.

The Botanical Garden of Pisa

Source: http://www.ortobotanicoitalia.it/toscana/pisa/

Again, Italy lead the way with Giovan Battista Porta (1540 - 1615), founder of the *Academia Secretorum Naturae* in Naples in 1560. In 1603 it was the turn of the famous "Accademia dei Lincei", founded by Federico Cesi in Rome, which still exists and is active. Among those outside of Italy are the *Royal Society of London* (1662) and *Académie des Sciences in Paris* (1666).

The Accademia dei Lincei (from lynx, *Lynx lynx* Kerr, an animal endowed with acute vision, chosen as a model for scientists who need to be acute observers of nature) had among its members **Galileo Galilei**, who encouraged the use of the microscope, which he perfected, and the mycologist **Giovanni Antonio Battarra** from Rimini (1714-1789) author of a book on Fungi that is still famous.

Federico Cesi (1585-1630), will be remembered as the founder of the Accademia dei Lincei, and to have collected, along with his friend John Heck (1577-1618/1620?), An "*Iconografia di funghi*" which has remained unpublished. This precious codex was kept in the valuable private library of Pope Clement XI and consisted of a large number of colored plates divided into three folio volumes, each with 200 plates and 2 to 3 fungal species illustrated on each table. Ownership of the codex changed

---

the town, under the guidance of the botanist Andrea Cesalpino, who had succeeded Luca in the direction of the Garden. Not even this location was satisfactory, both with respect to the scarce sunlight that the plants received, and the distance from Sapienza, the center of university of that time. Therefore in 1591 the Botanical Garden was transferred to a third location, which is its location today, near Piazza dei Miracoli between Santa Maria and Via Roma.

33 The Botanical Garden of the University of Padua was founded in 1545 as the "Horto medcinale" annexed to the patavium studio for the cultivation of indigenous and exotic plants for scientific and didactic purposes. For this reason it represented a significant step in the quality of teaching and a model to which institutions with a similar structure in foreign countries from which the students came.
In consideration of the important cultural activity carried out without interruption for almost half a millennium, in 1977 the Botanical Garden of Padua was entered into the List of World Heritage sites of UNESCO.

34 It is an ancient botanical garden, closely tied to medical science, which grew in importance with the creation, in the most important Italian universities, of the department of "Lectura semplicum", which regarded plants and how to extract their medicinal properties. At Bologna this department was created in 1539 and the first tenured professor was Luca Ghini who immediately noted the importance of a botanical garden. It was needed for medical students to recognize and study plants used for therapeutic purposes. However, Luca Ghini was soon transferred, without having had a chance to implement his project. The Botanical garden of Bologna was created only twenty years later, in 1568, when botany had become an important means of having a profound knowledge of which plants would have served to improve the health of the citizenry. It was entrusted to Ulysses Aldrovani, who made it unique by planting a wide variety of species: officinalis, exotic and rare.

several times, was given up for lost, and found again in the eighties[35], preserved in the Library of the *Institut de France* in Paris.

Giovanni Battista Porta (1540-1615), an open-minded scientist, devoted himself to the most varied branches of learning, writing numerous works. He wrote about Fungi in Chapter X of "Villa" (1592), both reposting what was written in classical times, as well as his own observations and even included an attempt at classification. He describes for the first time in Italian botany species such as the "Spongiole" (*Morchella* Dill: ex Pers. sp.), The "Monacelle" (*Helvella monachella* (Scop.: Fr.) Fr.), the "Peperella" (*Lactarius piperatus* (L.) Pers.), the "Richione" (*P. eryngii* (DC.) Quél.). Porta's great accomplishment is to have first explicitly hypothesized in his work "*Phytognomonica*" (1588), almost two centuries before P.A. Micheli provided experimental proof, that Fungi reproduce by seeds.

Fabio Colonna (1567-1650), Neapolitan and academic of the Lincei, author of several botanical works was also the intuitive force behind the impetus for systematic botany. In his book "*Ekphrasis*" (1606) he presents only six species of Fungi, but with descriptive clarity and precision never before seen in drawings: the "Cardoncello" (*P. eryngii* (DC.) Quél.), the "Pezicae Plinii" (fam. *Pezizaceae* Dumort.)[36], the *Pleurotus ostreatus* (Jacq.) P. Kumm., the *M. procera* and the *C. ruber*.

***Lactarius piperatus* (L.) Pers.**

Source: AMB archive, photo by G. Consiglio

[35] P. De Gregorio speaks of this recently in Bolletino A.M.E.R. 38-39, 1996, pp. 50-53.

[36] Under this name from time to time various genera and species of Fungi were included, for example: pezizas and licopersica. The column is limited to describing pezizas and it does so as its equal: "*... they are hollow with the shape of an acetabulum or a pyx: the larger ones contain up to four ounces of water; some have round openings, others have an irregular and angular upper border, making three or more angles, or with long handles similar to those of oil lamp spouts...*" (Lazzari, 1973).

***Pleurotus ostreatus* (Jacq.) P. Kumm.**

Source: AMB archive, photo by A. Bianchin

6.3 The Baroque period

Although they had perceived that Fungi were very unique plants, until the seventeenth century scientists did not trouble themselves with examining how Fungi reproduced as they quietly relied on the theories of Aristotle. The authority of this eminent philosopher, the greatest in antiquity, was also recognized in scientific issues and no one had ever dared to challenge his claims. Therefore, as he had claimed, it was widely thought that the Fungi sprouted by spontaneous generation, without seeds. The seventeenth century saw the spawning of the first doubts on this theory. It was discussed, there were disputes, new theories were proposed and new discoveries made, but despite Micheli's insights the certainty of fungal reproduction through spores does not occur until the nineteenth century with Louis Pasteur.

Some supported the reproduction of Fungi by fragments (in the Italian writings referred to as "furstuli"), based on the experience of inserting fragments of fungi in a litter of horse manure which was an old method of artificial cultivation of mushrooms (*Agaricus* sp.). Among these was the famous **Marcello Malpighi** (1628-1694), who, however, along with important observations of microscopic Fungi, also advanced the hypothesis that Fungi could have seeds.

The "desire" to find fungal seeds did lead to some blunders. For example, the German physician and botanist, **Christian Mentzel** (1622 - 1701), takes for the seeds peridia, those tiny "eggs" contained in *Cyathus striatus* (Huds.) Willd. According to **Paul Silvio Boccone** (1633-1704), there were seeds and these were tiny and are scattered throughout the viscous humors of the fungus.

***Cyathus striatus* (Huds.) Willd. (longitudinal section)**

Source: AMB archive, photo by M. Sarasini

Proponents of spontaneous generation, based their arguments on Pliny, who saw Fungi as the product of a fermentation of the juices of the earth, or the sap of trees, a phenomenon that could occur either on ill or dead plants, or living and healthy plants, but which were destined for death.

It must be said that while these scholars held opinions which today are absurd, they were in keeping with the state of knowledge of that time; they were attentive scholars who supported their ideas based on their continuous and discriminating experiences.

Fortunio Liceto (1577-1657), the Genoese author of the oldest book on Fungi: "*De spontaneo viventium ortu*"[37] who is not cited by **Giacomo Lazzari** (1907-1993) in the "*History of Italian Mycology*", is a typical example of how Baroque culture, relying on the theories of Aristotle, addressed scientific issues. By adapting Aristotle's, theories Liceto addressed the spontaneous generation of living organisms, which is commonly referred to as being born "ex putri"', i.e., from rotting substances, examines the then current opinions on the matter and then lays out the generic and specific causes of spontaneous generation. The text consisting of three hundred twenty-three pages, divided into a preface and four books, contains bizarre explanations on the origin of Fungi: "*...they are born from stone, animal excrement, wood....* ", and in particular provides an explanation of the origin of the Deer Truffle (*Elaphomyces granulatus* Fr.).

[37] "*De spontaneo viventium ortu*" is preserved in the library of the Centro Studi Micologici -- A.M.B. This literary work dedicated to the Venetian senator Lorenzo Giustiniani, it was printed in the print shop of Domenico Amadio in the town of Vicenza in 1618.

***Elaphomyces granulatus* Fr.**

Source: AMB archive, photo by A. Montecchi

Luigi Ferdinando Marsili, or Luigi Ferdinando Marsigli, (1658-1730), a soldier and scientist, published in 1714 "*Dissertatio de generazione fungorum*", which is interesting for the perspicacity that he demonstrates in his careful examination of the underground root portion of the fruitbody, in his drawings of the substrate sections, descriptions and reproductions of the hyphae and microscopic magnification of their intertwining; it is a remarkable work of experimental structuring.

Giovanni Maria Lancisi (1654-1720), renowned physician and ecclesiastic, published in Marsigli's work "*Dissertatio epistolaris de ortu, vegetatione et textura fungorum*" in which he maintained that Fungi are simply pathological plant outgrowths similar to those that are formed in the human body; with morphology and coloration dependent on the conditions in which fermentation takes place and toxicity dependent on the plants which produce them. In essence he repeats the concepts already expressed by Pliny.

Paolo Boccone (1633 - 1704) from a noble family of Palermo, made numerous study trips throughout Italy and abroad, until at age fifty he became a Cistercian monk, nevertheless continuing with his travels. A naturalist who was very famous in his time, he is to be remembered because in his study of Fungi he preferred to represent them with drawings rather than through analytical descriptions which is an especially appropriate choice in mycology.

The work that interests us is his 1767 publication "Museo di fisica ed esperienze", which shows forty-four species in drawings, which although not very elegant are accurate, so much so that are were accurately identifieded by Fries and other mycologists. About twenty species had never been represented before, eg: *Lycoperdon excipuliforme* (Scop.) Pers., *Cortinarius violaceus* (L.) Gray, *Lycogala epidendrum* (J.C. Buxb. ex L.) Fr., *Lycoperdon pyriforme* Schaeff., etc.

Fries himself adopted the nomenclature several specific names used by Boccone.

Cortinarius violaceus **(L.) Gray**

Source: AMB archive, photo by M. Floriani

Lycogala epidendrum **(J.C. Buxb. ex L.) Fr.**

Source: AMB archive, photo by G. Visentin

***Lycoperdon pyriforme* Schaeff.**

Source: AMB archive, photo by G. Consiglio

6.4 The beginnings of the industrialized society (1700s)

6.4.1. Mycology in the early eighteenth century in Europe

The study of Fungi during this historic period, compared to that of botany was quite modest as this sector of naturalism was considered unimportant. However, between the seventeenth and eighteenth centuries interest in mycology was revived, by several European scholars.

John Ray (1628-1705), botanist and theologian at Cambridge was meticulous in his description of Fungi in his works: "*Historia plantarum*" (1686) and "*Synopsis Methodica*" (1690) in which depicts one hundred and eighty four species of Fungi. He attempted a classification of these Fungi as follows:

- "***terrestres***" (epigean soil),
- "***tree***" (epigean tree-dwelling)
- "***suterrestres***" (hypogeous).

Each group is then divided into

- "*cap mushrooms*" (with or without gills)
- "*without caps*"
- "*inserted sideways on tree trunks*"
- "*turn to powder to maturity*"
- "*hypogeous*".

Joseph Pitton de Tournefort (1656-1708), from Aix en Provence, France, was one of the greatest botanists of all time, director of the Botanical Garden of Paris; he is considered the forerunner of Linnaeus in his attempt to create a plant classification system, which he based on a single characteristic: the flower. He deals with Fungi mainly in his treatise "*Istitutiones rei herbariae*" (1700), considered to the cornerstone of botany before Linnaeus.

According to De Tournefort Fungi, along with moss, belonged in the class "Herbs and sub-shrubs without a flower and seed" and are divided into 7 groups, which can be considered as Genuses:

- ***Fungus***: with cap and stem, with gills or tubules, roughly the Order *Agaricales Clements*;
- ***Fungoides***: sunken or funnel-shaped;
- ***Boletus***: with pockets or windows, a mix of the *Morchellaceae* Rchb., *Phallaceae* Corda, etc.
- ***Agaricus***: those that grow on the trunks of trees, basically the current *Polyporaceae* Fr. ex Corda;
- ***Lycoperdon***: Fungi at maturity dissolve into powder, mainly the current epigean Gasteromycetes (Sarasini, 2005);
- ***Coralloides***: the current *Gomphaceae* Donk.
- ***Tuber***: current hypogeous fungi, which also includes the increasingly common in popular knowledge members of the family *Tuberaceae* Dumort.

Source: http://en.wikipedia.org/wiki/Joseph_Pitton_de_Tournefort

Interestingly, in a report on the artificial cultivation of *Agaricus campestris* L. var. *campestris*, o *Agaricus bisporus* (J.E. Lange) Imbach, De Tournefort is convinced that at least these fungi reproduce by seeds and not merely by virtue of horse manure.

***Agaricus campestris* L.**

Source: AMB archive, photo by R. Brotzu

Johann Jakob Dillen (Dillenius) (1687-1747), best known as a scholar of cryptogams, but in his youth he concerned himself with Fungi. In his work "*Cathalogus plantarum circa Gissam nascentium*" (1719) he described all one hundred and sixty species and contributed significantly to mycology at a systemic level.

He divided Fungi into two classes: with cap and stem, without a cap.

In the first class (with cap and stem) he placed those:

a) Mushrroms with gills (*Amanita* Pers. sp.)

b) Aculeates (family *Hericiaceae* Donk), Scrobiculati (*Morchella* Dill. Ex Pers. sp.), porous (*Boletus* Fr. sp.).

In the second class (without cap) he placed those:

a) with a stem (*Fungoides*),

b) without a stem.

These Fungi can in turn be flat *Agaricus* (lamellate, porous, hairy, smooth, etc..), or concave: membranous (*Pezizaceae* Dumort) or full (Gasteromycetes epigean and *Tuberaceae* Dumort.).

As can be seen, this is a classification based on orderly and methodical guesswork, which was in fact preferred by Linnaeus.

Sébastien Vaillant (1699-1722), was a contemporary and competitor of De Tournefort in academia, he left an unfinished magnificent work, "*Botanicon Parisiense*" published posthumously in 1727. The part dealing mycology was developed by his editors from notes found among his papers. He includes a total of one hundred and sixty one species in nine genuses: *Agaricus* L. ex Fr., *Boletus* Dillenius ex Fries, *Ramaria* S. F. Gray (creato di sana pianta), *Corallo-fungus*, *Coralloides*, *Fungoides*, *Fungus*, *Lycoperdon*, *Tubera*.

Many of these species were quite new e.g. *Cordyceps militaris* (L.) Fr., *Craterellus cornucopioides* (L.) Pers., *Schizophyllum commune* Fr. He was the first in history to describe the *Amanita phalloides* (Vaill. ex Fr.) Link, while not taking into account the question of edibility (JJ Paulet will be the first to do this sixty years later).

Source:
http://it.wikipedia.org/wiki/S%C3%A9bastien_Vaillant

Vaillant also attempted to bring order to the vast group of cap mushrooms (for him, all within the genus *Fungus*), distinguishing six families based on the hyemnium: smooth, nipple-like, aculeate (Idni), tubular (*Boletus* Fr.), with venation (*Cantharellaceae* J. Schröt.), with gills (*Agaricaceae* Chevall.). His chief merit is accuracy, both in the accuracy of the characterizations which for the first time introduced significant number of new species.

***Schizophyllum commune* Fr.**

Source: AMB archive, photo by G. Consiglio

6.4.2. The work of Pier Antonio Micheli

Pietro Antonio MICHELI
(1679 - 1737)

Pietro Antonio Micheli (1679-1753) is considered the founder of modern mycology, at the very least, as the author of several fundamental mycological discoveries. Micheli's passion for botany was born by reading the works by Mattioli and Boccone, while he was an apprentice bookbinder. This passion was enhanced both by the teachings of the monks of Vallombrosa, and by his explorations in their forests scattered throughout the Tuscan mountains which gave, the not yet twenty year old Micheli, his own rich herbarium and the opportunity to maintain relationships and exchanges with European scientists. At twenty-seven he became court botanist to the court of the Grand Duke Cosimo III of Tuscany, with an annual pension and the main task of providing plants for the Botanical Gardens of Tuscany, which he did with many uncomfortable trips throughout Italy.

After an adventurous trip to Germany (he had been sent by the Grand Duke to do industrial espionage on the manufacture of tin!), he was given a work of De Tournefort, and he focused on the study of cryptogramme plants, then considered to be "*plants without seeds*".

Source: http://en.wikipedia.org/wiki/Pier_Antonio_Micheli

Micheli, however, was not convinced that plants could exist without seeds and devoted himself to detailed observations with the aid of a magnifying glass and a microscope. He studied cryptogams, especially bryophytes (mosses), but also Fungi and spore powders, which he immediately suspected was a seed powder. Meanwhile, this young scientist's fame grew out of all proportion, as he did not have academic qualifications, but he maintained a correspondence with the most important Italian and European botanists.

In 1717 he founded with other enthusiasts the Società Botanica Fiorentina (Florentine Botanical Society) Fiorentina which was entrustedwith the "Giardino dei Semplici", which still has a yew tree that he planted.

Taxus baccata L.

Source: http://commons.wikimedia.org/wiki/File:Taxus_baccata01_by_Line1.jpg

Micheli's scientitifc reaserach can be found in his masterpiece "*Nova plantarum genera*", published in 1729 after a veritable calvary of prayers and solicitations to obtain the necessary financing. He managed to get a "sponsor" for each of the one hundred and five plates that make up the work. Both the book and the handwritten manuscript are preserved in the library of the Centro Studi AMB (AMB Center for Studies). Micheli died in 1737, returning from a disastrous trip to the Veneto region. He is buried in the Santa Croce church in Florence, along with other great men of Italy.

His epitaph reads: "*happy with little, extremely well versed in every natural science, famous everywhere for his discoveries and writings, and above all else most dear to all good people of his time for his wisdom good character and modesty*".

To this is added the testimony of Fries, "*Micheli alone made the greatest contribution to mycology than all other scientists taken together*".

Micheli's discoveries in fungal biology were his greatest accomplishment. Even though partially advanced by several of the insights De Tournefort, he was actually the first to demonstrate that even Fungi reproduce by seeds ("spores") and not by spontaneous generation. The "origins", as well as of the "universal veil" and the development of young fruitbodies, were all very clear concepts to Micheli "*all these fungi, before they show their form as a fungus, were wrapped in a shell or strip, which in some species, as they grow, scattered in a powder, others in a dander, others lint, and finally some in small pieces, which remained permanently on the on the mushroom's cap*".

After an extremely careful microscopic investigation he became convinced that the secret in the reproduction of the Fungi was the underside of the hat, and where he discovered "*minute seeds*

distributed ... in very regular order; and ... each of them situated above a base, which caused me to wonder: who knows that this is not the flower, or the cup of the fungi?". Here at last was proof of the discovery of the "basidia" and "spores". Micheli must also be given credit for the discovery of the "cystidia".

He described many experiences in his works, ranging from the sowing of spores in reproduction in the natural habitat of various species of laboratory micromycetes (molds), and he rightly claims the right to the discovery the fungal seeds ("spores").

The above shows that at the basis Micheli's classification of Fungi was an examination of the fertile portion (hymenium) of the fungus as he created four major classes of Fungi based on the location of the hymenium. The second classification is interesting, as he includes the genuses: *Fungus*, *Suillus*, *Polyporus* e *Boletus*. The genus *Fungus* corresponds to the current family of *Agaricaceae* Chevall. and describes well six hundred and thirty eight species out of one thousand five hundred contained in his work. Unfortunately, Micheli used as a classification criterion the color of the various parts of the fungus, which proved to be a completely inconsistent method. The genus *Suillus* included fungi currently ascribed to *Boletaceae* Chevall. The *Polyporus* genus included what is currently classified as the terricolous *Poliporaceae* Fr. ex Corda. With the genus *Boletus* he defined *Morchellaceae* Rchb.

He placed in the third class Fungi with "seeds" ("spores") on the outer surface. Of particular interest in this genus is *Ramaria* S. F. Gray and genuses placed for the first time in then brand new field of brand-new Micromycetes (molds): *Byssus*, *Botrytis*, *Aspergillus*.

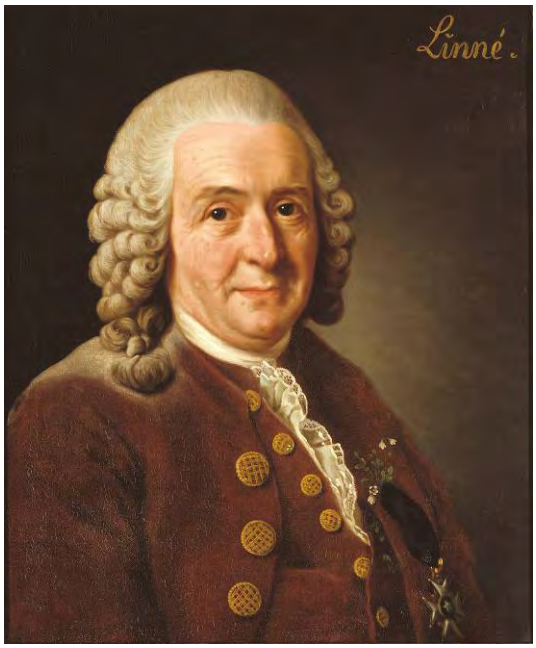
***Sphaerobolus stellatus* Tode**

Source: AMB archive, photo by G. Visentin

Included in the fourth class are Fungi with the "seeds" ("spores") inside the fruitbody. We find for example the genuses: *Clathrus*, created by Micheli, which corresponds to the current *Clathrus* Micheli ex Pers.; *Lycogala* ("*the viscous liquid it contains suggests the name, literally meaning wolf's milk*"); *Mucilago*, *Lycoperdon* (described with modern precision); *Carpobolus* (from the greek Karpòs = fruit and bolo = throw) i.e fungi that during maturity "throw" the spores (present name" *Sphaerobolus stellatus* Tode ex Pers); *Geaster*, *Tuber*, *Cyathoides*, small fungi in the form of a bird's nest (current family of *Nidulariaceae* Dumort.) with a small "eggs", known today as " peridioles".

The forty-six plates dedicated to Fungi are grouped in the "*Nova plantarum genera*", which has two hundred and sixty eight species included in it, later almost all of these would be explained by Fries. In some cases there are descriptions without a corresponding table and then interpretation becomes difficult, as Micheli's descriptions are too synthetic. A tepid sort of assistance with Micheli's species was provided by the discovery of a remnant of Micheli's herbarium at the Botanical Garden of Florence that contains about thirty precious "mycological relics".

6.4.3. Mycology after Pietro Antonio Micheli



Carl Linnaeus (1707-1778), Swedish, author of "*Systema Naturae*" (1735), is considered the greatest botanist of all time, as he provided a final organization of all plants on the basis of a universal applicable guiding principle that is still valid today. He based his system on the sexual elements of plants and for plant classification he invented a dichotomous system, also known as binomial nomenclature, which consists of a name ("Genus") followed by an epithet ("species"). Exalted and unsurpassed in botany in general, Linnaeus did nothing to further advances in mycology, indeed he damaged it, according to Fries, because he did not use a microscope and could not apply to fungi the research based on sexual elements, unlike with plants.

Source: http://it.wikipedia.org/wiki/Linneo

Mycological research continued in any event thanks to the work of numerous scholars, many of whom were adherents of Micheli and based their classifications on the location of the "seeds" ("spores") on the fertile part of the fruitbody. Several systematic and iconographic works by scholars that should be mentioned her are:

Gottlieb Gleditsch (1714-1785), author of "*Methodus Fungorum*" (1753), the first real treatise of mycology in general.

Christian Schaeffer (1718-1790), author of "*Fungorum qui in Bavaria ac Palatinatu circa Ratisbonam nascuntur*" (1774), the first color atlas of Fungi, with hand colored drawings.

Georg Batsch (1761-1802), author of "*Elenchus Fungorum*" (1789) full of watercolor tables painted the author himself.

Pierre Bulliard (1752-1793), with his "*Histoire des Champignons de la France*" (1783) created a two-volume iconographic masterpiece of French mycology with hundreds of beautifully colored plates and an incisions and reproduction system invented by him.

J. Jacques Paulet (1740-1826), author of "*Traité complet sur les champignons*" (1775), has a hsirotical part, a descriptive part with tables and a part with toxicology with various experiments he carried out on animals . Paulet, considered the father of mycotoxicology, was the first to identify the toxicity of *Amanita phalloides* and related species and reported the phenomenon of the delayed onset of symptoms.

James Sowerby (1757-1822), author of a superb collection of fungal plates, "*Coloured figures of English Fungi or Mushrooms*".

Various Authors (1845), "*Flora Danica*", an outstanding collection of 2500 plates, illustrating flowering plants and cryptogams of Denmark.

While the theory of spontaneous generation continued to resist the assaults of experimental methods, many scientists produced valid experiments that established a solid foundation for the hypothesis of sexual reproduction of Fungi.

Source: http://en.wikipedia.org/wiki/James_Sowerby

Within this context is the discovery by Johann Hedwig (1730- 1799) which for a long time held to be the only receptacle for the production of spores, until, when in the middle of the nineteenth century, Joseph Henry Léveillé (1796-1870) discovered the "basidia".

Another much discussed issue of that time, was whether the sexual reproduction of fungi occurred in a manner similar to that of higher plants, or had different characteristics; the latter concept is closer to what we know today.

Giovanni Antonio Battarra (1714-1789), priest, philosopher and naturalist whose the first contact with mycology happened, as he told it, in the Abbey of Vallombrosa, where he had traveled on foot from Rimini, studying the beautiful color plates of "*Sylva fungorum*" of Father Bruno Tozzi. It was 1740, and Battarra was only twenty-six. From that moment, the passion for mycology never left him. Four years later he had already painted four hundred plates in watercolor and soon became an expert in engraving intaglio plates to prepare for his future work, "*Fungorum agri Ariminensis historia*", published in 1755.

His book is the first purely mycological monograph to be published in Italy: eighty pages with forty intaglio plates that he engraved.

Source: http://www.webalice.it/mondellix/Storia_Micologia2.htm

The introduction, which contains his notes on the use of Fungi and their toxicology, is followed by a systematic description of the two hundred and forty species.

On the question of the fungal generation Battarra was a supporter of reproduction by "seeds" ("spores"), based on the authority of Micheli.

His notes on the edibility and toxicity of Fungi are interesting. After doing a sort of safety ranking he places in the top spot the "Chanterelle" (*Cantharellus* sp.) as opposed to "Porcini" (*Boletus* sp.) and the "Caesar" (*Amanita caesarea*) (Bonazzi, 2003) Fungi. Like a good native of the Emilia Romagna

region, he spends considerable time on cooking mushrooms, noting that it was often by cooking them in the wrong manner problems that are mistaken for poisoning arose. "*Mushrooms must be cleaned well, scalded, squeezed and soaked in vinegar: only then you can mushrooms be coke*." Batarra provides information on the edibility or toxicity of each mushroom, with only one rather basic error: he indicated that *O. olearius* (which he called *Polymyces phosphoreus* Battarra due to phosphorescence of the lamellae, a phenomenon first reported by him) was edible.

With respect to systemization Battarra follows his own system, which basically left much to be desired due to its empiricism. This cannot be said for his descriptions of the species, which showed him to be an acute investigator and describer of specific characteristics. Even his plates are accurate and represent real progress compared to the very famous ones by Micheli.

Persoon, who dedicated a type of fungus, *Battarraea* Pers. (Sarasini, 2005) and Fries, who recognized that he was in the top tier in the field of eighteenth century mycology provided very positive feedback on Battarra's work.

Giovanni Antonio Scopoli (1723-1788), completed his studies in Trento and Innsbruck. He practiced as a doctor, but his main interest was botany. He spent sixteen years as a doctor in Idrija, a town in Carniola (Slovenia) not far from Cividale, then a mining village with two thousand people for him to attend. He was subsequently a professor of mineralogy at Chemnitz (Hungary), and Professor of Botany Chemistry at the University of Pavia, where he rebuilt the Botanical Gardens. Scopoli wrote many works on the natural sciences. The most important work in botany is the "*Flora Carniolica*" (1760 and 1772), the result of ten years of hiking in western Slovenia.

Source: http://it.wikipedia.org/wiki/File:Scopoli_Giovanni_Antonio_1723-1788.jpg

He divided Fungi into eleven types, according to Linnaeus's system, relying mainly on external characteristics. He is very precise and effective in speciography; he was able to distinguish each species so well that e made it impossible to mistake it even with just a simple description, without the aid of colored plates or line drawings. In other words, for each species he studied (a total of one hundred and eighty) he discovered those specific characteristics that were constant and typical of each species. Thirty of these species bear his name: an example is: *Amanita caesarea* (Schaeff. in Scop.: Fr.) Pers. Many mushrooms species were described by Scopoli in his other works on botany.

***Cantharellus cinereus* (Pers.) Fr.**

Source: AMB archive, photo by G. Consiglio

The fundamental contribution to mycology given by abbot **Lazzaro Spallanzani** (1729-1799), a professor at the University of Modena and Pavia during this historical period must also be mentioned. He irrefutably demonstrated the generation of microscopic organisms and with his laboratory experiments he demonstrated the impossibility of "spontaneous generation". This hypothesis was confirmed much later, in a truly definitive manner by L. Pasteur.

In 1787 in Turin an interesting work by **Vittorio Pico** (1750-1823)[38], doctor and naturalist in Turin, entitled "*Melethemata inauguralia*" appeared that included the topic of Mycology. In this work are several important speciopraphic explanations such as the basics of nomenclature. Pico was also the author of several dissertations in which he addressed issues related to toxicity and edibility of mushrooms.

Source: http://it.wikipedia.org/wiki/Lazzaro_Spallanzani

To complete the picture of Italian authors who dealt with mycology in the eighteenth century, **Carlo Allioni** (1728-1804), must be mentioned. Physician, naturalist and famed botanist he was the author of "*de Tractatio Miliarum Origine Progressu, Natura, Et Curatione*"; which takes into account in the study of systemics of Fungi the characteristic of the "color of the gills".

[38] Vittorio Pico gave scientific dignity to "... *the most valued and mysterious underground fruit...*" (hypogenous fungus) that he described in his graduate thesis that he wrote while at the University of Turin in 1788. Pico defined the *Tuber magnatum* Pico come: "…*deliciosissimum autumni productum peculiare Montis Ferrati, Astensibus et Liguris Collinis*…".

7. THE CONTEMPORARY AGE

7.1 Mycology in Europe in the early nineteenth century

Beginning in 1815 up to our time.

By the early nineteenth century mycology was a fully recognized science and, most importantly, completely independent of any botany. If these fundamental advances were due to the efforts of foreign mycologists, it is also true that this occurred because of the complete confirmation and application of the principles of Micheli on Fungi systemization based, both on the position and morphology of the fertile part of fruit body.

It was the great mycologist **Christian Hendrik Persoon** (1755-1836) who brought Micheli's work to fruition. Persoon's work is based on a detailed analysis and a comparison of shapes and characters that was more thorough than any such work ever performed before him. His principal work is the "*Synopsis Methodica Fungorum*" of 1801. This work expressed for the first time the concept that the part referred to as "fungus" is nothing more than the fruit-bearing part of a much more complex body. Persoon divides Fungi into two major classes: "angiocarpus" with spores that mature within the fruitbody and "gymnocarpus" with the fertile part outside of the fruitbody and he describes seventy one types and one thousand five hundred and twenty-six species.

Sorce: http://it.wikipedia.org/wiki/Christian_Hendrik_Persoon

Other important mycologists of the period were: **Christian Nees** (1776-1858) and **Augustin Pyrame de Candolle** (1778-1841).

Despite the great progress made in mycology at the beginning of the nineteenth century, a great deal of confusion still remained in this field. The main causes were due to a lack of connection among the mycologists of the time, inadequacy of investigation and lack of an accepted and shared methodology for systematic mycology. It had become essential to find a new classification system for Fungi based on unified characteristics.

Elias Magnus Fries (1794-1878), successfully undertook the realization of this type of classification and is widely regarded as the father and the greatest exponent of modern mycology, a field to which he dedicated his entire life. His is the cornerstone of modern mycology and provided the basis for the formation of generations of mycologists, making the current advances of this science possible.

Fries was Professor of Botany and Prefect of the Botanical Garden at Uppsala University (Sweden). His main work is the "*Systema mycologicum*" (1821), completed by supplements in 1832. His other important works are: "*Epicrysis*" and "*Icones selectae Fungorum*" the result of assiduous herborization, study of the works of previous authors, including the ancients, and exchanges with the most well known mycologists of the day.

Source: http://it.wikipedia.org/wiki/Elias_Magnus_Fries

Fries described several thousand Fungi (the alphabetical index "*Elenchus Fungorum*" of "*Systema mycologicum*" includes more than ten thousand entries) with short and precise diagnosis. Classification is based on the concept of "phylogeny", ie the evolutionary development stages of Fungi, from the most simple to the most complex, typical of fungus with a well developed hymenium. Therefore there are four large Classes: Coniomycetes, Hyphomycetes, Gasteromycetes and Hymenomycetes. This last Class, "*fungi with fertile area, or exposed "hymenium*", is divided into seven Orders. This classification was often changed due to progresses made in mycology and which Fries honestly took into account (among these were the discoveries of Hedwig and Léveillé that led to the distinction between Basidiomycetes and Ascomycetes). Meanwhile, Fries interest shifted exclusively to macromycetes. Fries' success was massive, so much so that his names were adopted by the International Botanical Congress in Brussels (1910) as the basis for modern mycological nomenclature.

Even today the Friesian mycological system, although based solely on macroscopic morphological characters, continues to be an indispensable aid for anyone preparing for the study of higher Fungi. Giacomo Bresadola himself was essentially faithful to Fries' system.

7.2 Mycology in Italy prior to unification

7.2.1. Mycology in the Piedmont-Sardinian states

Several botanists and mycologists were formed in early nineteenth century, at the Botanical deaprtment (with its associated Botanical Garden), of the University of Turin which at that time was the capital of the Kingdom of Sardinia. There were many scholars who were "minor" figures among expert mycologists, but were famous in their time and considered significant in the field. Among these are:

Carlo Antonio Ludovico Bellardi (1741-1826), botanist emeritus was well known and respected by Linnaeus, Willdenow, Haller, etc. His most important work was the "*Appendix ad floram Pedemontanam*", which contains the description of twenty species of Fungi with seven color plates.

Source: http://www.torinoscienza.it/multimedia/giovan_battista_balbis_12647

Giovanni Battista Balbis (1765-1831), educated at the University of Turin was first student and subsequently assistant to Allioni. In 1794 he was the victim of political influences of the time and became mired in the Jacobin conspiracies plotted in Turin which caused him to leave for France (G. Lazzari, 1973). His entire career was tied to his previous revolutionary activity. He is responsible for two weighty volumes of "*Flora Ticinensis*" published in 1816 and in 1821 and "*Flore Lyonnaise*"(1827-1828).

Paolo Cumino (1762-1808/1812?), a Carthusian monk of the Order of St. Brunone (Friar Ugo Marìa Cumino) lived at the Certosa di Pesio and was a distinguished amateur mycologist. Little is known about him due to the suppression of monasteries and the seizure of religious property by the French invaders. There is memory of him among the corresponding members of the Academy of Sciences of Turin (Lazzari, 1973). Cumino left an interesting memory mycological work entitled "Fungorum Vallis Pisii specimen" (Turin, 1805). The work describes one hundred fifty-seven species of Fungi distributed in twenty genuses.

Giovanni Francesco Re (1772-1833), student of Allioni; he published the "*Flora Segusiensis*" in 1805 and "*Flora Torinese*" in two volumes in 1825 and 1827. Both his works have lists and brief

descriptions of numerous Fungi. Additional mycological information can be found are in the "*Appendix altera ad floram Pedemontanam*" published in 1827 (Lazzari, 1973).

Giovanni Biroli (1772-1824), graduated in medicine and philosophy at Turin. He wrote a "*Flora Aconiensis*" (1808) in two volumes in which are described two hundred species of macro and micromycetes, distributed in twenty-three genuses according to the classification adopted by Bulliard (Lazzari, 1973). The work of these mycologists is reported in the 7th four hundred page volume of "*Herbarium Pedemontanum*" published in Turin in 1837.

Domenico Viviani (1772-1840) deserves a brief comment as the author of a significant mycological work. Born in Liguria, a graduate in medicine, but more interested in botany, after a rather difficult period became Professor of Botany at the University of Genoa, where he founded the Botanical Gardens. He published several works on botany, illustrated with excellent plates. His most important work is "*I Funghi d'Italia*" (1834), a folio volume with sixty plates (one hundred and five of which he prepared), representing seventy-two species of Fungi. Almost all species are accompanied by an extensive explanatory text with a diagnosis in Latin, descriptions, bibliography, information on edibility, etc... Its plates, which as hand painted, are among the most beautiful of Italian mycological iconography.

The value of this work arises from the fact that the plates were drawn from his actual observations, that is, not copied from foreign works, from the notices reviewed, and the breadth of research, which encompassed a broad swath of Italy.

7.2.2. Mycology in the Italy of the Austro-Hungarian Empire

7.2.2.1. Lombardy

Mycology in Lombardy during the period of Austrian rule was characterized by attention to the actions of the public authorities towards the economy and sanitation. These were provisions designed to prevent poisoning from mushrooms, which was unfortunately, a very frequent occurrence during that period of history, through a series of rules governing their sale to the public. The task of studying the appropriate regulation was entrusted to the universities of Pavia and Padua, which was followed by notices or calls: communications issued by the "Municipal Congregations". These provided dispositions on stores and species permitted for sale. These are interesting and meaningful for their exact and valid reports, amendments proposed by mycologist Giovanni Larber in 1829: "*to grant the license to sell only after vendors took an examination, providing a duty on the part of all physicians to report all cases, even slight, of poisoning, making innkeepers and restaurateurs responsible of any poisoning that occurred on their premises*".

These provisions on fungi stimulated a copious production of books and pamphlets, which were useful mainly for the mycological education they provided, although their scientific value is modest. Among the various authors are:

Domenico Bayle Barelle (1768-1811) who published "Descrizione esatta dei funghi nocivi o sospetti".

Giovanni Zantedeschi (1773-1846) author of "Descrizione dei funghi della provincia di Brescia".

Giuseppe Bergamaschi (1787-1867) who wrote "Osservazioni micologiche" which described all the Fungi in the province of Pavia.

Giuseppe Moretti (1782-1853), botanist for 25 years at the University of Pavia, gave great impetus to mycological studies. He drafted a "Prospetto dei funghi innocui del territorio lombardo." At his school, he taught the great Carlo Vittadini, discoverer of the *Amanita vittadinii*, which Moretti published his work "Il botanico italiano" (Lazzari, 1973).

Giuseppe Bendiscioli (1787-1864) who in 1827 published "Collezione dei finghi commestibili e malsani della provinica di Mantova", which also addressed the issue of cultivation.

Francesco Cima (sec XVIII – 1873?), surgeon, author of "Relazioni e tavola sinottica del fungi comestibili" (Bergamo - 1826) which contains dangerous generalizations regarding the "character of toxic and edible mushrooms" admitted for sale in the city of Bergamo.

Pleurotus ostreatus **(Jacq.) P. Kumm.**

Source: AMB archive, photo by C. Lavorato

Volvariella bombycina **(Schaeff.) Singer**

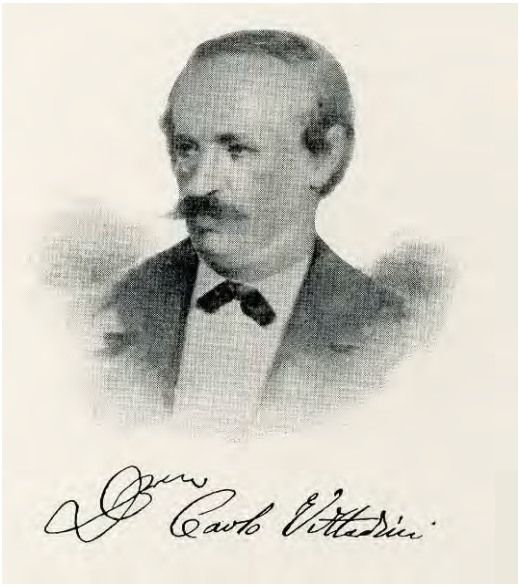
Source: AMB archive, photo by G. Visentin

Domenico Nocca (1758-1841), assistant to Scopoli collaborated with G. B. Balbis in the publication of "*Flora Ticinensis*" (1816-1826) containing the first and important provision of regional mycological flora, with two hundred and thirteen species of Fungi.

Of interest in this period are the first experiments in mushroom cultivation, which can be considered, even if empirical and approximate, an attempt to solve the evidently widespread problem, of mushroom poisoning with safer and readily available species. **Antonio Perego**, professor of physics at the lyceum in Brescia, is known to have obtained *Pleurotus ostreatus*, on the estate of Count Bettoni in Salò (BS), cultivated on substrates made of pressed laurel berries (empty husks) for the production of medicated oil (Lazzari, 1973).

Anche **Paolo Barbieri** (1789-1875), assistant keeper of Botany and Botanical Garden's of the lyceum of Mantua also carried out experiments on the cultivation of *Volvariella bombycina* (Schaeff.) Singer, a species that was already considered edible, and pleasant tasting, using as substrate for cultivation a mixture of Valonia oak leaves[39] (Lazzari, 1973) straw, compost and horse manure (Lazzari, 1973).

Similar experiments were conducted in Liguria in Porto Maurizio (IM) by the Marquis **Giuseppe Lascaris**, who successfully cultivated with not indifferent harvests *Agaricus bisporus*. The growing medium consisted of residues of olive pressings[40], accumulated in ditches and exposed to moisture and shade (Lazzari, 1973).



Carlo Vittadini (1800-1865) who first studied in Milan and then at the University of Pavia, where he graduated in medicine was a pupil and then assistant to professor Moretti, wrote his thesis, "*Tentamen mycologicum, seu, Amanitarum illustratio*" (Essay on mycology or Amanite explained), inspired by the connection between medicine and mycology. In it, after a general section and one on mycotoxicology is a description of fourteen species of the genus *Amanita* Pers. that he studied. These include the above mentioned *Amanita vittadinii* which he describes as a "*lonely, lover of wetlands, and of suspected edibility*" and accompanied by a superb plate in black and white.

He describes the proper methodology for analyzing the true characteristics differentiating one species from another similar species through a rigorous morphological examination.

Source: http://www.sboltrepo.it/serata-commemorativa-del-prof-carlo-vittadini/

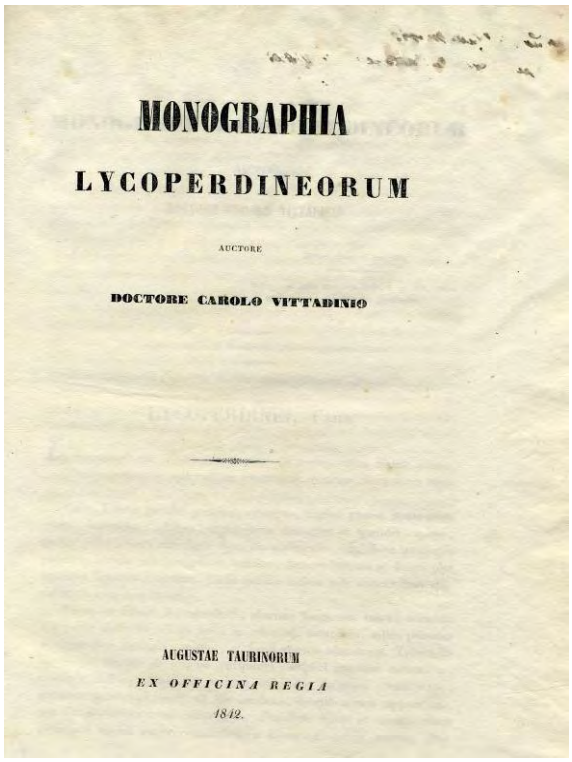
[39] The Valonian Oak (*Quercus macrolepis* Kotschy) were used for vats for the tanning of hides.

[40] Cultivation of olives began to take hold in the current area of Imperia (Port Maurizio -- Oneglia) at the end of the XVI century, when olive oil began to replace and other animal fats as a condiment for food and thus increased the demand for it.
In the eighteenth century this became an important font of income and commerce in the "Basso Ponente". The export of olive oil mainly passed through the port of Oneglia. The city was chosen as the headquarters of various foreign merchants thanks to numerous customs and excise facilitations. Thanks to these investments many companies were created for the processing and sale of olive oil that in the XVII century became the most exported Ligurian product. Olive oil was not just used for food but also for industrial purposes, such as making soap.
During the VXIII century its price constantly increased which made its cultivation very profitable pushing farmers of the "Basso Ponente" to give preference to the cultivation of the olive tree at the expense of grape vineyards and citrus groves (the price increased from 50-60 lire a barrel around 1770 to 150-200 lire in the first decade of the century). Around 1775 the "Basso Ponente" supplied 1/3 of the entire Ligurian production, which was about 200,00 barrels. It was during this period that terrace cultivation became diffused and day laborers increased at the expense of the traditional tenant farm. In the area of Oneglia and Porto Maurizio it became the sole crop to the point that it represented 71% of the entire agricultural production.

Adhering to Fries invitation to Italian mycologists, to study the Tuberaceae Dumort he then completely devoted his efforts to that study. The result of his research was "*Monographia tuberacearum*" edited by Rusconi in Milan in 1831, completed by five colored plates designed and engraved by him, in which he describes sixty-five species, of which fifty-one are totally new. In all he discusses ten new or revised genuses. This work filled a truly remarkable hitherto neglected gap in the field of mycology.

When his assistantship ended Vittadini dedicated himself to the medical profession, practicing in Milan. His mycological background was paramount in the medical field as in 1835 "*Descrizione dei funghi mangerecci più comuni d'Italia*", distinguished for all those approximating and even dangerous works on the edibility of mushrooms, then in circulation. In this work Vittadini describes fifty-six species, of which fifteen are new, in all their aspects: morphological, biological, ecological, toxicological and gastronomical. The work is accompanied by 44 (forty-four) beautiful plates engraved on copper, colored by him.

The toxicological aspect of treatment which was based on his personal observations, experiments on animals and himself is important. Vittadini was the first to recognize the absolute harmlessness of the *Amanita citrina* Pers.


MONOGRAPHIA

LYCOPERDINEORUM

AUCTORE

DOCTORE CAROLO VITTADINIO

AUGUSTAE TAURINORUM

EX OFFICINA REGIA

1842.

In 1841 he won a competition at the Academy of Sciences of Turin with "*Monographia Lycoperdineorum*".

Beautiful and significant is the slogan with which he presented this work: "*Melius est notas exsactius definire species, quam novas plerumque incertas proponere*" ("*It is better to define more precisely a known species, rather than proposing new species which is mainly uncertain*"). Bringing order to the chaos that reigned in this group of Fungi, he describes fifty species, of which twenty-three new, and many of these descriptions are still valid.

In 1844, at the invitation of the Government, concerned with the numerous cases of poisoning, he wrote "*Trattato sui funghi mangerecci più conosciuti e paragoni con quelli velenosi con cui possono essere confusi*".

Vittadini also dealt with micromycetes, in particular in his works on "mal di calcino" (muscardine disease), which seriously damaged the farming of silkworms.

Source: AMB archive

In the meantime his health had become very frail and Vittadini was no longer able to keep pace with the tremendous progress in the study of hypogeous fungi in Europe, mainly due to the work of Tulasne ("*Fungi ypogaei*", 1851), who was able, thanks to the recent discovery of the basidia (Léveillé and Berkeley), to distinguish between the hypogeous fungi "Basidiomycetes" and the "Ascomycetes", which greatly improved systematics. In fact, Tulasne brought the species up to one hundred twenty-four with twenty-five genuses.

Antonio Venturi (1806-1864) devoted himself to mycology with his travels and original experiments, ecological observations and studies on cultivation. In 1842 he published "Studi micologici" with description of sixtytwo species, and in 1845 "I miceti dell'agro Bresciano ", complete with sixty-four tables and a rich repertoire of bibliographic comments, and toxicological and ecological criticisms. He was author of several species, which could not withstand later criticism. In his day he had a considerable reputation and was a member of numerous Italian and European Academies.

Amanita vittadinii **(Moretti) Vittad.**

Source: AMB archive, photo by C. Zovadelli

Amanita citrina **Pers.**

Source: AMB archive, photo by G. Consiglio

7.2.2.2. Veneto

In the Veneto as well the Austro-Hungarian government regulated the sale of mushrooms and commissioned the University of Padua to draw up standards for consumer protection. From this work came the publication of "*Osservazione sopra i funghi mangerecci*" (1815). It was a rather general work from a botanical standpoint, but had some good practical advice; for example, readers were advised not to rely on empirical evidence of toxicity, which was firmly rooted in popular belief.

Giovanni Larber (1785-1845), following the family profession became a physician, and is mentioned here for the depth of his work: "*Dei funghi, saggio generale*" (1829). It is a comprehensive and scholarly treatise in six parts, interesting on both a naturalistic and cultural level. The most important part of his work is that which deals with the description of one hundred and twenty species of higher Fungi, with twenty-one colored plates, which unfortunately, are not always original, and not always accurate. His distinctions between edible and poisonous fungi are also not very accurate.

Source: http://www.bibliotecabertoliana.it/mostre/ritratti/galleria6.htm

Count **Giuseppe Marzari Pencati** (1779-1836), described forty-six species of higher Fungi in his botanical work: "*Elenco delle piante spontanee osservate nel territorio di Vicenza*" (1802).

Ciro Pollini (1782-1833) published the "*Flora Veronensis*" with four hundred species of macro and micromycetes in the Verona area and northern Italy.

Fortunato Luigi Naccari (1793-1860) left us with "*Flora veneta*" with a description of ninety-seven species of Fungi.

7.2.3. Mycology in the Papal States

In the final years of the eighteenth century "*Trattato dei funghi*", was published anonymously in Rome; a scholarly, but rough and outdated work when compared to mycological knowledge of the time.

In the early nineteenth century, the Prefect of the Botanical Garden of Rome, **Ernesto Mauri** (1791-1836), in his dissertation "*Di due funghi mangerecci del contorno di Roma*" describes two macromycetes that had been eaten in Rome for a long time as a excellent to eat: *Polyporus corylinus* and *Tricholoma effocatellum*. For the former he also described the improvised method by which farmers obtained the fungus. In the proper season they would scorch suitable hazel branches and then expose them to rain: soon young fruitbodies would appear on the branches which would be brought into town and sold, or given away with their substrate.

Meanwhile, in the Papal States, as in Lombardy and the Veneto regions, a service was set up to control the sale of mushrooms. An important contribution, inspired by poison prevention, was provided by the Roman physician **Vincenzo Ottaviani** (1790 - 1853) in a never published work that contained an extensive descriptive section with five hundred colored plates in watercolor.

Matteo Lanzi (1824-1907), chief physician in Rome's hospitals, is the most reliable Roman mycologist of this period. Trained in mycology through inspection activity in the markets, he left various works. Interesting is his 1873 pamphlet "*Il fungo della ferula*" (*P. fuscus* var. *ferulae* Lanzi), which is a presentation of a much sold mushroom in Roman markets and discussed with Inzenga and other Sicilian mycologists. The Lanzi published in serial form "*I funghi della provincia di Roma*" in which he accurately and precisely dealt with some one hundred twenty species of mushrooms. "*Funghi mangerecci e nocivi di Roma*" is a veritable and complete treatise of descriptive mycology with a display of three hundred thirty-two species according to the Friesian method. All the species which Lanzi studied and identified directly in their habitat reported in his works are still current.

7.2.4. Mycology in the Kingdom of the Two Sicilies

In this kingdom, which included all of southern Italy, the following earned an important place in nineteenth century mycology:

Francesco Briganti (1802-1866), a doctor like his father Vincenzo, from whom he also inherited a passion for mycology, and resuming and completing his studies with "*Historia fungorum Regni Neapolitani*" (1847). The work describes in detail sixty species, all belonging to the Agaricaceae Chevall family, accompanied by forty-six black and white plates. These plates are examples of excellent craftsmanship and are drawn directly by the author. Some of the species treated are new species.

Orazio Comes (1848-1917) occupies a prominent place in the Southern mycology. Professor of Botany for forty years at the Royal School of Agriculture of Portici, he left numerous works and a monograph entitled "*Funghi napolitani enumerati*". This monograph of great scientific value deals with regional flora, is rich in surveys and comparative criticism, and is divided into two parts. The first illustrates two hundred and forty species of "Basidiomycetes" which he examined or collected; the second part contains new species. The work is complemented by severl interesting more extensive discussions which address in particular the development of the fruitbodies of *P. tuberaster* (Jacq. ex Pers.) Fr., the phosphorescence of *O. olearius* (DC.) Singer and disquisitions on *P. eryngii* var. *ferulae* (Lanzi) Sacc.[41].

***Ferula communis* L.**

Source: AMB archive, photo by S. Scandurra

[41] The *Pleurotus* of the *Umbelliferae* are a group of fungal species that in the common practice is referred to as the "Group eryngii" where the entities that constitute it are united by the apparent growth in terrestrial, but in fact turn out to grow on rotting roots of some *Umbelliferae*. In the light of current knowledge and limited to Sicily, the "Group eryngii" consists of the following entities: *Pleurotus eryngii* var. *eryngii* (DC.) Quél.; *Pleurotus eryngii* var. *elaeoselini* Venturella, Zervakis & La Rocca; *Pleurotus eryngii* var. *ferulae* (Lanzi) Sacc.; *Pleurotus eryngii* var. *thapsiae* Venturella, Zervakis & Saitta; *Pleurotus nebrodensis* (Inzenga) Quél. (Scandurra, 2011).

***Pleurotus eryngii* (DC.) Quél. – [*Pleurotus eryngii* var. *ferulae* (Lanzi) Sacc.] [41]**

Source: GMEM-AMB archive, photo by C. Siniscalco

***Eryngium campestre* L. (esemplari giovani)**

Source: AMB archive, photo by S. Scandurra

***Pleurotus eryngii* (DC.) Quél. – [*Pleurotus eryngii* var. *eryngii* (DC.) Quél.]** [41]

Source: GMEM-AMB archive, photo by R. Carletti

***Elaeoselinum asclepium* subsp. *Asclepium* L. (Bertol.)**

Source: AMB archive, photo by S. Scandurra

***Pleurotus eryngii* (DC.) Quél. – [*Pleurotus eryngii* var. *elaeoselini* Venturella, Zervakis & La Rocca]** [41]

Source: AMB archive, photo by S. Scandurra

***Thapsia garganica* L. nel suo ambiente**

Source: AMB archive, photo by S. Scandurra

***Pleurotus eryngii* (DC.) Quél. – [*Pleurotus eryngii* var. *thapsiae* Venturella, Zervakis & Saitta]** [41]

Source: AMB archive, photo by S. Scandurra

***Cachrys ferulacea* (L.) Calestani in its growth environment**

Source: AMB archive, photo by S. Scandurra

***Pleurotus nebrodensis* (Inzenga) Quél.** [41]

Source: AMB archive, photo by S. Scandurra

Giuseppe Inzenga (1815-1887), botanist, agronomist and professor of Agronomy at the University of Palermo described in "*Fungi Siciliani Centuria I*" (1865) and "*Fungi Siciliani Centuria II*" (1879) two hundred species of macromycetes, of these forty are depicted in color plates of good quality. Several species are presented as new and received the authoritative confirmation of Fries.

Inzenga's work is interesting because it highlights the significant differences Sicilian mycological flora from that of mainland Italy. Examples worth mentioning are the various *Pleurotus* sp., including *Pleurotus nebrodensis* (Inzenga) Quél., subsequently recognized as varieties of *P. eryngii*, or typical forms of *Armillaria mellea* (Vahl) P. Kumm.

Particularly interesting is the discussion of *Boletus satanas* Lenz, which, according to the Inzenga, is the most sought-after edible mushroom on the slopes of Etna (and only found there). He asked Fries for an explanation of this extraordinary fact, but received no ansie.

Source: http://it.wikipedia.org/wiki/Giuseppe_Inzenga

***Armillaria mellea* (Vahl) P. Kumm.**

Source: AMB archive, photo by M. Floriani

***Boletus satanas* Lenz**

Source: AMB archive, photo by G. Visentin

7.3 Mycology from the unification of Italy up to the Second World War II

7.3.1. The origins of Italian Mycology

In every field of knowledge it is customary to speak of "school", ie a particular orientation, with its themes and methods of research, that a scientist or learned individual adopts and which is followed successfully by his disciples and followers. This occurs almost exclusively in the university but not always, at least with respect to mycology.

While the great professors of the sixteenth and seventeenth centuries were both botanists and mycologists, in the nineteenth century university professors specialized in cryptogamology (algae, fungi, lichens, etc..) giving rise to real mycological schools.

The main characteristic of these mycological university schools was that they were concerned almost exclusively micromycetes, for two main reasons:

1. these fungi lent themselves well to scientific inquiry as they are easily stored and easily reproduced in the laboratory
2. they had a large economic interest linked to animal and plant pathology, both in medicine and to emerging industrial interests.

In Milan a coeterie of natural scientists including some scientists who were passionate about mycological and botanical sciences gathered around **Luigi De Cristofori** (1803-1837), who was naturalist scholar of zoology and botany.

Giuseppe Balsamo Crivelli (1800 – 1874), scholar of cryptogamology who studied mosses, fungi and liverworts. He identified Botrytis bassiana as the cause of the silkworm disease, which wrought extensive damage to the textile industry. We believe that. Crivelli should be credited with having inspired in all his young scientists friends, a love and passion for mycology.

Carlo Vittadini, we have already discussed in paragraph 7.2.2.1.

Giuseppe De Notaris (1805-1877), graduated in medicine at the University of Pavia was introduced to the study of Cryptogams by Crivelli with whom he published in 1833 "*Enumerazione delle piante crittogame non descritte della Folra crittogamica dell'Italia settentrionale*", by Ciro Pollini (1782 - 1833).

De Notaris was a distinguished professor of Botany at the University of Genoa first, and subsequently Rome. He was the promoter and coordinator of "Erbario crittogamico italiano" and in collaboration with Cesati reorganized the systematics of pyrenomycetes.

Source: http://commons.wikimedia.org/wiki/File:Acta_Horti_berg._-_1905_-_tafl._136._-_Giuseppe_De_Notaris.jpg

Vincenzo Cesati (1806-1883), naturalist and diplomat was a victim of Austrian retaliation and was exiled from Lombardy after the insurrection of 1848. He was Professor of Botany at the University of Naples. He collected copious mycological material relating primarily to Micromycetes.

However, the Italian mycological school of macromycetes has its origins outside of the universities. No doubt Giacomo Bresadola must be the founder and leader of this branch of mycology; he had students, admirers and correspondents all over the world and was a consultant for Italian and foreign university scientists.

7.3.2. The Pavia School

Santo Garovaglio (1805-1882), professor of botany at the University of Pavia succeeded Moretti, restored the Botanical Garden and with the help of the Ministry of Agriculture and administrative authorities of Pavia formed the first " Laboratorio crittogamico" specializing in treating and preventing fungal diseases.

Giovanni Briosi (1846-1919), a versatile and very active thinker, succeeded Garovaglio as a botany professor, as well as in the laboratory. Under his leadership, the laboratory acquired international importance. Briosi with the help of his cryptogam laboratory assistant Fridiano Cavara published the herbarium "*Funghi parassiti delle piante cultivate e utili*". As was customary for publications of this type the work was published on subscription and limited to one hundred and fifty copies, due to the difficulty of finding a sufficient number of fungal specimens.

The "Cryptogam Laboratory" of Pavia trained many students. Among them were:

Giuseppe Gibelli (1831-1898), graduated in medicine from the University of Pavia and became first assistant at the "Cryptogam Laboratory". He published, together with Cesati and Passerini, the "*Compendio della flora italiana*". Gibelli was responsible for the "discovery of mycorrhizal fungi" and he can be considered the founder of the " mycological school of Turin".

Romualdo Pirotta (1853-1936), graduated in Natural Sciences from the University of Pavia attended the "Cryptogam Laboratory". He was professor at Modena and director of the Botanical Garden of Rome. He published many works on parasitic fungi and phytoparassitic dieseases. In 1884 he founded a major scientific journal: the "*Annuario del Regio Istituto Botanico di Roma*" which became "*Annali di Botanica*". Pirotta was also devised and created the "Parco Nazionale degli Abruzzi".

Rodolfo Farneti (1859-1919), plant pathologist and mycologist was conservator at the Institute of Botany of Pavia and its adjoining "Cryptogam Laboratory". He demonstrated the variation in saprophyte parasite nutrition, of several micromycetes. He studied diseases of rice and the chestnut tree. His best known book on mycology was "*Funghi mangerecci e velenosi*", published in Milan in 1892.

Fridiano Cavara (1852-1929), graduated in Natural Sciences from the University of Bologna became Briosi's assistant at the "Cryptogam Laboratory" of Pavia. He taught in various Italian universities and as a mycologist and plant pathologist, published numerous works, in collaboration with Bresadola and Saccardo. His work "*Funghi mangerecci e velenosi*" published in Milan in 1897was very successful.

7.3.3. The Padua School

The mycological School of Padua is identified with the prestigious name of Pier Andrea Saccardo. His tireless efforts and his unique achievements, through his personal work and that of the scientists trained at his school, shone a bright light on "Science of Mycology", not only in Italy but all over the scientific world (Lazzari, 1973).

Pier Andrea Saccardo (1845-1920), graduated from the University of Padua with a degree in Philosophy (in those days the faculty of philosophy also included the natural sciences), becoming interested in Fungi while working at the Botanical Garden of Padua. He succeeded his teacher, De Visiani, as Professor of botany and Prefect of the Botanical Garden.

From that moment his focus was exclusively on mycology. His first important work was "*Fungi Veneti novi vel critici*" (1882), the result of herborization performed throughout the Veneto region, which led to the discovery of a few thousand species, from the few hundred previously known. This was especially true with respect to micromycetes, which were Saccardo's, who was an excellent

microscopist. Specifically, in 1887 he began publishing "*Fungi Italici autographice delineati*"; it is composed of fifteen hundred original plates, without comment, showing all the characteristics of both fungi and the various substrates they invaded. He was soon famous world-wide and Fungi from all over the world, including exotic ones, were sent to him to be classified.

At one point he also devoted himself to systematics, but the work which gave him immortal fame, and that really does honor to "Italian Mycology" is the "*Sylloge Fungorum omnium hucusque cognitorum*" which collects and classifies all known fungal species (known seventy eight thousand three hundred and sixteen species of Fungi taken from mycological literature of the world, in which the Fungi are found (Lazzari, 1973)), together with a brief diagnosis and arranged systematically, distributed in twenty-five volumes. It is an immense and invaluable work, a gold mine of information, with references, indexes, synonyms etc.., that Saccardo was able to complete thanks to the help of other talented mycologists[42].

Source: http://it.wikipedia.org/wiki/Pier_Andrea_Saccardo

The work received praise and admiration everywhere and was honored with many awards including from the Accademia dei Lincei. It was rightly compared to the work of Linnaeus in the field of Botany.

Botany was not just a secondary interest for Saccardo and devoted himself to it, authoring numerous weighty works. It is worth remembering that he founded a "*Iconotheca botanicorum*", ie a collection of portraits of botanists through the ages, located in the Botany institute he directed.

He was shy and austere man, totally dedicated to his studies, he refused honors and offices, but many academies and associations were honored to have him as a member. He was among the founders of the "Italian Botanical Society" in 1888. In mycology he identified thousands of new species and hundreds of new genuses. For example, the mycological flora of Veneto, which in 1871 counted just two hundred forty-five species was enriched up to the number of four thousand six hundred species, many of them completely new to mycological science world-wide.

Saccardo's School is the pride of Italian Mycology and it out of it came other important mycologists.

Augusto Napoleone Berlese (1864-1903), assistant to Saccardo and subsequently lecturer. Particularly important his is work on parasitic diseases of mulberry, the nutrition of silkworms. While he mainly devoted himself to "Micromycetes", he piad particular attention to macromycetes in the "Fungi Veneti", making use of his exceptional skills as a draftsman. Before his untimely death, he managed to publish three volumes of illustrated of the "*Sylloge Fungorum omnium hucusque cognitorum*" of his mentor.

Giacomo Bizzozero (1852-1885), was first a technical assistant at the Botanical Garden of Padua and then assistant to the Saccardo; in 1885 he published "*Flora Veneta cryptogamica*", the first part of which is devoted to Fungi (two thousand four species) and the second part which contains illustrated six thousand species of "Lichens", "Algae", "Mosses," "Liverwort" and "Coracee".

Carlo Spegazzini (1858-1925), guided by Saccardo to undertake mycological studies and author of many works even as a young man. At the age of twenty he emigrated to Argentina, participated in a scientific expedition to Patagonia, became a professor at the University of La Plata. He discovered

[42] Among these Berlese and Voglino were responsible the "Indexes" of the first four volumes. Cuboni and Mancini contributed to "Agaricinee", while Berlese, De Toni, Fischer and Trevisan addressed the other sections. Saccardo's son, Domenico, and the German mycologist Sydow, Trotter, Traverso and Meschinelli were responsible for the "supplements". "*Sinonimia*" was the fruit of the contribution of Mussat (Lazzari, 1973).

Argentine Fungi (he described about 4,000 species); his most important work was "*Fungi argentini novi vel critici*". He maintained a very close correspondence with Saccardo and Bresadola.

Giovanni Battista De Toni (1864-1924), assistant to Saccardo, was primarily a scholar of algae, but also collaborated on the "*Sylloge fungorum omnium hucusque cognitorum*".

Ottone Penzig (1836-1929), a German naturalized Italian citizen, who was also assistant to Saccardo. He was then Professor of Botany at the University of Genoa, where he revived the Botanical Garden. He studied Fungi during his time in Padua, studying microparasites on citrus and fungi of several specific areas.

Caro Benigno Massalongo (1852-1928), a colleague of Saccardo, held the Botany chair in Ferrara. He was primarily a botanist of great fame and authority, but loved mycology and was a friend of Bresadola. He left sixty mycological works which dealt with one thousand six hundred forty five species, many drawn by himself and, mainly from Verona. He also addressed higher Fungi, leaving drawings of three hundred forty-five species of "hymenomycetes" excellently illustrated in color.

Giovanni Battista Traverso (1878-1955) was another of Saccardo's assistants in Padua, he dedicated himself to mycology ("Myocromycetes") and contributed to the "*Sylloge Fungorum omnium hucusque cognitorum*". He was also in charge of toxicology and cultivation of mushrooms. He held the chair of Plant Pathology at the University of Milan. In the field of higher Fungi his commitment to the completion and publication of Bresadola's "*Iconographia micologica*" is crucial to remember and this was undoubtedly his greatest contribution.

7.3.4. The publication of "Flora Italica Cryptogama"

An early work with this title by **Antonio Bertolini** was published in Bologna (in installments) between 1858 and 1862. A subsequent work with the same title was promoted by the aforementioned Cavara. This last work, much more complex and ambitious than the first, began in 1905 and was not completed until 1943. During its long period of preparation the best Italian crytogamologists of the time contributed to it.

The work was organized into 5 sections:

Fungi: this was the largest section and was divided as follows:

Pyrenomycetes, edited by G. B. Traverso

Uredinales, edited by A. Trotter

Gasterales, edited by L. Petri

Hyphales, edited by T. Ferraris

Hymeniales, edited by P.A. Saccardo

Laboulbeniales, edited by E. Colla

Ustilaginales, edited by R. Ciferri

Bibliographic Italian mycological index by G. B. Traverso

Algae, by A. Preda

Lichenes, by A. Jatta

Bryophyta, by G. Zodda

Pteridophyta, by A. Fiori

The first and most extensive portion of "Fungi" is dedicated to mushrooms. In this section, the portion on higher Fungi (*Hymenials*) was entrusted, by unanimous consent, to G. Bresadola who managed to complete much of the work, but then fell ill, had to give up what he had prepared which went to Saccardo, who completed the work. Bresadola followed Fries' classification ("*Hymenomycetes europaei*" of 1874), even though it had already been superseded by the progress made systematics in the early twentieth century. Written in Latin, each unit of use (Class, Order, Family and Genus) provides a comprehensive description and analytical key. A very detailed description of each species

(two thousand four hundred and thirty one species and varieties distributed amongone hundred and twenty two hundred sixty-three Genuses: synonymy, bibliography, iconography, diagnosis, habitat, distribution range, observations (Lazzari, 1973).

7.4 Subsequent Mycology Schools

Source: http://commons.wikimedia.org/wiki/File: Acta_Horti_berg._-_1905_-_tafl._136._-_Giuseppe_De_Notaris.jpg

At the end of the nineteenth century as well as in the early decades of the twentieth century mycological work coming out of universities became increasingly numerous, thanks to the many numerous specific publications of the Italian Botanical Society, the University Institutes of Botany and Acts of Scientific Academies.

7.4.1 The Turin School

The University of Turin was already distinguished by a flourishing school of botany under the direction of C. Allione. **Giuseppe De Notaris** (1805-1877), was trained at the Botanical Garden of Turin under the direction of G. G. Moris, where he began his study of Italian "Micromycetes", which gave impetus to "Mycology" on the Italian peninsula (Lazzari, 1973).

Giuseppe Gibelli (1831-1898), already cited in the school of Pavia, he was lecturer in Turin and can be considered the true forerunner of the mycological school of Turin. Researching the causes of disease of the chestnut tree, he observed the root hairs of infected plants were wrapped in special formations of fungal hyphae, but then discovered that the same phenomenon occurred in healthy chestnut plants and as well as in almost all plants with foliage. He had discovered mycorrihzal fungi". It was subsequently a German scholar, A.B. Frank Berlin who explained this phenomenon as a form of symbiosis between Fungi and higher plants and call it just "mycorrhiza".

Oreste Mattirolo (1856-1947), professor at various universities and finally Director of the Institute of Botany, with its adjoining Botanical Garden, in Turin. He particularly devoted himself to the study of various fungal forms based on ecological factors. He was soon recognized as the lading specialist on hypogeous fungi, not only of the Tuberaceae Dumort. He authored many publications of lesser importance, but he began by publishing the monograph "I funghi ipogei italiani", a general and thorough work on hypogeous fungi. Mattirolo's authority in this field was recognized around the world. He also fostered the artificial cultivation of truffles in Italy, following the example of southern France.

Pietro Voglino (1864-1933), a scion of the Paduan school, although he spent most of his career in Turin. While in Padua he collaborated with Saccardo in the study of "Micromycetes" and the writing of "*Sylloge Fungorum omnium hucusque cognitorum*". In Turin his focus was *Agaricaceae* Chevall of which studied the physiology and in particular their malformations ("Teratology"). He published several small "Flore mycologiche"; his microscopic studies on local species were also very important.

7.4.2. The Roman School

The Roman school must thank De Notaris for its origins, who during the four years he taught in Rome was able to spread his knowledge and exercise power that knowledge of attracted to spur to the interest of promising young "mycologists".

Giuseppe Cuboni (1852-1920) was first assistant in Botany at the University of Rome, then teacher at the school of "Viticulture and Enology of Conegliano Veneto", where he acquired great fame with his work on the "blight of the vine". He also worked on Saccardo's "*Sylloge Fungorum omnium hucusque cognito rum*". His main interest was Phytopathology.

Carlo Bagnis (1854-1879), graduated in Natural Sciences from the University of Rome, under the advice of by De Notaris he was encouraged to study Phytopathology and related systematics. During

his brief life Bagnis undertook the illustration of the mycological flora of Rome on which he published two important contributions with the title "Micologia Romana", with two hundred species, mostly "Micromycetes" of which several were new species. Bagnis also illustrated a collection of Fungi which were the result of an expedition to Tunisia with the "Italian Geographical Society." He collaborated in the publication of "Erbario Micologico" by Thümen entitled "*Mycotheca Universalis*" on which other Italian mycologists also collaborated.

7.4.3. The Tuscan School

The Tuscan school numbered several eminent botanists among those several passionate about mycology, especially the Universities of Pisa, Siena and Florence, which gave considerable contributions to the study of Fungi (Lazzari, 1973).

Giovanni Arcangeli (1840-1921), graduated in Natural Sciences from the University of Pisa, was the first professor of Botany at the University of Turin, then returned to Pisa as a professor of Botany. He was particularly passionate about higher Fungi of which he was an expert, often discussing them with expertise in meetings of the Italian Society of Botany. He published "*Illustrazioni di Macromiceti del Livornese*", "*Illustrazioni di Macromiceti del Pisano*" and "*Funghi mangerecci e velenosi*" (1900).

Source: http://it.wikipedia.org/wiki/Giovanni_Arcangeli

Pasquale Beccarini (1858-1920), Professor of Botany at the University of Florence was the author of several mycological works. He published a "*Flora micologica dell'Avellinese*" with two hundred and thirteen species, above all micromycetes. He described the Fungi in the northern Schengen-Si northern of Eritrea in Ethiopia, etc.

Attilio Tassi (1820-1905) beginning in 1860 he was prefect of the Botanical Garden of Siena. In collaboration with F. Tassi he collected material of inestimable value which is still preserved in the "*Mycotheca Universalis*", which is an integral part of the "*Herbarium Universitatis Senensis*".

Flaminio Tassi (1851-1917), scholar of mycology in the province of Siena; he was the author of a large collection of chronicles of Micromycetes entitled "*Novae mycromycetum species, descriptae et iconibus illustratae*". His is also the author of "*Flora micologica di Viareggio*". In collaboration with A. Tassi he contribute to the realization of "*Mycotheca Universalis*", which is an integral part of the "*Herbarium Universitatis Senensis*".

In Tuscany during the late nineteenth and the beginning of the twentieth century numerous other publications on mycology were published. Some of these are particularly interesting with regard to the ecological aspects of the macromycetes and are worth mentioning.

Count **Ugolino Martelli** (1860-1934), secretary of the "Italian Botanical Society" was engaged in writing "*Determinazioni delle Agaricaceae Chevall. descritte dal Micheli*".

P. Pellegrini (1867-1957) published a work on "*Funghi della provinica di Massa e Carrara*" which deals with two hundred thirty-seven species of higher Fungi numbered and accompanied by accurate descriptions of the localities in which they could be found, which was the main focus of this study.

E. Barsali (1876-1945) published "*Flora micologica della provincia di Pisa*" with contributions on hymenocyetis and micromycetes.

7.4.4. The Emilia Romagna School

In Emilia Romagna, a place of merit belongs to:

Antonio Bertoloni (1775-1869), physician and later professor of botany at the University of Bologna who is famous for being the first author on the flora of Italy the "*Flora Italica sistens et plantas in Italia et in insulis circumstantibus sponte nascentes*" . In the last years of his life he published a "*Flora Italica Cryptogama*", which was published in installments between 1858 and 1862.

Giovanni Passerini (1816-1893) was a professor at the University of Parma for many years and holder of many prestigious assignments. He wrote several mycological works, but his most important work is the illustration of the "*Funghi parmensi*" with rich bibliographic data and critical observations on several hundred species. He was also very devoted to the study of Micromycetes and Phytopathology.

In addition to Passerini's work other works have addressed the Fungi of the Emilia Romagna region. Among the most important publications are: "*Enumerazione dei funghi della provincia di Bologna*" by **Girolamo Cocconi** (1824-1904) who was also in charge of *Ustilagineae* and Uredinali.

Fausto Morini (1858-1927) worked with Cocconi in Bologna and was subsequently director of the Botanical Garden in Sassari and Messina. He published important work on Uredinali and the biology of some species of *Amanita* Pers. and *Boletus* Fr.

Antonio Mori (?-1902), Director of the Botanical Garden of Modena published many works on Micromycetes as well as on higher Fungi, in particular on *Tuberaceae* Dumort.

7.4.5 The Trento School

The province of Trento gave birth to the greatest "Italian mycologist" of all time and founder of the Italian School of the branch of Mycology which deals with macromycetes.

Giacomo Bresadola (1847-1929) from Ortisé (in the municipality of Mezzana - Val di Sole - TN) lived a very modest life until the end of his days, but his immense work and its importance to mycology in the world have drawn a furrow so deep in "Italian Mycology" to make Trento the capital of peninsular mycologists. The Bresadola Mycological Association (Associazione Micologica Bresadola – "AMB"), was founded in Trento in 1957 as the Mycological Group "G. Bresadola", it was honored to take the "master's " name and pursues, in the spirit of volunteerism and with the same humility that Bresadola possessed, his same goal, which is the study in particular of macromycetes and every aspect that issues involved in that study. Even today at the dawn of the twenty-first century Trento, thanks to AMB remains the "parent" of all mycologists working in Italy.

Giacomo Bresadola entered the seminary at age sixteen, after attending technical schools in Rovereto. Ordained as a priest, was first assistant in Baselga to Piné Roncegno and Malé, and then beginning1874 a parish priest in Magràs in Val di Sole (TN). In 1875 he became director of the bishops canteeen. He was "simple priest" for most of his life and only on the occasion of his eightieth birthday, while the whole world bestowed honors and accolades on him, was he appointed Canon of the Cathedral of Trent becoming a "Monsignor". It is thus not correct to refer to him as a prior. This erroneous appellation stems from the fact that his French correspondents addressed him as "Monsieur l'Abbé" (eg. Quélet), which was a term used for any priest. Bresadola's scientific importance (but also the human value) can be found in his works and in his correspondence. While his works are not numerous, both due to his modesty, as well as lack of means. His monumental "*Iconographia Mycologica*", "*Fungi tridentini*" and dozens of contributions, would in 1979 be collected by the "Comitato Onoranze Bresadoliane", on the occasion of the 50th anniversary of his death, in "*Omnia Bresadoliana extracta in unum collecta*".

His writings are immense and prodigious, but unfortunately are only partially accessible as most of his notes are in the United States; but it was with his letters, sent everywhere in the world, that Bresadola undertook an intense and sought after role of consultant and infallible teacher to non-academic mycologists in a classroom without boundaries. His reputation was in fact his original analysis, advice, and solutions to difficult problems that he lavished both directly to those who came to consult him (he almost never moved from Trentino), or by correspondence.

He transmitted his teaching not via a university professorship, but by his modest studies in the country; he had no academic titles, but he was generous with his self-taught knowledge.

Bresadola's passion for mycology arrived via boatny through an initial interest in mosses and lichens, and exploded when he was able to return to Magràs, in his Valle di Sole, where he took long walks in the woods with two friars of the convent of Malé. To one of these friars, P. Placido Giovanella, he dedicated a new species, "*Omphalia Giovanellae*" today known as *Clitopilus giovanellae* (Bres.) Joss.

His first official contact with the mycology came with his purchase of the books of Venturi and Vittadini and the breakthrough came when "he had the courage" to write the great professor Andrea Saccardo to ask him how to obtain his works and offering to carry out mycological research in Trentino. They formed a long lasting friendship and partnership. Even Lucien Quélet, was among Bresadola's teachers, from whom he learned his tendency towards a precise morphologic analysis, uniting it with microscopic research advocated by Saccardo.

Bresadola began to be known throughout Europe, with his work "*Fungi tridentini novi vel nondum delineati*", of which the first installment was published in 1881. In the meantime he had begun contributing to major European botanical periodicals. He was among the founders of the *Société mycologique de France* along with Quélet, Boudier and Patouillard.

The articles he submitted to foreign journals related to exotic fungi that collectors and travelers sent him from all over the world (Australia, Africa, Asia as well as Europe) which he could only study meticulously from dried specimens with, with an old microscope that was his only investigative tool.

In this manner he gained fame, experience, and an excellent knowledge of all kinds of Fungi, creating many new species.

"*Fungi Tridentini novi vel nondum delineati*" was collected in two volumes (1881 and 1892) but had subsequent publications. It is a superb atlas of species found in Trento, containing two hundred and eighty one species, or varieties, described and illustrated, and of which one hundred fifty-five bear the name Bresadola. One hundred and twenty new species were created by him and submitted with the endorsement "Bres. No. sp. ", among which many have become familiar to the amateur collector, for example: *Suillus tridentinus* (Bres.) Singer, *Clitocybe candida* Bres., *Russula azurea* Bres. etc. There are a total of two hundred and seventeen, with exception of seven plates executed by one of his students, his great aunt Julia Turco – Lazzari, all the plates are the work of Bresadola.

The great importance of this work lies in the fact that the mycologist is also a painter, the ideal situation. Thus, the designs, the color, the detail and subtlety of the details, elements that "give life" to the plates and document them in an incontrovertible manner are all excellent and help document the written description and discussion of the species. It needs to be kept in mind that these images are not a type of photograph, but stress specific determining and diversifying characteristics of the Fungi, as observed during their various stages of development; all enriched by artistic talent.

Another peculiarity of the "*Fungi Tridentini novi vel nondum delineati*" are the critical notes, the polite scientific controversies with which the author supports his views, and the critical revision he makes on the same species published by him.

Bresadola is known for his work on higher Fungi, in particular "hymenomycetes", but he also dealt with "Micromycetes", working with Berlese, then assistant to Saccardo in Padua, on the publication of "*Mycromycetes Tridentini*" (1889) in which they discussed three hundred species. He was well suited to this due to his skill in microscopic analysis. Catoni in his bio-bibliography of Bresadola lists one thousand and seventeen new species and varieties described by Bersadola, of which six hundred forty-six are hymenomycetes, seventy-five Gasteromycetes, forty-seven Pyrenomecytes, two hundred and fourteen Deuteromycetes and two are Tuberaceae Dumort.

***Russula azurea* Bres.**

Source: AMB archive, photo by G. Consiglio

***Suillus tridentinus* (Bres.) Singer**

Source: AMB archive, photo by C. Lavorato

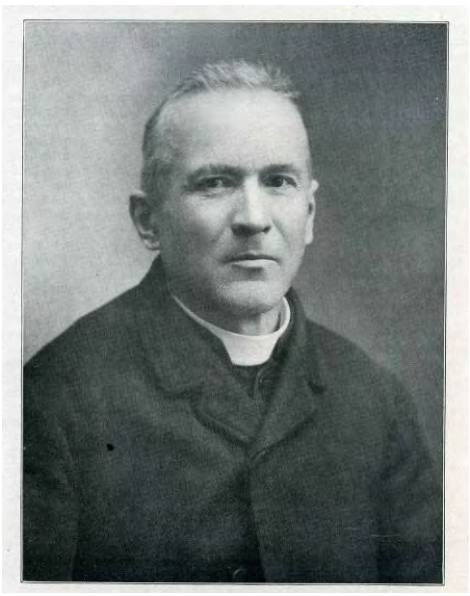
However we should not be misled into thinking that that Bresadola was a fanatic creator of new species. Far from it. The mistake of hurriedly creating new species destined to certain condemnation is very popular among mycologists due to haste, ambition, and superficiality. Bresadola made his pronouncements only after careful research and bibliographic checks of collections and herbaria. On the one hand, this allowed him to create species that were certain, even if not all could be "saved" by subsequent criticism; while on the other hand, to complete, without pride and arrogance, an important work of review and a "cleaning" of false and duplicated species that littered mycological literature. These are his words: "*Those who, having observed certain forms in only one specimen, or in a few specimens, and only once or a few times, consider it as an autonomous species, but in reality it is nothing more than similar form, which cannot be found in other individuals of the same species err. Doing so may create false species, which then cannot be found, because the constant forms always reproduce, by law of nature, forms similar to them. In establishing my species I have always tried to adhere to these principles ...*".

The last and greatest work of Bresadola is the "*Iconographia micologica*" (1925-1933), the result of a long and complex work that threatened to be sold abroad because of his financial hardship and at the last minute was guaranteed to Italy thanks to professor G.B. Trener, founder and director of the Museum of Trento and prof. G.B. Traverso. A committee was formed which collected worldwide subscriptions and Bresadola was able to see the his first volumes published. The work, completed posthumously, consists of twenty-five volumes depicting twelve hundred and fifty species of macromycetes, distributed in one hundred forty-three genuses, accompanied by descriptions, a bibliography and notes in Latin. A twenty-sixth volume contains indexes and a “Bresadolian” bibliography, as well as a biography of Bresadola written by Traverso. A twenty-seventh volume was added later on the Amanitaceae R. Heim ex Pouzar by E. J. Gilbert and a twenty-eighth on “*Elaphomycetales et puberale*” edited by A. Ceruti. The work, though it lends itself to some criticism on the systematic plan is impeccable and flawless in its characterization of species and therefore still very valid.

It was only toward the end of his life and that the inhabitants of Trento and Italian society in general became aware of the greatness and genius of this humble priest. On the occasion of his eightieth birthday, in 1927, at the initiative of his friend and his Trentino disciple G. Catoni prepared, a great celebration of that greatly cheered Bresadola’s last years. He was showered with municipal and academic honors by the government, the church, universities. Catoni gathered from around the world ratings and testimonials, all moving and unanimous in recognizing the magnitude of the "Master". The best judgment was, however, the spontaneous, unsolicited on this occasion, expressed by CG Lloyd in 1923 during a visit to Bresadola in Trento: "*In my opinion, he is the world's greatest mycologist. This illustrious scientist will leave an imprint in systematic mycology equal to that of Persoon and Fries*".

And Professor Caro Massalongo confirmed: "*It is not an exaggeration to say that there is no living scholar of mycology, who has not turned to Don Bresadola for help and advice in the study of fungi, especially of hymenomycetes, in which he proved himself the supreme maestro, earning in this regard to be compared only to the two most famous naturalists of the last century, and that is to C.H. Persoon and E. Fries. One cannot understand how this self-taught man, alone and without adequate means, has been able to acquire such a deep knowledge of these cryptogams, not only our own, but those from different and distant regions of the globe, which to him were sent to be diagnosed*".

LIFE AND WORKS OF GIACOMO BRESADOLA



Giacomo Bresadola (1847 – 1929) was an illustrious son of the Trentino, the best known and largest of the Italian mycologists, from which the Bresadola Mycological Association (AMB), founded in Trento in 1957 as the Mycological Group "G. Bresadola" is honored to be named. As modest as Bresadola'a life was, as great was his work and his importance in the Italian and world mycology.

The eldest son of Simon and Domenica Bresadola, he was born on February 14, 1847, in the small village of Trentino Ortisç (Municipality of Mezzana, Val di Sole), at that time part of the South Tyrol, a province of the Habsburg Empire, 1,479 meters above sea level, halfway up the Mezzana mountain, on the left side of Noce. Today ones arrives by a daring road that breaks off from the Tonale State Road 42 just before Pellizzano[43]. He was baptized with the name of his maternal grandfather, Giacomo Antonio Bresadola[44].

Portrait of the Italian mycologist G. Bresadola.
Source: AMB archive, photo by G. Visentin from *Mycological notes* - Biblioteca Micologica AMB-CSM

Though it had noble origins, as shown by a document dated 1529 which placed a Giacomo Antonio and Pietro Bresadola in a catalog of rural nobility, his family was part of the farming class; they were a tenacious, honest, industrious and religious people that also included capable artisans and enterprising merchants who were interested in education and culture, placing emphasis on the education and spiritual formation of their children. Giacomo attended elementary school in his hometown, but soon he was given the opportunity to develop through new experiences beyond his healthy and safe mountain nest. At nine years of age he was sent to his uncle Don Angelo Bresadola, who was pastor at Cloz (Val di Non), but this experience did not last long, probably due to young Bresadola's decisive temperament, his liveliness and restlessness, and his uncle sent him back to his parents.

In 1857 he was in Montichiari (Brescia), with his father who, following a custom of the Solander people, had opened a shop selling ironworks and copper (). It is worth mentioning at this point that the elder Bresadola, like the Solander people in general, has a tradition of widespread emigration to the Veneto plains as well as to other provinces of Italy[45]. In 1859 Bresadola as at Solferino, and the roar of cannon and the visit to the battlefield of Solferino after the war was an event that he always remembered. It was there that Bresadola became aware of the problems associated with earning a living, typical of an emigrant.

After a brief return to Ortisé, recognizing a predisposition that had during early studies and reinforced in his father's shop at Montichiari the 1860-61 school term found him the Scuola Reale Inferiore Elisabettiana di roverto (Real Schule) taking technical courses. He was appreciated for his brilliance, dedication to his studies and the good marks received.

[43] The name, according to experts, means "place of nettles", although the derivation was later ennobled improperly from the Latin horticulum, small vegetable garden. The home of Bresadola is one of the last of the country, upstream, and carries a plaque commemorating the SAT post in 1947. A bronze bust of David Rigotti, however, is placed on the outer wall of the apse of the church since 1967. On 31 December 1998 the inhabitants of Ortisè were 99, distributed in 31 families.

[44] After him will arise, in almost regular intervals, the other eleven brothers (one died and one stillborn newborn): Giovanni Domenico, Margherita Miradio, Maria Clementina, Geltrude Candida, Adelaide Carolina, Domenica Petronilla, Angelo Pompeo, Massimiliano Emmanuele and Elvira Domenica.

[45] Currently in Italy there are 104 telephone users with surname Bresadola, including 6 in Piedmont, 22 in Lombardy, including 14 in the province of Brescia, 5 in Veneto, 50 in Trentino Alto Adige, of which 41 are in the province of Trento; 1 in Friuli Venezia Giulia, Liguria and Tuscany; 13 in Emilia Romagna and 5 in Lazio.

Photo by G. Visentin from *Iconographia Mycologica* (AMB-CSM mycological library)

At the end of his fourth year, his life changed: perhaps he had an existential crisis, perhaps reinforced by the disappointment that he experienced as an injustice of only being be ranked second. Whatever the reason it induced him to abandon his ambitions and his family hopes for his undertaking the technical path of commerce to devote himself, during the years, 1864-65 to 1865-66, to the study of the Greek, Latin and philosophy at the upper Gymnasium (classical lyceum) at the seminary of Trento, exhibiting an aptitude and a rapid understanding of those subjects. In 1866 he began studying theology at the Seminary of Trento and was ordained a priest July 31, 1870. He was 23 years old and was a priest for almost fifty-nine years.

His pastoral work was always humble and rendered behind the scenes. He was fist sent to be vice rector of in Baselga di Pine (October 10, 1870), then to Roncegno (September 13, 1872) and Malè in the Sun Valley (28 August 1874) with his uncle, Don Angelo Bresadola. On 12 May 1877 was deservedly made rector of Magràs, a small frazione of the town of Malé in the Sun Valley, where he remained until February 28, 1884. Already while in Baselga, with the help of Francesco Ambrosi (1821 - 1898) he had gained a solid knowledge of flowering plants and then, under the tutelage of Gustavo Venturi (1830-1898) of bryophytes and lichens. While at Roncegno he had completed his first herbarium. Now at Magràs, assisted by less pressing pastoral obligations and encouraged by the Capuchin friar Padre Placido Giovanella from Cembra-to whom he would dedicate, *Omphalia giovanellae* today known as *Clitopilus giovanellae* (Bres.) Sing. – began (he had always been interested in botany) his specific interest in the world of Fungi. It was no longer a general instinctive "passion", but had become a precise and scientific study based on the use of the microscope, reading and a critical comparison of books, and correspondence with the distinguished contemporary mycologists. In 1878 he "dared" to write to Professor Saccardo asking where and how to find his works, thus establishing a copious and lengthy correspondence with the eminent professor. Giving impetus and justification for reading to the book of nature, was his faith as priest: "*Who is cold and indifferent to the spectacle of nature is not a man, because man, the image of God, the archetype of beauty, of course, is naturally moved by the imposing sight of this diverse universe, in which the beauty of plant life plants exalts the beauty*". Now, in this small village, pasta part from some initial inevitable failures, the mycological scientist Bresadola is born, immediately attractung the attention of mycologists around the world. He found a reliable guide in Lucien Quélet and became a founding member of the *Société Mycologique de France*.

In 1881, at age 34, he published the first 14 dossiers on "*Fungi Tridentini Novi, Vel Nondum Delineati, Descripti, Et Iconibus Illustrati*": when finished would be composed of 217 plates and 232 pages of text. Priase of this work soon arrived from every country, especially from France (Lucien Quélet and Jean Baptiste Barla) and Padua (PA Saccardo and C. Massalongo). It was the start of dried packets of fungi being sent to Bresadola from the most remote regions for classification, as he had become the undisputed specialist of *Agaricomycetes* along with Lucien Quélet, the *Aphyllophoromycetideae* with Narcisse Théophile Patouillard and Hubert Bourdot, as well as of *Discomycetes* with Émile Boudier.

On March 1, 1884 he is sent to Trento, which in the meantime was in the midst of a renewed fervor flurry of scientific studies. The Prince Bishop Giovanni Giacomo della Bona have him the job of administrator and later a procurator of the Bishop's Table, with food and housing in the bishop's headquarters and an annual honorarium of 400 guilders.

Portrait of the Italian mycologist G. Bresadola the day of his 36th birthday.
Source: AMB archive, photo by G. Visentin - AMB-CSM Mycological library

This charge ended on November 17, 1885 with death of the bishop, who in the meantime had appointed him as his executor. Except for a few trips and some short absences he would not leave the capital until his death. Under the new Bishop Eugenio Carlo Valessi he was then appointed, as was the practice, by the Emperor Franz Josef, on 18 November 1885 he became the Secretary of ecclesiastical administration until 30 September 1887 when he was appointed board member of the Chapter of the Cathedral of Trent.

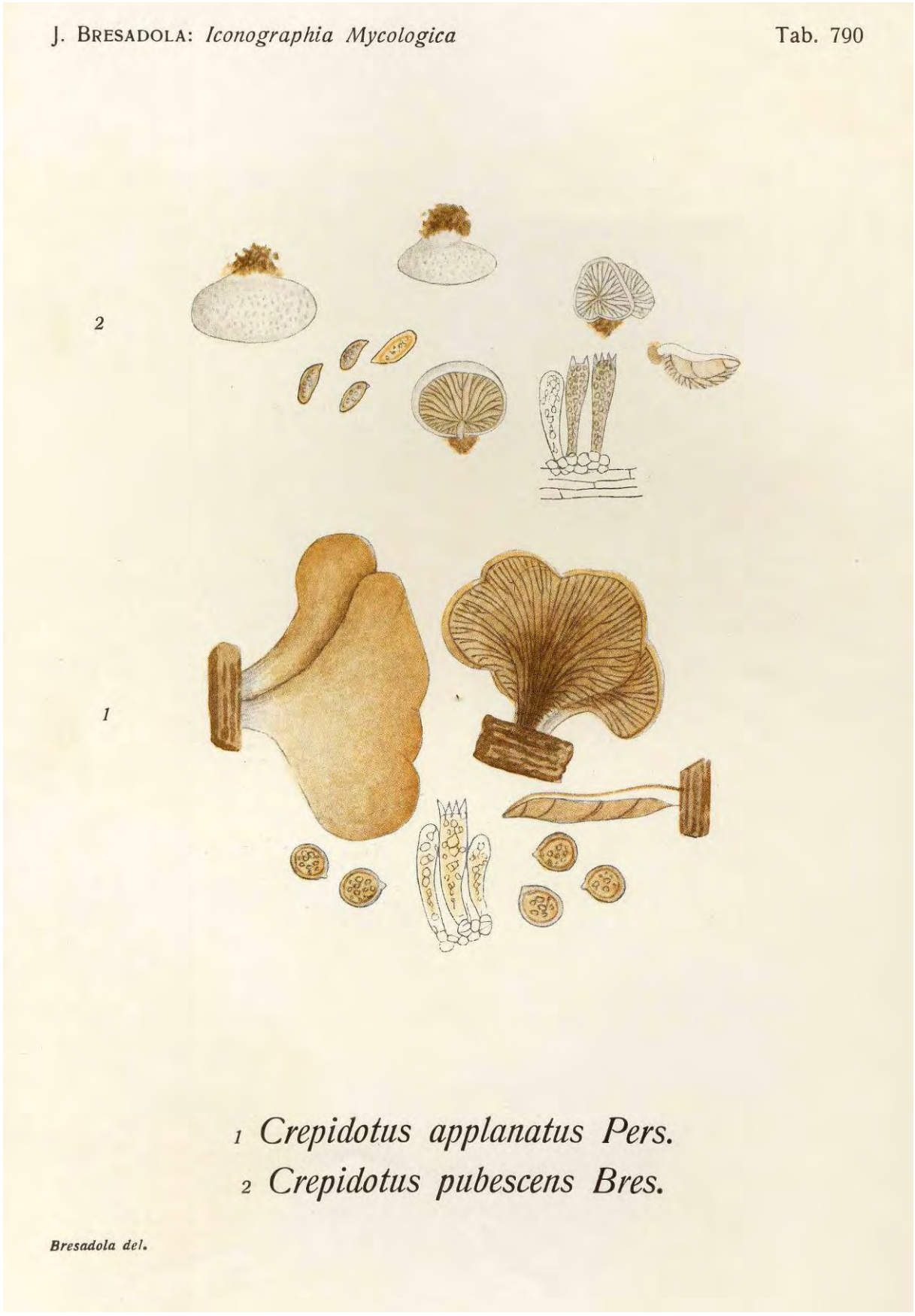


Photo by G. Visentin from *Iconographia Mycologica* (AMB-CSM mycological library)

In 1898 he published another informative scientific book for lay readers, "*I funghi mangerecci e velenosi dell'Europa media, con speciale riguardo a quelli che crescono nel Trentino e nell'alta Italia*" containing 100 color plates, a very useful book appropriate if we consider that, according to the Mattirolo, in Europe alone each year are there were about ten thousand victims of poison mushrooms. His work on the popular distinction between edible and poisonous mushrooms resulted in frequent conferences and he was involved in experimental studies, most of them conducted on himself. This work was followed in 1916 with the brochure "*Synonymia et adnotanda micologica*" and in 1920 and 1926 two dossiers of "*Selecta micologica*", a result of a macro and microscopic study of European and exotic herbaria, which allowed to him to give synonyms, with his other publications, to more than a thousand species. And new species created by Bresadola increased to one thousand.

The Trento years, far from the Magràs woods, are difficult and fraught with worry. Relations with the Curia are not really idyllic and serene; he pays for being a priest and a scientist, looked upon as almost an inferior priest, something like a sharecropper, incapable of choosing between science and theology, nor did he ever endeavor to prove that even a sharecropper priest is useful.

However it was during these years that Don Bresadola garnered the title of great mycologist. In a city without a university or scientific tradition, he quickly became a reference point for the famous mycologists of time (from Sydow and Henning in addition to these cited above), and for his roughly 400 student correspondents around the world, as shown from his address book; he maintained an extensive correspondence, provided counseling, diagnosis and advice with each group. He became, as we would say today, a virtual world traveler, without moving from Trento and Trento became a world center for mycological studies.

Numerous of university scientists relied on Bresadola rely for information and confirmation of the classification of Fungi, museums and botanical institutions sent entire collections of Fungi to be classified and named. He was thus able to classify Fungi of Poland, Saxony, Hungary, Sweden, Portugal, Eritrea, Cameroon, Congo, USA, Puerto Rico, Cuba, Brazil, Tierra del Fuego, Philippines, Borneo, Java, Solomon Islands, Australia. And without moving from Trent prepares mycological collections at several museums in Padua, Turin, Stockholm, Paris, New York, Washington, Leiden, Cincinnati, Berlin, Leningrad, Uppsala, Regensburg. Numerous mycological Societies in Europe and America wanted him as an honorary member. With its 400 students and has created corresponding to the largest school in the world of mycological studies and this old self-taught without a university chair has recognized "*the highest of mycologists*" (P.R. Pirrotta of the University of Rome), "*the most learned mycologist in the world*"(C.G. Lloyd of Cincinnati).

His correspondence is immense and phenomenal, and unfortunately only partially accessible as most of his notes are overseas in the United States, in Washington D.C., but it was with the letters, sent everywhere in the world, that Bresadola carried and intense activity of providing his sought after and infallible advice, and of non-academic teaching to mycologists in a classroom without boundaries. His reputation was in fact due to his original diagnosis, advice, and solutions to difficult problems that he provided both directly to those who came to consult him (he almost never moved from the Trentino region), and by correspondence. He did not operate from a university position, but from his modest studies/study, he did not have university degrees, but lavished his self-taught learning. As Traverso said, "*Truly this is worthy of the highest admiration, that this bold traveler (I have allowed the simile) was not lost in the vast wilderness of science like a wise sailor Giacomo Bresadola came, so to speak, by sea to the coast without any expert guidance to show him the way, without any of those useful aids, which benefit only those studying in large cities and famous scientific schools*".

Photo by G. Visentin from *Iconographia Mycologica* (AMB-CSM mycological library)

To a residence in the curia Bresadola preferred a modest in Vicolo Cristoforo Madruzzo, no. 11, owned by the Curia. As Catoni said, "*in the small room of a few square meters where he is works, you will find a chest of drawers with a glass cupboard that serves as a library; a table in front of a sofa, some chairs and an armchair. And on all of this furniture piles of books and pamphlets with dedications and stamps in tribute in every language, magazines, photographs, manuscripts, programs, drawings, envelopes bulging with notes in Latin and inside fungi. On the floor, along the walls and in corners, packages, boxes and parcels of all sizes on which on which one could read their origins from many different countries of this world. Looking closely, one does not have an impression of disorder or abandonment, because every object has its place, neat and clean, without a speck of dust*". The bedroom is the painting studio and workshop, with the old-fashioned Zeiss microscope on a small table, and the work table is the window sill. He left Trento rarely and only to collect new herbs and fungi to enrich his collection.

In 1909, after more than twenty years of active service, he managed to have a modest pension, he left behind office work and devoted himself entirely to his studies. He begins to think back to Ortisè, but health problems, especially a persistent hyperuricemia, which dissuaded him from abandoning Trento. Even his economic conditions are not flourishing and he was often reduced to selling magazines, herbaria (among these one given to Stockholm with 30,000 species) books and other materials to fund his research and the printing of his books etc.

In May 1915 the war forced him to leave from Trento for safer places. Returning there two years later he continued to work, maintaining a consulting relationship and collaboration with top mycologists of the time. He dedicated himself passionately to the preparatory work for his most important work, "*Iconografia Micologica*", hoped for by G. B. Traverso and G. B. Trener, whose publication was sponsored by the Lomabrdy Milan chapter of the Società Botanica Italiana (Italian Botanical Society), and the Museo Civico di Storia Naturale of Trento (Natural History Museum of Trento). The financial support is given by "*honorary patrons*" and by "*oblatores munificis elargitionibus exordia operis adjuverunt*", which totaled 177 and were scattered in 16 different countries. There were 508 subscribers located all over the world.

Due to lack of time and ill health time Bresadola had to renounce preparing the portion on hymenocytes of of Saccardo's "*Flora italica cryptogama*" as well Rabenhorst's. He has around sixty minor publications children, now collected in "*Omnia Bresadoliana extracta in unum collecta*", 1979, by the Comitato Bresadoliane and by the Gruppo Micologico G. Bresadola di Trento on the occasion of the fiftieth anniversary of his death.

It was only towards the end of his life that Trento and Italian society became aware of the greatness and genius of this humble priest. With the approach of his eightieth birthday, his most faithful friends formed a "Il Comitato per le onoranze a Don Giacomo Bresadola" (Committee in honor of Don Giacomo Bresadola) and in 1927 they prepared a huge celebrations, on the initiative of his friend and disciple from Trento, G. Catoni, that brightened the final years of his life. Honors rained down on him from governments, the church, universities, municipalities and academia. In a few weeks Catoni was able to gather opinions and testimonials from the farthest corners of the globe, all moving and unanimous in recognizing the greatness of the Master. It is very significant that all these judgments were unanimous, in a world, that of study and science, which certainly not immune to jealousy and resentment.

Photo by G. Visentin from *Iconographia Mycologica* (AMB-CSM mycological library)

On February 14, 1927, the date of his eightieth birthday, his most loyal friends organized public celebrations during which he was presented with the first volume of the *Iconografia*, celebratory speeches were read by Giulio Catoni, as director of the Osservatorio Fitopatologico del Consiglio Agrario (Council of the Pytopathological Agriculture) (The Abbot Giacomo Bresadola – on the Occasion of his Eightieth Birthday) and by Giovanni Battista Trener, founder and director of the Museo Civico di Storia Naturale (The Abot Giacomo Bresadola- Italian Glory). Following in that year was "The Abbot Giacomo Bresadola and his mycological work" (L'Abate Giacomo Bresadola e le sue opera micologiche) by Louis Fenaroli of the University of Milan. In the same year the university of Padua awarded him an honorary degree and the Italian Government that of Official Knight of the Crown of Italy. With his innate good humor and irony Bresadola left written on a card:

"When a soul has risen

for eighty carnivals

you can put on boots

to go to the next life"

and on the back of the card name appears: *Russula mustelina*.

Don Giacomo Bresadola died on 9 June 1929 at 82 years of age, at 19.45 in his modest home at Vicolo Madruzzo and he is buried, at the city's expense, in the memorial chapel for illustrious persons, accompanied by a marble bust. On 12 September 1930 a bust of Bresadola is unveiled doors of the hall of solemnities of the *Museo di Storia Naturale* of Trento. Today a statue by Davide Rigotti to honor him in Piazza Dante in the garden opposite the railway station.

Bresadola was "simple priest" for most of his life and only on the occasion of his eightieth birthday, while the whole world bestowed honors and accolades upon him, was he appointed canon of the Cathedral of Trento and he became a "Monsignor" and therefore improperly called Abbot. This stems from the fact that the term "Monsieur l'Abbé" was used by his French correspondents (eg. Quélet), who used this term with any priest.

His character. Taking into account that Bresadola destroyed, by making them synonyms, over a thousand species of other authors, which would presumably cause him a host of enemies, the unanimity of the positive judgments, as we discussed above, concerning both his science of his are a little surprising. As evidenced by Trener, "*anyone who sought him out for his knowledge was never rejected by him, no one who went to him or returned to him was turned away, nor were they ever able to surprise him, having an energetic temperament and virile as ever, an act of impatience, no one was ever able to detect even a shade of envy. Many instead owe him much for his generosity as he was generous with advice and assistance. Proof of this is the fact that his one thousand new species, he allowed about two hundred to be published by others*".

Science and goodness came together with great modesty. Proof of this is the wonder with which the denizens of Trento saw awards and titles from all over the world rain down on this almost unknown inhabitant on the occasion of his eightieth birthday. As Trener stated: "*Even the writer must confess that, he lived for almost thirty years among Trentino scholars, the only scholar who was not even known by sight, to our societies and journals of the country, until four years ago was the Abbot Bresadola*". And to those who were surprised Bresadola responded: *Have I not enjoyed the esteem and the consent of all my fellow students? What else could I have wanted?*

Social life. As evidenced by the Catoni, affability and scholarship of Bresadola made his company quite sought after company. Especially in the summer, wherever he goes he made friends and acquaintances. Crowds of people come to his home to inspects fungi or to have him give out his famous recipes. His presence was south in the salon of the Baroness Giulia Turco-Lazzari, his mycology student, a skilled painter (some of its tables can be found in "*I funghi mangerecci e velenosi*" and in "*Iconographia*"). He was a sought after Context and dear guest of Caro Massalongo at his villa in Tregnago.

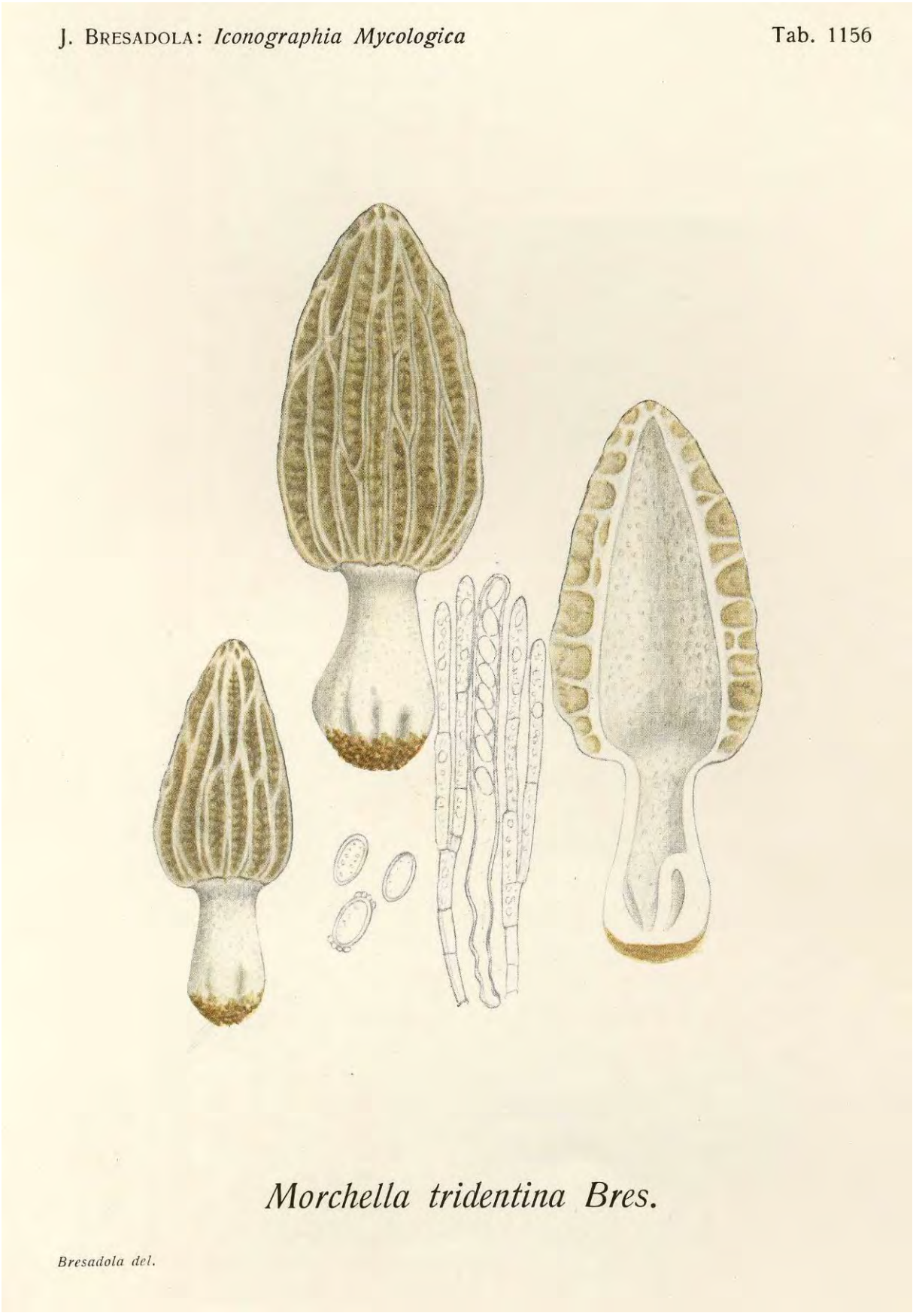


Photo by G. Visentin from *Iconographia Mycologica* (AMB-CSM mycological library)

The portrait. Catoni described him as. "*He is of mizzen stature, but very complex, very lean, without being thin, which allows on to see a strong muscles, and his face is suffused with a rosy hue and a light he has lively brown eyes, an oval face broad cheeks, go with regular line that tapers towards the chin, which is slightly elevated. His forehead is large and broad. He has well-cut lips, which compress against each other when he is in thought, and open in a rather sweet smile that radiates across the face when chatting amicably. He has a joyous spirit, composed manner, jokes and funny quips that cheer but do not harm are frequently on his lips. He loves the company of friends, and his conversation is amiable and enjoyable. He is an educated man, because his knowledge also encompasses the fields of philosophy, history and the positive sciences. He is a wise man, a scholar, a font of innocent goodness*".

The testimonies. As mentioned above, Giulio Catoni, who was in charge of preparing Bresadola's biography on the occasion of the celebrations for his eightieth birthday, had the idea of having the Master's disciples, who were already known in the scientific community, and his most famous correspondents in the world, comment on the work and activities of the Master. A sentence, a few personal memories, just enough to briefly outline the characteristics of man and his work were called for.

Among the many opinions expressed on Bresadola the best was the spontaneous, unsolicited one given on the occasion already expressed by **Curtis Gates Lloyd** in 1923 during a visit to Bresadola in Trento: "*In my opinion, the Rev. Giacomo Bresadola is the world's most learned mycologist. This distinguished scientist will leave an imprint in systematic mycology equal to that of Persoon and Fries*".

And professor **Caro Massalongo** testified: "*It is no exaggeration to say that there is no scholar of mycology living, who has not gone to Don Bresadola for help and advice in the study of fungi, especially for hymenocyetes, in which showed himself to be a true master, earning in this regard to be comparble only to the two famous naturalists of the last century, i.e., C.H Persoon and E. Fries. One can not understand how this self-taught, alone and without adequate means, has been able to acquire so much knowledge of these cryptogams, not only our own, but those of distant regions of the globe, which were sent to him for a diagnosis*".

Here are a few more excerpts from these judgments.

Professor **Oreste Mattirolo**, Director of the Royal Botanical Institute of the University of Turin: "*…wonderful diviner and authority on fungal species, to whom a wise and safe ictu oculi et ingenii plaudiranno welcome, and mycologists from all over the world*".

Professor **Ottone Penzig**, Director of the Royal. Gardens and Botanical Institute, University of Genoa: "*No researcher can work without consulting at every step the classical works of our beloved colleague; ... the diagnoses and descriptions of Fungi given by the Abbot Bresadola are unsurpassed clarity and accuracy*".

Carleton Rea, Worcester: "*The last eminent scientists Emile Boudier, N. Patouillard and G. Bresadola form a triumvirate whose work will remain as an imperishable monument of their greatness*".

J. Ramsbottom, British Museum in London: "*British mycologists have shown they greatly appreciate his scientific work, electing him an Honorary Member of the British Mycological Society, but also for all for all mycologists indiscriminately he is an appreciated teacher*".

Professor **P.R. Pirotta**, Director Royal Institute and Royal Botanical Garden of Rome: "*…The greatest of living mycologists*".

Professor **A. Trotter**, Higher Royal Institute of Agricultural of Portici: "*As Professor P. A. Saccardo, often repeated to me the words of Abbot Bresadola judgment on higher Fungi can be regarded as a gospel!*"

Professor **Sebastian Killermann**, Regensburg: "*He received me very cordially in Trento and he started me in the best way, in this difficult science*".

Photo by G. Visentin from *Iconographia Mycologica* (AMB-CSM mycological library)

Eugen Gramberg, Konrektor, Königsberg: "...*I came and I was enlightened by him like by no other mycologist; ... he never mentioned - like other scientific authorities – that I made too much use of him, while he was constantly besieged for advice, determinations, etc.*".

Professor **L. Petri**, Director of the Royal Station of Plant Pathology, Rome: "*His work has been and will always be a sure guide and a bright example to every mycologist*".

Professor **Egidio Barsali**, Royal. Botanical Garden of Pisa: "*The depth of the doctrine ... and the serenity of judgment make his diagnosis a certain text in the interpretation of multiple fungal forms*".

H. Bourdot. "*It may well be said that he was the first of which has fixed micrographic characteristics, on which we can rely. I found him ... in the science of a Master, but also the generosity of a friend*".

Professor **P. Voglino**, Director phytopathological Observatory of Torino: "*Careful, diligent, shrewd observer, the Abbot Bresadola is the most illustrious the Master among botanists and mycologists, because who turns to him in doubt of classification, always receives not only a comprehensive answer, but wise advice*".

John Egeland, Kristiania, Oslo: "*Rev. Bresadola is the most complete mycologist of our time ... his diagnosis, his observations, his descriptions of every species of Fungi are models of accuracy and precision*".

Professor **Fridiano Cavara**, Director of the Botanical Garden of Naples: "*The writer has treasured for 30 years, the profound learning and incomparable goodness of Don Giacomo Bresadola*".

Professor **G. B. Traverso**, Royal University of Milan: "*The works of Abbot Bresadola… constitute a monument aere perennius that he created with diligent, patient and careful work*".

E. Pelterau, Société Mycologique de France : "*I'm a few years older than he, I witnessed the birth of mycology, and no author was more useful for guiding me through the intricacies of this complicated science*".

Pa. Camille Torrend, Collegio "Antonio Vieira" of Bahia, Brazil: "*For over thirty years this modest priest has been the undisputed master of the new mycological generations, as well the old, in order to not commit the lamentable error in the determinations of the species, have also gone through the crucible of his judgment*".

Professor **A. Bourdarzew**, Botanical Garden of Leningrad: "*I know of no authority greater than Bresadola in this scientific domain. His extraordinary erudition ... joins a infinite goodness*".

Victor Greschik, Cecoslovacchia: "…*Brilliant Nestor of mycology …the most acute observer and accurate diagnostician*".

Dr. **René Maire**, University of Algiers: "*All modern systemic mycologists are a little or alot, directly or indirectly, students Bresadola*".

Dr. **William A. Murril**, Lynchburg, Atlanta: "*As a mycologist I consider Don Bresadola the first in Europe, I admire him as a man, as a friend*".

Kellenbach, Darmstadt: "…*It is wonderful how a man in such a late age may still ... always indicate the right way to those who seek him for advice and help*".

These are part of the testimony of mycologists living in 1927, but many others who had already disappeared by this date, could have contributed to render even more brilliant of his "state of service". Among Italians: P. A. Saccardo, Spegazzini Inzenga, Berlese and R. De Corbelli. Among the French : Quélet, Patouillard, Boudier and Barla. Among the Germans: Rehm, von Höhnel, Henning, Magnus, Kalkbrenner, Schulzer and Winter. Among the British: Berkeley and Cooke. Among Americans: Atkinson, Ellis and Peck.

Streets named Bresadola

In Trentino: Malè, Mezzana, Riva del Garda, Dimaro, Cavalese, Roveré della Luna, Bedollo, Cles. Inoltre, in Rome and Bergamo.

The "*Wild Fungi Special Project*" of ISPRA visiting the marble monument located in Piazza Dante in Trento, during a pause in the proceedings of the Fourth International Congress of Mycotossicology, Trent 6 to 7 December 2007 [from left: A. Crema (GMEM-AMB), C. Siniscalco ("*Wild Fungi Special Project*" and GMEM-AMB), A. Iannarelli (ARTA Abruzzo and GMEM-AMB), B. Cocciante (ARTA Abruzzo and GMEM-AMB) e G. Attili (ARTA Abruzzo and GMEM-AMB).
Source: GMEM-AMB archive, photo by anonymous.