



## Review

# Giuseppe Bianchini (1888-1973): the father of Italian forensic mycology

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### Abstract

Giuseppe Bianchini trained within the Sienese School of Forensic Medicine and immediately distinguished himself for his innovative approach to the discipline, making very important use of biochemistry, haematology, histopathology, and physiology. During his long career as a scholar and professor of forensic medicine, an important part of his research was the study of the ‘biology of the corpse’, for which he was inspired by the presence of fungi on cadaveric material. Indeed, Bianchini considered the study of fungi, which was completely ignored at the time, to be of particular interest both in terms of the chemistry of the corpse and in determining the chronology of death. He was the first in Italy to attempt to identify and describe a mycological biota in the different states of decomposition of the corpse.

### Keywords

Fungi, moulds, thanatology, death chronology, history medicine

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### Introduction

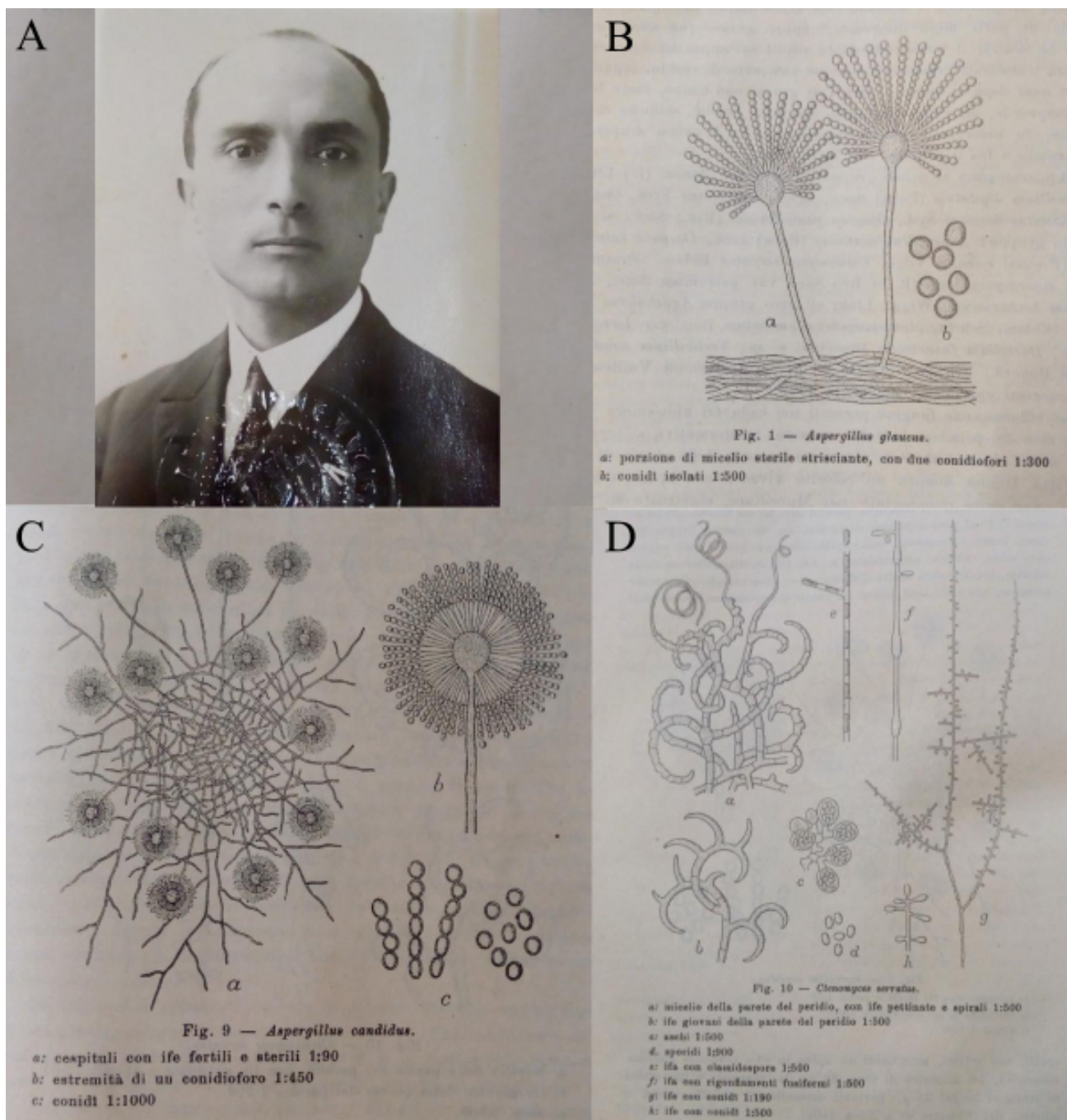
Born on 20 September, 1888 near Siena, in San Quirico d’Orcia, Giuseppe Bianchini (Fig. 1A) graduated with distinction in Medicine at the University of Siena on 8 July, 1913. During his first five years at university, he was an internal trainee at the Institute of Anatomy and, in the academic year 1910-1911, he also attended the Institute of Surgical Pathology. In the sixth year of his medical course, he was called by Prof. Angelo Ruffini to assist the Chair of Histology and Embryology at the University of Bologna. Because of family reasons, however, he remained there for only a few months. In 1910, he took part in the campaign against cholera in Puglia, together with Prof. Achille Sclavo, his teacher of Public Health at the University of Siena (Martini and Orsini, 2022a, 2022b; Orsini and Martini, 2022). Cholera had again broken out in Italy, 26 years after the previous epidemic. This time, however, the disease was fairly easily contained, thanks to the discovery of its aetiological agent and the implementation of science-based protocols. This experience was an important one for the young Bianchini.

After graduating, he began a course at the School of Health in Florence in 1914. The following year, as part of this course, he was sent to Libya as a military medical *attaché* and, for the whole of 1917, ran the Department of Medicine of the Military Hospital in Tripoli (Archivio Università di

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Siena). From January to June 1918, while still in Tripoli, he took over the direction of a hospital for contagious diseases. Subsequently, he was assigned to the Italian consulates in Tunis and Algiers until August 1919, when he returned to Italy.

This was the beginning of his academic career. On 16 October 1919, he became a tenured assistant to the Chair of Legal Medicine and Insurance at the University of Siena, under the guidance of Cesare Biondi, a great exponent of the Siena School of Legal Medicine. Founded by Giacomo Barzellotti at the beginning of the 19th century: this school counted among its members such personalities as Gasparo Mazzi, Carlo Livi, the great criminal anthropologist Salvatore Ottolenghi, Domenico Mirto,



**Fig. 1** – A) Giuseppe Bianchini at the age of 46 (Archivio dell'Università di Siena); B) *Aspergillus glaucus* (Bianchini, 1923); C) *Aspergillus candidus* (Bianchini, 1923); D) *Ctenomyces serratus* (Bianchini, 1923).

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Biondi and Bianchini themselves, and Mauro Barni. During the period in which he was an assistant (1919-1926), Bianchini undertook his studies on the biology of the corpse, blood, and tumours. In 1923, on the basis of his qualifications, he was appointed as a teacher in Legal Medicine.

Among the publications presented by Bianchini, the examining board considered the most important subjects to be:

- “On lesions due to multiple contusive traumas, whereby the investigator was able to establish the histopathological alterations of the skin and subcutaneous tissues”;

- “Cytology of red blood cells” and related publications.

- “Platelets and the distribution of morphological haematic elements in the vessels of the corpse”;

and finally, his most recent studies on

- “in vitro tissue culture” (Archivio Università di Siena - Examining board 1923).

These publications, “on account of the importance of the subjects treated, the clear vision of the most complex biological problems, and the method whereby investigations were carried out” (Archivio Università di Siena - Examining board 1923) constituted the major contributions to legal medicine and its related disciplines.

On 16 March 1926, Bianchini was appointed “untenured professor” of Legal Medicine at the R. University of Cagliari (Archivio Università di Siena - Ministry of Education 1926); he therefore ceased to be an assistant at the University of Siena. In the same year, he moved to the University of Bari, where he taught for a decade and actively participated in the organisation of the Institute of Legal Medicine.

#### *Return to Siena and the first studies on the “biology of the corpse”*

In this period that the studies initiated by Bianchini when he was an assistant in Siena were structured into the first draft of the totally original concept of “biology of the corpse” (Cazzaniga, 1944). “Other authors would later make their own considerations and deductions regarding the issue of absolute and relative death and the thanato-chronological implications that stem from it; but it is to him that we must attribute the great merit of a theory that still carries great weight today” (Barni, 1993).

In March 1936 Bianchini’s mentor, Cesare Biondi, died. Despite invitations from numerous Italian universities, Bianchini decided to return to the University of Siena, where he took over the teaching of Legal Medicine and Insurance, formerly Biondi’s domain. In Siena, where he had many professional and personal relationships, he taught at the Faculty of Medicine and the Faculty of Law until the end of his academic career. In January 1937, as a former pupil of Biondi and a teacher of Legal Medicine, he commemorated his mentor in a ceremony held in the Great Hall of the University of Siena in the presence of all the teachers and students: all the lectures of that day were cancelled. However, despite his great sense of gratitude towards Biondi, Bianchini detached himself from his former master as regards his research interests. Indeed, being well versed in biology and histopathology, he was particularly interested in the research carried out on the morphology of normal and pathological blood by the pathologist Adolfo Ferrata, whom he had met in the early 1920s, when Ferrata was teaching in Siena. Bianchini distinguished himself for his innovative interpretation of the Legal Medicine discipline. In particular, he critically re-read the pathognomonic signs deemed essential and certain for judicial purposes based on the most up-to-date discoveries in biochemistry, histology, physiology, and haematology.

Bianchini’s wide knowledge on these fields prompted him to address his scientific production towards four specific areas. The first one of paramount importance deals with forensic thanatology, which was flanked by asphyxology, insurance medicine and the field of occupational diseases. As regards the last subject, Bianchini endorsed the social and humanitarian lessons of his mentor Cesare Biondi, enriching his theses through constant direct observation.

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### *Institutional roles and acknowledgements*

In 1944 Bianchini was appointed Dean of the Faculty of Medicine and Surgery of the University of Siena, a position that was renewed in 1947 and which he held until the end of 1950. In 1955, he was elected Rector of the University of Siena, following the expiry of the mandate of Mario Bracci, a member of the Constituent Assembly and a judge of the Constitutional Court.

During Bianchini's rectorship, which ended in 1964, several structural improvements were made: the work involved a new polyclinic; the University Building was modernised; the premises of the Institute of Public Health were enlarged, and new facilities for the Institute of Botany, Biology and Zoology were built. In addition, the Faculty of Sciences was instituted and plans were drawn up for the foundation of the Faculty of Economics, which in those days was innovative.

In June 1958, Bianchini was awarded the Order of Merit of the Republic. On 1 November of the same year, he was assigned to the status of "fuori ruolo" (a non-institutional position as a consultant). Five years later, on 1 November 1963, he retired, having reached the age limit. Nevertheless, he continued to perform his duties as Rector until the natural expiry of the three-year mandate, on 31 October 1964. On 1 June 1965, the title of Emeritus Professor was conferred upon him. He died on 7 March 1973.

### **Forensic thanatology and the biology of the corpse**

In the area of forensic thanatology, Bianchini was particularly interested in the effect of the superposition of foreign organisms, insects, mites, and fungi on the corpse. "While insects and mites had long been known to have a thanato-chronological meaning and a post-mortem destructive potential, equally interesting to Bianchini was the action of moulds, which he studied with veritable passion [...]. The coincidence between the development of the genus '*Penicillium*' and retarded putrefaction – which was really no coincidence – did not escape the Master's notice" (Barni, 1993). Although the role of fungi in the decomposition of the organic material of the corpse had already been amply studied in the fields of agrarian chemistry and human and animal pathology, it was substantially neglected by scholars in those days.

Even the scientific literature on the subject was very scant (Bianchini, 1929). Indeed, Bianchini complained that his colleagues regarded moulds as "uninfluential guests of the corpse" and gave absolutely no importance to their "disintegrating action on the matrix that hosts them" (Bianchini, 1923). In his view, the only exception was to be found in the studies conducted by Julius Kratter (1848-1926), an Austrian forensic pathologist and a co-founder of the German Society of Legal Medicine; in corpses found covered in moulds two or three months after burial, Kratter attributed a destructive action of the skin to fungi (Bianchini, 1923). For his part, Bianchini deemed the study of fungi to be of particular interest with regard to both the chemistry of the corpse and the chronology of death.

Referring to his own communication entitled "The fungi of the human corpse" (Bianchini, 1923), which was delivered at the "Accademia dei Fisiocritici" in Siena on 27 July 1923, Bianchini stated: "When I first began to study the fungi of the human corpse, I was inspired by the dual purpose of monitoring the chemical modifications that the material of the corpse undergoes when it is subjected to the enzymatic action of these saprophytes, which at the time were little known and scantily considered, and of utilising this study – as far as might be possible – to tackle the issue of the chronology of death" (Bianchini, 1925). In these studies, Bianchini clearly saw the need for an interdisciplinary approach. This prompted him to forge bonds of research with numerous colleagues at the various Italian schools of biology, botany, mycology, chemistry, and pathology. In this framework, he entered a close collaboration with the Siena botanist and mycologist Arturo Nannizzi. In the botanical field, Nannizzi is best known for his studies on *Atropa belladonna* L. and the possibility of using its active

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principle in the treatment of encephalic parkinsonism (Nannizzi, 1938; Mazzarello, 2010, 2013). As far as mycology is concerned, Nannizzi played a key role in Italian medical mycology, especially for his fundamental contribution to the taxonomy of dermatophytes (Nannizzi, 1926; Nannizzi, 1927; Nannizzi, 1930). In his honor, the genus *Nannizzia* was established (Stockdale, 1961; Dukik, 2020).

With Gino Pollacci (1872-1963), director of the Botanical Institute of the University of Siena, Nannizzi was co-author of a work of fundamental importance in the field of Mycology: “*I Miceti patogeni dell’uomo e degli animali, descritti, delineati e preparati per l’osservazione al microscopio, con notizie sopra i rimedi per combatterli*” (Pollacci and Nannizzi, 1922-1930), published in ten issues, from 1922 to 1930. Each volumes contains ten different fungi including a sample of the actual species and a loose-leafed illustrated text describing each fungus, also often including the fungus’ pathological effect on humans and/or on cattle or other mammals. A total of 100 microfungal species are described, accompanied by about 400 illustrations, made by Nannizzi and 100 slides for microscopic observation. On Nannizzi’s contribution to the work Pollacci wrote in the preface to the first issue: “For this publication I have procured the collaboration of the Technician Mr. Arturo Nannizzi who is also a renowned draughtsman and excellent preparer and it is by his work that each species is accompanied by different drawings [...], and its microscopic preparation” (Pollacci and Nannizzi, 1922-1930).

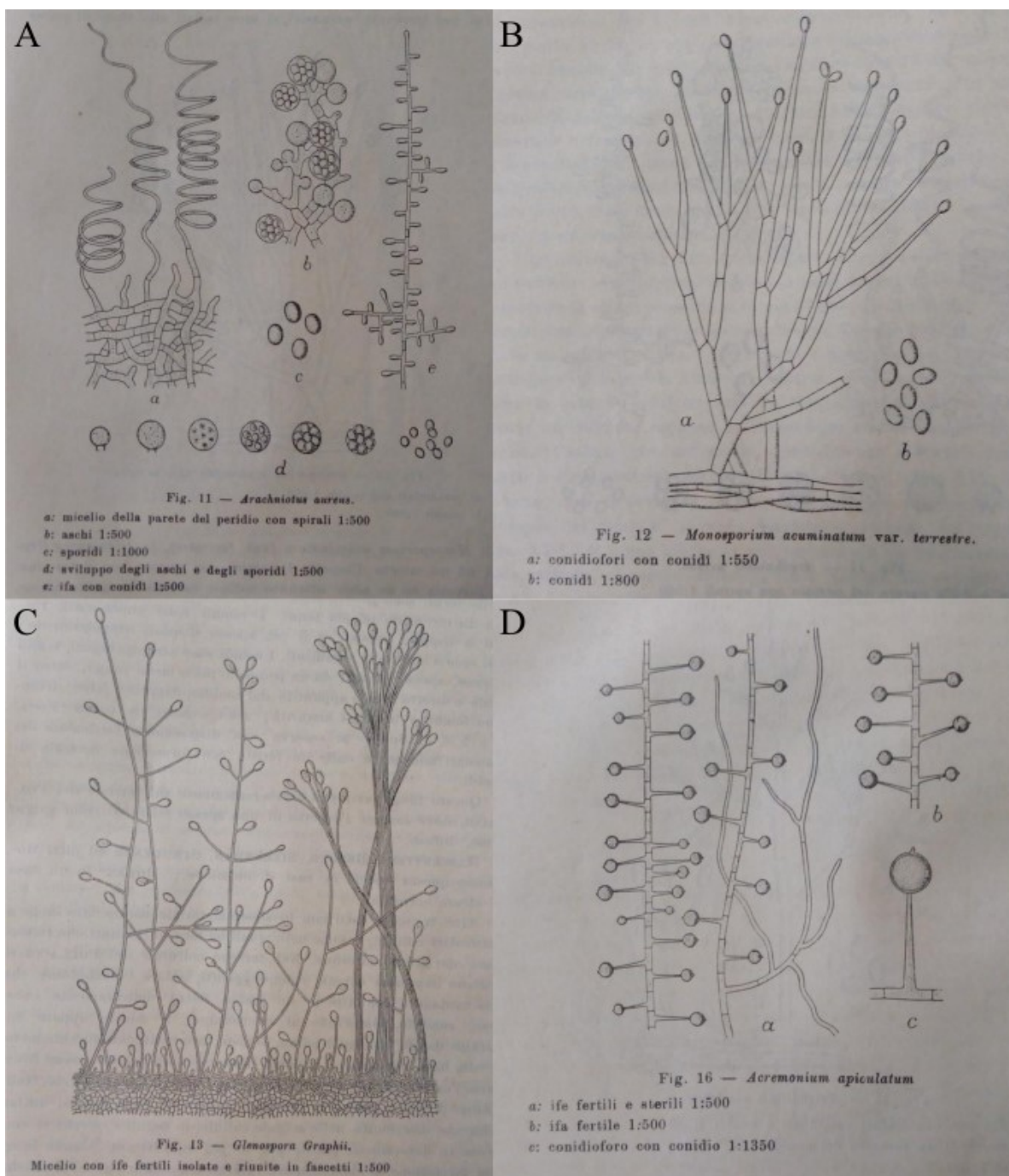
Thus, the scope of Bianchini’s studies on the chemistry of the corpse and the chronology of death appears even more evident at a time when contemporary mycologists showed little interest in these micro-organisms present on corpses, or only a morphological and botanical interest. In the above-mentioned presentation (Bianchini, 1923) at the Accademia dei Fisiocritici in 1923, Bianchini claimed that the only person to have dealt with this subject, with particular reference to Legal Medicine, had been the French doctor Frédéric-Louis Heim de Balsac (1869-1962), a professor of Industrial Hygiene (from 1905 to 1937) and of Agriculture and Production of materials (from 1923 to 1937) at the University of Paris. The basic concept from which Heim started out was the following: “according to the state of decomposition of the corpse, the flora that inhabits it must change, just as the bacterial species do during the various successive stages of putrefaction” (Cazzaniga, 1944). This happens because both fungi and bacterial species, by means of the chemical reactions that they carry out, determine the constitution of the nutritional medium in which they live. The metabolic products possibly released by fungal organisms into the culture medium (viz. corpses) where they develop can induce or inhibit the growth of other organisms, including fungi (Heim, 1893). Indeed, according to Bianchini, “Each flora is what it is according to the nutritional medium in which it develops, and, consequently, according to the time that has elapsed since death” (Bianchini, 1923). Based on this idea, Bianchini proposed that all the fungal species present in corpses should be collected and that the circumstances in which they develop, and the state of the corpse should be accurately recorded.

The fungi were examined both directly on fresh preparations on glass slides and after isolation in pure culture. For the cadaver isolation he used a specially developed agar-meat medium, which was named ‘Pollacci medium’ in honour of the then director of the Institute of Botany Prof. Gino Pollacci. The peculiar formulation of this culture medium is as follows: “to 500 g of well-ground beef pulp add 1000 g of distilled water, boil, filter and add: Witte peptone 10 g, sodium chloride 5 g, agar-agar 15 g. Boil and filter while hot, neutralise, boil again for half an hour, filter again if necessary and add 70 g glucose. This mixture, poured into containers, is sterilised fractionally three times in a Koch pot”. Fresh cadaveric material, exhumed one to ten years after burial, was used for research purposes and a few corpses were left expressly ‘out’ on the ground, in a laboratory room, or in the open countryside. Old bones were taken from cemetery ossuary or ancient burials. Some anatomical parts were taken at various distances from death and placed in special warm-humid chambers.

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## Conclusion

His studies led him to write: “The fungi found in corpses, and which were the subject of my research, can roughly be grouped into three categories. The first comprises strains that develop in the corpse during processes of transformation (colouring, gaseous, colliquative period); the second comprises strains that develop on residues of desiccated or fatty soft tissues (about one year after death); the third comprises strains that develop on bones that still exude fat or are covered by organic residues (10 years after death). As will readily be understood, these groups do not have an absolute value, as it



**Fig. 2** - A) *Arachniotus aureus* (Bianchini, 1923); B) *Monosporium acuminatum* (Bianchini, 1923); C) *Glenspora graphii* (Bianchini, 1923); D) *Acremonium apiculatum* (Bianchini, 1923).

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has been observed, albeit rarely, that there may be some interference between the first group and the second and between the second and the third” (Bianchini, 1923). The fungi described by Bianchini in three different categories are shown in Table 1 and in the figures 1B-D and 2A-C.

Bianchini therefore deserves the great credit for having been the first Italian researcher to pave the way for forensic mycology, whose studies were later continued by another great Italian mycologist, Raffaele Ciferri (Ciferri et al., 1943) in the 1940s. Bianchini proposed the methods for establishing which fungi may be present and at what times in the various stages of the process of corpse transformation are still important topics in the field of forensic mycology. The observations enabled Bianchini to define a minimum time limit below which death could not have occurred (Bianchini, 1925). Furthermore, the first list of species provided by Bianchini (Table 1) represents a very important starting base with which to compare achievements in this area.

**Table 1** - List of the different species of fungi reported by Bianchini in three stages of corpse decomposition in the first column and the corresponding current names in the second column (from Bianchini, 1923).

Bianchini's species	Current name
<b>First category</b>	
<i>Aspergillus glaucus</i> (L.) Link	=
<i>Penicillium digitatum</i> (Pers.) Sacc.	=
<i>Mucor racemosus</i> Fresen.	=
<i>Oospora rivaltae</i> Sacc. & P. Syd.	<i>Oidium inaequale</i> Rivolta
<i>Oospora penicillioides</i> (Rivolta) Sacc.	<i>Oidium penicillioides</i> Rivolta
<b>Second category</b>	
<i>Aspergillus candidus</i> (Pers.) Link	=
<i>Oospora sulphurea</i> (Preuss) Sacc. & Voglino	<i>Torula sulphurea</i> Preuss
<i>Ctenomyces serratus</i> Eidam	=
<i>Stemphylium macrosporoideum</i> (B. et Br.) Sacc. var. <i>quercinum</i> Sacc.	<i>Monodictys castaneae</i> (Wallr.) S. Hughes
<i>Eurotium herbariorum</i> (Wigg.) Link	=
<b>Third category</b>	
<i>Arachniotus aureus</i> (Eidam) J.Schröt	<i>Amauroascus aureus</i> (Eidam) Arx
<i>Monosporium acuminatum</i> Bon. var. <i>terrestre</i> Sacc.	=
* <i>Dactylium fusarioides</i> Bianchini ( <i>nuova specie</i> ) = (in 1927)	<i>Fusarium chlamydosporum</i> Wollenw. & Reinking
<i>Dactylium fusarioides</i> Gonz. Frag. & Cif.	
<i>Verticillium candelabrum</i> Bonord	<i>Clonostachys candelabrum</i> (Bonord.) Schroers
<i>Glenospora graphii</i> (Harz & Bezold) Vuill.	=
* <i>Acremonium apiculatum</i> Bianchini (sp. nov.)	Probably never correctly published

\*Both of Bianchini's descriptions of 'new species' were not considered valid. Shortly after, *D. fusarioides* was validly redescribed by Ciferri and Gonzales-Fragoso (1927) as *Dactylium fusarioides* Gonz. Frag. & Cif, (now *Fusarium chlamydosporum* Wollenw. & Reinking). While it is more difficult to understand how and whether *Acremonium apiculatum* was validly described.

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### Conflict of interest

The authors declare no conflict of interest.

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