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# THE ROLE OF PIER ANTONIO MICHELI (1679–1737) IN THE DEVELOPMENT OF MYCOLOGY

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## Abstract

The role of P.A. Micheli in the development of mycology is reviewed. The relevance of detection of the occurrence of reproductive structures in Ascomycetes and Basidiomycetes is highlighted. Pioneering in use of the microscope, he first observed and described, with detailed illustrations, basidia and cystidia on the lamellae of agarics. He equated spores with seeds and proved, through germination experiments, the origin of new sporophores from spores.

P.A. Micheli (1679–1737) first devoted himself to the study of fungi around 1710, at the age of 30; this study culminated twenty years later in publication of *Nova Plantarum Genera* (1729), which dealt, besides several new genera of Phanerogams, with some Cryptogams and particularly with fungi. In the introduction to *Nova Plantarum Genera* (NPG), Micheli foresaw publication of a second volume that would be dedicated mainly to a deeper analysis of mosses and their 'flowers', to submerged marine plants and to 'diluvian' plants (Lazzari, 1988a). Work leading to publication of *Nova Plantarum Genera* was frequently interrupted by travels throughout Italy and foreign countries (Tyrol, Austria, Bohemia, Prussia and Thuringia). During these travels he collected many new plants in order to enrich the botanical gardens of Pisa and Florence. In fact in 1706 he was appointed, by the Grand Duke Cosimo III, assistant to Dr M. Tilli, curator of the Botanical Gardens in Pisa. He was also charged as a keeper of the Boboli Garden in Florence. Through active correspondence and frequent travels, Micheli was in close contact with, and was highly regarded by, contemporary botanists of his time, such as the English botanist W. Sherard, member of the Royal Society, the English naturalist J. Ray, J. Scheuzer from Zurich, G. Marsili, Professor of Botany at Padua University, and others (Francini Corti, 1980; Lazzari 1988b). His scientific work was delayed by many tasks given to Micheli by both the Grand Ducal Court and his direct superior, Dr M. Tilli, as Tilli was very demanding and probably even jealous of Micheli's brilliance and great popularity among the most famous botanists of his time.

There were two thrusts to Micheli's studies on fungi, although he did not specifically indicate them as such. The first, and perhaps the most important in his opinion, was a botanical challenge to find flowers, petals and stamens in plants that the esteemed French botanist Tournefort had relegated to Class XVII, characterized as 'Des herbes dont on ne connaît ordinairement'. The second thrust of Micheli's work was a more biological quest to find 'seeds' in 'plants' that his contemporaries had declared 'seedless'; Micheli was convinced that if there is a 'flower' then there must necessarily be a 'seed', and, if fungi reproduce by means of 'seeds', where can they originate from if not from a 'flower'? On page 72 of *Nova Plantarum Genera* Micheli wrote: "Though Tournefort does not attribute flowers to the XVI Class, neither flowers nor seeds to the following, we are still convinced not only that plants belonging to the XVI Class have flowers, but that even the ones belonging to the XVII Class have flowers and seeds as well, as everything that is created by nature, since we are firmly convinced that no plant exists without a flower or a seed. And though amongst both older and younger scholars (including those who in our times clever in identification) are there those who affirm that they have identified plants without flowers or seeds, this is because they did not carefully look into these characters or because such characters were so small as to easily escape their attention even with the help of a microscope". In conclusion, Micheli wanted to prove that fungi reproduce in the same way as all the other plants.

*Nova Plantarum Genera* is the only work published by Micheli in his lifetime. This was accomplished with many sacrifices and a few humiliations, and thanks to the contribution and subscriptions of many of his friends and admirers. In *Nova Plantarum Genera* no less than 106 pages out of 230 deal with fungi, exclusive of the Lichen - Agaricus, which was not listed among fungi, but was considered to be intermediate between fungi and lichens. Of the 108 plates printed in the book, 45 are of fungal species. Following the convention of the time before the introduction of binomial nomenclature, the name of each species is a short phrase and is accompanied by quotes and descriptions from previous authors, Micheli's own description, the common Tuscan name and often some information on popular uses. The habitat and the site of collection are always given, providing very interesting information about the historical topography of Florence and its environs. The Herbarium Michelianum (FI-M), which was purchased by his devoted pupil G. Targioni Tozzetti, together with the manuscripts, is now included in the Herbarium Universitatis Florentinae (FI); the specimens, amounting to about 18,000, were almost exclusively collected by Micheli himself.

In *NPG* Micheli described a total of 1,050 species, exclusive of many

synonyms and duplicates, which were distributed among 30 genera (31 taking into account the 'Lichen Agaricus'). This is in sharp contrast to the ten genera (at most) proposed by his contemporaries. The new genera, as is indicated by the title of the book, are the most relevant and original part of Micheli's work. In his work, Micheli gave the 'seed' (spore) a prominent place in the definition of the genera and higher order taxa. He proposed four 'Distributiones', mostly corresponding to Agaricales, Aphyllophorales, Hymenomycetes, and Gasteromycetes, mainly determined by the presence or absence of 'flowers' (or 'stamens') and by 'seed' position in the body of the fungus.

The weak point of Micheli's system is that he wanted at any cost to find flowers in fungi, and to base his classification on them. However, while Micheli seemed to be convinced about the presence of 'seeds', he is more dubious about 'flowers' and 'stamens'. 'Flowers' and 'stamens' are identified and described only in the first two, but they are not described in the other two 'Distributiones', which are distinguished from each other depending on whether the 'seeds' are dispersed on the external surface of the fungus (*Hymenomycetes*) or contained within its body (*Gasteromycetes*). Micheli was confused by the 'elongated corpuscles', which he interpreted as stamens, but which are actually simple cystidia. He confesses his uncertainty as to their real nature in many cases.

The most relevant of Micheli's intuitions can be inferred from the unpublished manuscripts preserved in the Botanical Museum at the University of Florence (listed below) rather than in his published work (Ragazzini, 1993):

- Observationes XV accuratissimae circa fungorum vegetationem et fructificationem (1717).
- Tractatus de fungis terrestribus et arboreis, edulibus ac venenantis.
- Descriptio Agaricorum, fungorum et affinium plantarum Agri Florentini.
- Dei semi dei funghi, osservazioni di P.A. Micheli.

These manuscripts are enriched by water-colour plates, pen-and-ink sketches and numerous notes and comments revealing his great ability to observe, unbiased by contemporary convention, and how far he was ahead of his time. From the manuscripts we come to know how Micheli, having observed the cystidia on the surfaces of the lamellae in *Coprinus*, hypothesized their function, namely that of spacing the lamellae, so that there is room for the liberation of the 'seed'. He very clearly illustrated the distribution of spores in groups of four on the surface of the lamellae in the Agaricaceae. It took another century (Léveillé, 1837) to observe again the basidia with their four apical spores.

Unfortunately Micheli did not publish his discovery, for which we only

have the pen- and ink-sketch and some lines of comment in the manuscript 15: 38.

“I could observe very minute little seeds distributed in a very regular order, and what made me wonder even more was seeing that each of them was situated on a base which made me doubtfully ask: could it be the flower or the calyx of the fungi ? “

Another discovery of which there is no trace in *NPG*, but which is very evident in the manuscripts, are very clear sketches of asci with their spores ordered in groups of eight and with relevant notes beside them. The discovery of the 8-spored ascus, a hallmark of ascomycetes is today attributed to J. Hedwig who published it 50 years later.

Micheli's description of the development of some basidiomycetous carpophores, from their appearance to their decay is reported there: “I began observing what an art in taking the form of a fungus those round and ovate smallest corpuscles had, and from these observations, after the necessary time, I realised that taking the form of a fungus was nothing but an increase of all the body, a growth of the stalk and a spreading of the head that was closed around the stalk. But all of them, before assuming the shape of a fungus were closed into a cover or in layers, that in some species, as they grew, dispersed either in dust or in scurf or in down and finally in small pieces which remained permanently on the head of the same for the rest of their life”.

Micheli's desire to provide indisputable evidence of the reproduction of fungi by means of 'seeds' enabled him to dispel the notion of 'spontaneous generation' in fungi. In *NPG* Micheli refers on such experiments. He first sowed spores of one or more Agaricales species on decayed leaves collected in the environs of Florence and redispersed such leaves on litter in a wood. The results of these experiments, as he himself honestly confesses, were only tentative in Hymenomycetes. But results were irrefutable when he germinated conidia of moulds such as *Aspergillus glaucus*, *Monilia candida*, *Monilia racemosa*, and *Mucor mucedo*. He reported to have observed fungal growth on portions of pumpkin painted with spores of *Mucor* and other genera of moulds. Micheli gave the names to these and other common genera of today, for which he made a new systematic arrangement with keys to species. The official science of that time greeted these theories in different ways: censured and contested by those who repeated the same experiments with negative results and praised by those who reproduced the experiments successfully (e.g., G. Gleditsch). Today it is well known that the cultivation of fungi by sowing spores of Hymenomycetes can lead to positive results only in exceptional cases and exclusively with some saprotrophic species. In any case in the light of modern knowledge the

proofs which Micheli thought irrefutable cannot demonstrate reproduction of fungi, but only their means of spreading.

Nevertheless the publication of Micheli's experiences and results served as a spur to the apathy of the scientific world of those times, though he had more critics and detractors than followers. Even the great Linnaeus, who was becoming famous all over Europe [when Micheli died on January 2nd, 1737, Linnaeus published the first broad description of his system in *Flora Lapponica* (his *Species Plantarum* was published only 16 years later)], did not appreciate or probably did not understand Micheli's mycological method (Corti, 1980). It was by far easier and more practical to examine the external characters in order to list fungi into the ten genera used and recommended by Dillenius, rather than straining one's eyes at the microscope in the supposition that fungi belonged to the plant kingdom rather than to the animal one. The description of so many species quite injured Linnaeus's sense of propriety, since he thought that there was no need at all to divide them into so many species considering that most of them differed only in colour. In vain, several of Linnaeus's contemporary botanists such as A. Haller, M. Adanson and J. Hill tried to rescue here and there some of the genera described by Micheli. In vain C.H. Persoon tried to restore the whole of Micheli's system and to develop it. Even the theory of spontaneous generation was hard to kill. Only gradually and through a long period of time was Micheli's theory unanimously accepted. Fries, the scholar who set the bases of post-Linnaean mycological nomenclature, held Micheli in such a great esteem as to name him 'Divine Micheli'. He eagerly maintained that he contributed to developing mycology more than all the other scientists of his times, who were unable to follow his giant steps, and named him father of modern mycological science.

We would like to add that *Nova Plantarum Genera* has never been reprinted in Italy since 1729. There is an anastatic edition of 1976 printed in only 200 copies and published in Great Britain by Kingprint (Richmond, Surrey) with an introduction by Hawksworth (1976). This was used to translate the mycological part printed and distributed by the Florentine Mycological Group dedicated to P.A. Micheli.

In regard to the remainder of his work, including his manuscripts, we recommend that they be published and also translated in, in order to give to everyone the chance of reading the work quickly without getting lost in the difficult Latin text. The revision and correction of this text made by Father Brunone Tozzi from Vallombrosa, a very dear friend and master of Micheli, has not rendered it more accessible. It is a pleasure to communicate that one of us (M.L. Adversi) has also prepared a translation of the part of the *Nova Plantarum Genera* that deals with plants and

lichens. Nevertheless, as a consequence of the limited budget of our group it is still uncertain when it will be published. It is also our firm purpose to study systematically and possibly to publish some of Micheli's manuscripts.

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