

The collection of Brendel Botanical Models at the Botanical Garden of Naples, Italy

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Abstract. The Botanical Garden of Naples has a collection of *papier-mâché* models that reproduce plant structures, whole plants or fungi. They are known as Brendel Models, named after the German Company that built and supplied them to the Botanical Garden in the early nineteenth century. For their state of decay, due to time and continuous use for educational purposes, the models have undergone recovery interventions. Given their historical and artistic interest, and in order to preserve them, the models are no longer used today. In order not to completely lose such a cultural heritage for didactics, a CD-ROM has been created which includes, for each species reproduced by the models, photos in nature of the plants represented and didactic cards reporting all the useful information for the use of models in computer mode.

Riassunto. L'Orto Botanico di Napoli dispone di una collezione di modelli in cartapesta che riproducono strutture vegetali, intere piante o funghi. Essi sono noti come Modelli Brendel, dal nome della ditta tedesca che li costruì e li fornì all'Orto Botanico agli inizi dell'Ottocento. Per il loro stato di degrado, dovuto al tempo e al continuo uso a scopo didattico, i modelli sono stati sottoposti a interventi di recupero. Considerato il loro interesse storico e artistico, e al fine di una loro preservazione, i modelli non vengono attualmente più utilizzati. Per non perdere del tutto un tale patrimonio culturale per la didattica, è stato realizzato un CD-ROM che include, per ciascuna specie riprodotta dai modelli, foto in natura delle piante rappresentate e schede didattiche comprensive di tutte le informazioni utili per un loro utilizzo in modalità informatica.

Key words: Botanical anatomical models, Botanical Garden of Naples, Brendel

Three-dimensional models are very important tools in the studies of histology and anatomy of plants as they reproduce enlarged anatomical structures easy to analyze.

In the second half of eighteenth century and at the beginning of nineteenth century, there was a great demand for these didactical models in schools and universities worldwide. As a result, in Europe, many specialized factories manufactured models

for these scientific institutions. For the construction of the models, materials such as *papier-mâché*, wax, gypsum, glass and pottery were mostly used (FIORINI *et al.* 2007).

In particular, the Brendel Company, a German firm, first active in Breslau and later in Berlin, was specialized in reproducing plants, flowers and other plant structures (BRENDDEL 1893, 1894, 1914). The Brendel Company was also renowned

for masterfully represent the main types of inflorescences, phyllotaxis, fungi and life cycles of ferns (FIORINI *et al.* 2007).

THE BRENDEL BOTANICAL MODELS AT THE BOTANICAL GARDEN OF NAPLES

A very important collection of Brendel models reproducing flowers and other plant organs made of *papier-mâché* is conserved in the Botanical Garden of Naples. The collection currently consists of 109 elements with all of the most important models included in Brendel's production. The majority of the models represent floral structures, but there are also models representing fungi, mosses, vascular cryptogams, inflorescences and three-dimensional dispositions of leaves on trunks. Some of the models in the collection are illustrated in Figs. 1-11.

The models conserved in the Botanical Garden should belong to the oldest series of the Brendel's production; in fact, they have black painted bases (Fig. 4) while the models produced at the beginning of the nineteenth century were mounted on light wooden bases and finished with transparent varnishes (FIORINI *et al.* 2007). The models are well made, with a special consideration for structural details and for the colors of natural elements' structures. Unfortunately, there are no documents, purchase notes or inventory notes that could be used as a path for recreating the phases of purchasing the models by the Botanical Garden.

Many models are well preserved but some of them were damaged due to time and their repeated use for didactic purposes. To make Brendel's collection still usable, the models were retrieved, reorganized, and put in order according to systematic and anatomical criteria. The first step of the process of control and maintenance of the collection was devoted to the reorganization of materials and to the

classification of the models. Database containing pictures of all the samples in the collection were also created. The metadata necessary for rapidly monitoring the collection's size, the type of structures reproduced, the samples' conservation state and the damages were reported for each model. The basic screen of the database's mask includes the main data related to individual models and the link to a high-resolution photo.

The arrangement of the flowers' models was referred to the classification system proposed by Arthur Cronquist (CRONQUIST 1981, 1988). The models were divided into groups that reflect the different themes to which they refer. Thus, therefore, they are now divided into groupings dedicated to metamorphosed leaves, ovaries and ovules, stems, inflorescences, etc.

With the aid of some didactic panels, the models were assembled and are now exposed in historical display cabinets located in the main teaching room of the Botanical Garden of Naples (Fig. 12). The models with reproductions of metamorphosed leaves and the ones with phyllotaxis' diagrams put in the display windows were placed side by side with descriptive panels with photos (obtained from plants grown in the Botanical Garden of Naples) that highlight the structures reproduced in the models. The panels were made referring to texts of general and systematic botany (CRONQUIST 1981, 1988; JUDD *et al.* 2005; TONZIG & MARRÈ 1983; PIGNATTI 1982; RAVEN *et al.* 2005; STRASBURGER *et al.* 2006).

THE PRODUCTION OF CD-ROM

Given the historical interest and the artistic value of the models and to preserve them, the models are no longer used during university lessons. For these reasons, it was decided to organize a CD-ROM re-

porting all data referred to the models. The CD-ROM pursues the idea of creating a product suitable for all types of users, separating the educational material from the technological support and considering that scientific disclosure must take into account the differences existing in the cultural background of users, combining the needs of researchers with those of simple enthusiasts.

In the designing of the CD-ROM, a programming language compatible with the WEB was used. In particular, the html language was chosen; this is easy to manage and to use and does not require complicated installation phases. In fact, a software application that requires the use of powerful computers or installation of accessory plugins may discourage users with less experience in its knowledge. In particular, the plugins always need internet access to be loaded and they are often unwanted by the user, that is forced to install additional software without having the opportunity to evaluate the quality of the offered content. The layout of the pages follows linear patterns and the number of hyperlinks is reduced to the bare minimum. Animation effects such as roll-over are not used in order not to confuse the users with less experience (SIBILIO & MENALE 2005; SIBILIO *et al.* 2011). Use of the html language also predisposes the multimedia contents of the CD-ROM to a simple and rapid publication on the net. This publication is expected after the distribution of the CD-ROM.

The photos of the models are integrated with botanical documents, with photos of the entities represented in their natural environment and, in some cases, with images of scanning electron microscopy of pollen grains. The intent was to highlight the high educational value of the models and to add to the macromorphological characters, classically at the base of the systematics, micromorphological characters that togeth-

er with the data obtained from molecular studies can be used for phylogenetic analyzes.

The photos of models are accompanied by illustrative texts containing summary information that has the aim to provide useful elements for the understanding of each model. The texts were compiled by referring to general and systematic botanical literature (CRONQUIST 1981, 1988; JUDD *et al.* 2005; TONZIG & MARRÈ 1983; PIGNATTI 1982; RAVEN *et al.* 2005; STRASBURGER *et al.* 2006).

The consultation of the CD ROM has a simple interface. The user can choose whether to browse the patterns structured in alphabetical order or to use instead thematic one that implies higher levels of interactivity and background. For example, the user can choose to consult the models related to metamorphosed organs, those dedicated to reproductive structures, to flower symmetries or to organization of the inflorescences.

The CD-ROM is divided into two sections. The first one is dedicated to the history of the Brendel models and in particular to those in the Neapolitan collection and the second one includes systematic botany hints and a glossary.

For each model, a descriptive card shows the scientific name of the species reproduced and the systematic classification according to the classification system of CRONQUIST (1981, 1988). The description of the species is followed by references to phenology and distribution. All cards are completed by bibliographic references. Each card is matched with a photo and a description that highlight the characterizing elements of the reproduced structure (Fig. 13). The possibility to access to the flower's picture or to the pollen grains' image (Fig. 14) is indicated by two buttons positioned on the right side of the page. The glossary reports definitions of botanical terms. The different color in

which these terms are shown in the sheet implies the hypertext character and the possibility to access the explanation.

The use of a multimedia CD-ROM is the most suitable way for the enhancement of the Brendel models. Thanks to multimedia, these models can still play an edu-

cational role, even at a distance, entering in virtual form in an almost unlimited number of schools and academic courses.

This kind of product can become a valuable tool even in classrooms without internet access.



Fig. 1 - *Nymphaea alba* L.



Fig. 2 - *Lilium martagon* L.



Fig. 3 - *Anacamptis morio* (L.) R.M.Bateman, Pridgeon & M.W.Chase.



Fig. 4 - *Avena sativa* L. Model with black painted wood base.



Fig. 5 - *Aconitum napellus* L.



Fig. 6 - *Viola tricolor* L.



Fig. 7 - *Phaseolus vulgaris* L.



Fig. 8 - *Prunus cerasus* L.



Fig. 9 - *Humulus lupulus* L. Male flower.



Fig. 10 - *Theobroma cacao* L.



Fig. 11 - *Primula veris* L.



Fig. 12 - The botanical anatomical models arranged in a historical display cabinet in a teaching room of the Botanical Garden of Naples.

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Orto Botanico di Napoli - Università degli Studi Federico II:

Indietro *Cuscuta trifida* Bab. = *Cuscuta epithymum* (L.) L. subsp. *trifida* (Bab.)

Organi metamorfosati **Sottoclasse:** Asteridae **Ordine:** Solanales **Famiglia:** Cuscutaceae

Legenda colori **Modello:** fiore pentamero (in natura 3-4 mm), il tubo corollino supera di poco il calice breve, la corolla è rosea o bianca, stili clavati e lunghi il doppio dell'ovario. In alto a destra ed in basso sezioni di radici austoriali inserite nel fusto della pianta ospite.

Cuscuta trifida **Descrizione:** il pittimo è una specie ebeacea parassita, i fusti appaiono come un groviglio di filamenti di colore giallo, è in grado di parassitare piante sufruticose come *Thymus* ed altre specie tra le Lamiaceae, Asteraceae e Fabaceae. Fiori riuniti in **glomeruli**. **Antesi:** VI-IX

Dionaea muscipula **Distribuzione:** specie euroasiatica, distribuita su tutto il territorio italiano.

Drosera rotundifolia **Note:** il colore aranciato dei fusti sottolinea l'assenza di clorofilla. La pianta infatti utilizza la linfa grezza ed elaborata prodotta dal suo ospite per far fronte alle proprie necessità vitali. Essa infatti inserisce le radici austoriali nel fusto dell'ospite fino a raggiungere il sistema vascolare. Sono segnalati casi di parassitismo anche a carico di specie succulente.


Nepenthes distillatoria

Torna su

Indietro

Rif. bibliografico: Cronquist A. 1988. The Evolution and classification of flowering plants. 2nd Ed. New York Botanical Garden, Bronx, New York. - Pignatti S. 1982. Flora d'Italia. Ed. Edagricole, Bologna, 2:383. - Strasburger E., Noll F., Schenck H., Schimper A.F.W. 2006. Trattato di Botanica per le università. Ed. Antonio Delfino, Roma, vol.2.

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Fiore (51,5x20x21) in alto a sinistra. In alto a destra ed in basso sezioni di radici austoriali inserite nel fusto della pianta ospite (53x17x19)




Fig. 13 - Example of a descriptive card.

Museo di Paleobotanica ed Etnobotanica
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simmetria bilaterale *Viola tricolor* L.

Legenda colori **Sottoclasse:** Dillenidae **Ordine:** Viales **Famiglia:** Violaceae

Aconitum napellus **Modello:** fiore ermafrodita e zigomorfo, sepal prolungati all'indietro, corolla (in natura lunga 1-2,5 cm) gialla, blu e violetta, con petali superiori più lunghi del calice, **spigone** sottile. **Ovario** tri-carpellare, supero ed uniloculare, con stilo ripiegato ad S, 5 stami.

Delphinium consolida **Descrizione:** la viola del pensiero presenta fusto ascendente o eretto, ramificato e foglioso, glabro o con peli brevi. Stipole con segmento apicale lanceolato e piccoli segmenti laterali. Le foglie inferiori sono **cuoriformi** o **ovali**, quelle superiori **lanceolate**, ed in entrambi i casi crenate. **Antesi:** V-VII

Consolida regalis **Distribuzione:** Italia settentrionale, nei campi e nei pascoli da 0 a 2100 m.

Digitalis purpurea **Rif. bibliografico:** Cronquist A. 1988. The Evolution and classification of flowering plants. 2nd Ed. New York Botanical Garden, Bronx, New York. - Pignatti S. 1982. Flora d'Italia. Ed. Edagricole, Bologna, 2:117.

Linaria vulgaris **Glossario**

Orchis militaris

Orchis morio

Phaseolus vulgaris

Pisum sativum

Salvia officinalis


Trifolium pratense

Viola tricolor

Torna su

Indietro

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Fiore e sezione di fiore (51x32,5x19)


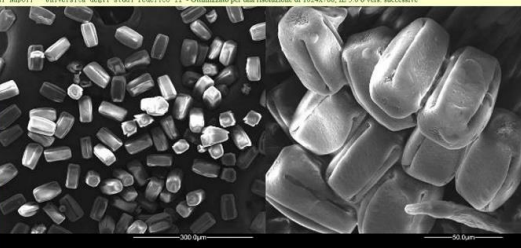
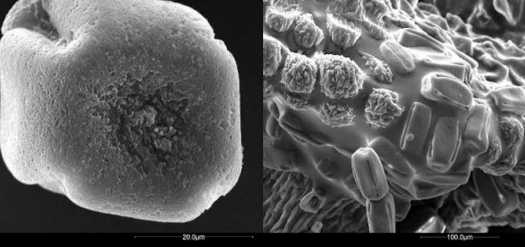




Fig. 14 - Example of the descriptive card of *Viola tricolor* L. with photos of the plant and scanning electron microscopy images of pollen grains.

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