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Non vascular cryptogamic collections from Herbarium Universitatis Taurinensis (TO): making the most to promote their utilization

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ABSTRACT
The Herbarium Universitatis Taurinensis (TO) contains over 130.000 scientifically and historically significant cryptogamic specimens, including type specimens. This paper presents the first results of a project aimed at the discovery, description and enhancement of non vascular plant collections hosted in Turin Herbarium.

Key words:
cryptogams, herbarium, Historical collections.

RIASSUNTO
Crittogame non vascolari nell'Herbarium Universitatis Taurinensis (TO): valorizzazione come base per un futuro utilizzo

L'Herbarium Universitatis Taurinensis (TO) contiene oltre 130.000 campioni, ad oggi scarsamente indagati, riferibili a crittogame non vascolari. Il presente lavoro illustra i primi risultati di un progetto volto al censimento, descrizione e valorizzazione delle collezioni crittogamiche della sede Torinese.

Parole chiave:
crittogame, erbario TO, collezioni storiche.

Herbaria are the repositories of preserved plants, enabling species to be studied and their distribution in space and time to be documented and analysed. They are essential parts of a research institute specialized in taxonomic botany and have potential to serve as data sources for biodiversity and conservation. Historically, herbaria with vascular plants have been most extensively studied than ones with non-vascular plants and this is particularly true for the Turin's collections.
The "Herbarium Universitatis Taurinensis (TO)" includes, in addition to well-known collections of spermatophytes (Forneris, 2004) many materials related to non-vascular plants. These materials, with few exceptions, have never been studied yet.
In 1891 Giuseppe Gibelli, who was Director of the Botanical Garden in Turin, undertook a great work of reorganization: most of the non-vascular cryptogams were merged into 5 big herbaria (Musci, Hepaticae, Algae, Fungi open to additions and Lichens not open). In these herbaria all specimens, coming from many different herbaria, were sorted according to systematic and alphabetical criteria. This task, conducted in a period where no technical aids for databasing existed, on the one hand certainly facilitated the consultation and comparison of samples, on the other hand completely destroyed the unity of the individual collections, making very complex even their detection. Moreover most of the cryptogamic samples are no longer associated to a catalogue, therefore, at present, data on the abundance, origin and geographical location of the exsiccata are not easily available. The lichen herbarium, unlike the other four, includes all materials acquired by the Botanical Garden since the second half of the Eighteenth century until 1950. The newly acquired lichen materials are preserved in folded envelopes according to the widely adopted management practices (e.g. Obermayer, 2002) and stored separately. This current section is regularly updated, contains more than 4000 specimens and is the only one for which a complete computerized catalogue is available (Isocrono et al., 2004).
Other cryptogamic materials can be found in closed

collections of particular works or celebrated authors, mainly formed by vascular plants, which are kept separated for their great historical and scientific value. In order to give value to this huge patrimony of exsiccata, and to improve their usability, in 2012 a project was undertaken for the census and cataloguing of collections and the digitisation of herbarium material by capturing both data and images and storing them in digital form.

METHODS

Preliminary activities were performed for preparing and organizing the cryptogamic materials. First step was to verify the presence of non-vascular plants in the "closed collections" (i.e. nothing may be added to them or taken away) hosted in TO.

As far as the 5 big cryptogamic herbaria, since no certain information about the numerical amount of these collections exists, the number of exsiccata in each sheet was manually counted. The labels associated with each samples have been analyzed in order to detect the collector and when possible, the collection itself. Several specimens show the collection name (in print or manuscript) on their labels, enabling an easy identification of the collection. In many other cases the name on the labels was not explicit: the way of preparing samples, the type of archival paper, the recognition of the writing of the authors were taken into account to fit the specimen in a given collection.

The comparison of the handwritings has been done through an atlas, prepared by the Herbarium staff on the basis of the handwritings on phanerogamic specimens, through the consultation of some specialized texts (Cuccuini & Nepi, 1999; Forneris, 2004) and a collection of photographs of historical exsiccata (Isocrono - private collection).

Since the original nuclei were dismembered and the samples merged together in taxonomic sections, two levels of identification have been carried out :

- recognition of groups of samples attributable to a specific botanist (named here nuclei);
- reconstruction, when possible, of how these nuclei have reached the Turin Herbarium.

Herbaria	Type	Number
* Algae herbarium	A	10527
* Bryophyte herbarium	B	30741
* Fungi herbarium	F	35000
* Historical Lichens herbarium	L	29804
* Lichens - Current collection	L	4932
Lorenzo Terraneo (1676 -1714)	AFLB	35
Carlo Allioni (1728-1804)	AB	15
* sir John Hill (1764)	ABL	97
Ludovico Bellardi (1741-1826)	ABL	142
G. Giacinto Moris - Flora Sardoa (1796-1869)	ABL	615
* Muscologia (?1800)	B	307
* Erbario Crittogamico Ossolano G. Rondolini (1818)	LB	20
A. Maurizio Zumaglini e G. Bruno herbaria (1804-1865)	AFLB	214
* Sextus Otto Lindberg bryophyte herbarium 1835-1889	B	242
* Beniamino Peyronel Erbario micologico fitopatologico 1890-1975	F	220
* Lichenes selecti Germaniae mediae Dr. Robert Schmidt 1882	L	54
* Oreste Mattirolo, erbario micologico (1856-1947)	F	20000
S.A.R. Luigi Amedeo di Savoia Duca degli Abruzzi Stellae Polaris (1899-1900), Plantae Ruwenzorenses (1906), Sorgenti del Uebi Scebeli (1928-1929)	AFLB	242
Piante acquatiche e palustri del Piemonte by Ferrari 1909	AB	23
Herbarium Alpium occidentalium (1919-2000)	AFLB	19

Tab. 1. Non vascular cryptogams in TO * = includes only non-vascular specimens , n = number of samples, A = algae , F= fungi = L = lichenized fungi , B = bryophytes.

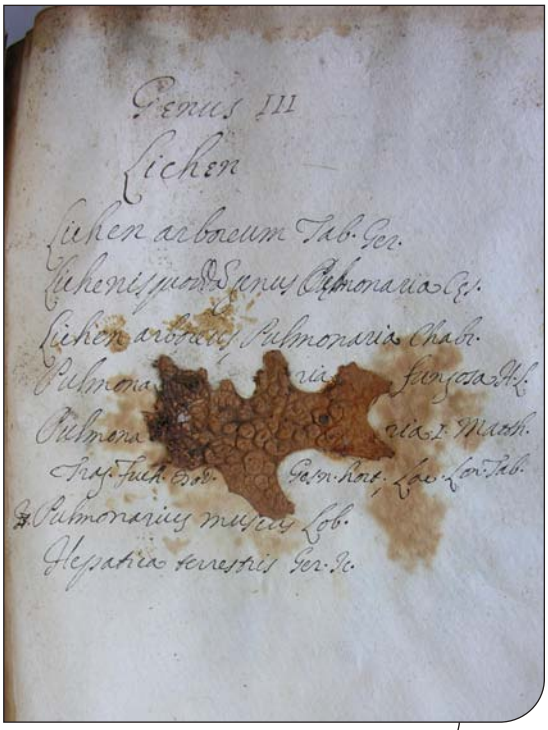

Fig. 1. *Lobaria polmonaria* (L.) Hoffm. Sheet from Lorenzo Terraneo (1677-1714) herbarium.

RESULTS AND DISCUSSION

The "Herbarium Universitatis Taurinensis (TO)" is an herbarium formed on a strong tradition of floristic research in Italy and the work of prominent personalities involved in Botany in Europe. Besides about 800.000 specimens of vascular plants, it contains many non vascular plants specimens for the most part remained unknown, because previous work has focused on phanerogams (see Forneris, 2004 for details).

More than 130.000 non vascular cryptogamic exsiccata have been found in TO Herbarium (tab. 1). Most of items date back to the 19th century and to the second half of the previous century. Cryptogams occur, obviously, in the five main non-vascular plants herbaria and in several other closed herbaria.

Non vascular plants in the TO herbarium: closed collections

The closed collections in TO contain over 22.200 specimens as a whole. The Lorenzo Terraneo's herbarium (fig. 1) dates back to the end of XVII century and it is the oldest collection in the University of Torino. Specimens are mounted in six bound volumes. It comprises 35 moss, lichen, fungi and algae specimens (out of 1035) not previously mentioned in papers deal with this herbarium (Mattirolo, 1912; Montacchini et al., 1994; Forneris 2004).

Among the closed collections it's worth nothing a well preserved herbarium of 97 British cryptogams, which dates from the first half of the 18th century that can be ascribed to Sir John Hill (1716 - 1775) a pioneer of botany in England (Isocrono et al., 2012).

Of particular note is the herbarium of Giacomo Giacinto Moris, a young student of first Balbis and later Capelli in Turin. His contribution, in the first half of the XIX century, was fundamental to the knowledge of Sardinian flora (Arrigoni, 2006). Six hundred and fifteen specimens of algae, mosses and lichens have been found in his herbarium. Moreover other Moris's specimens occur in the 4 big historical

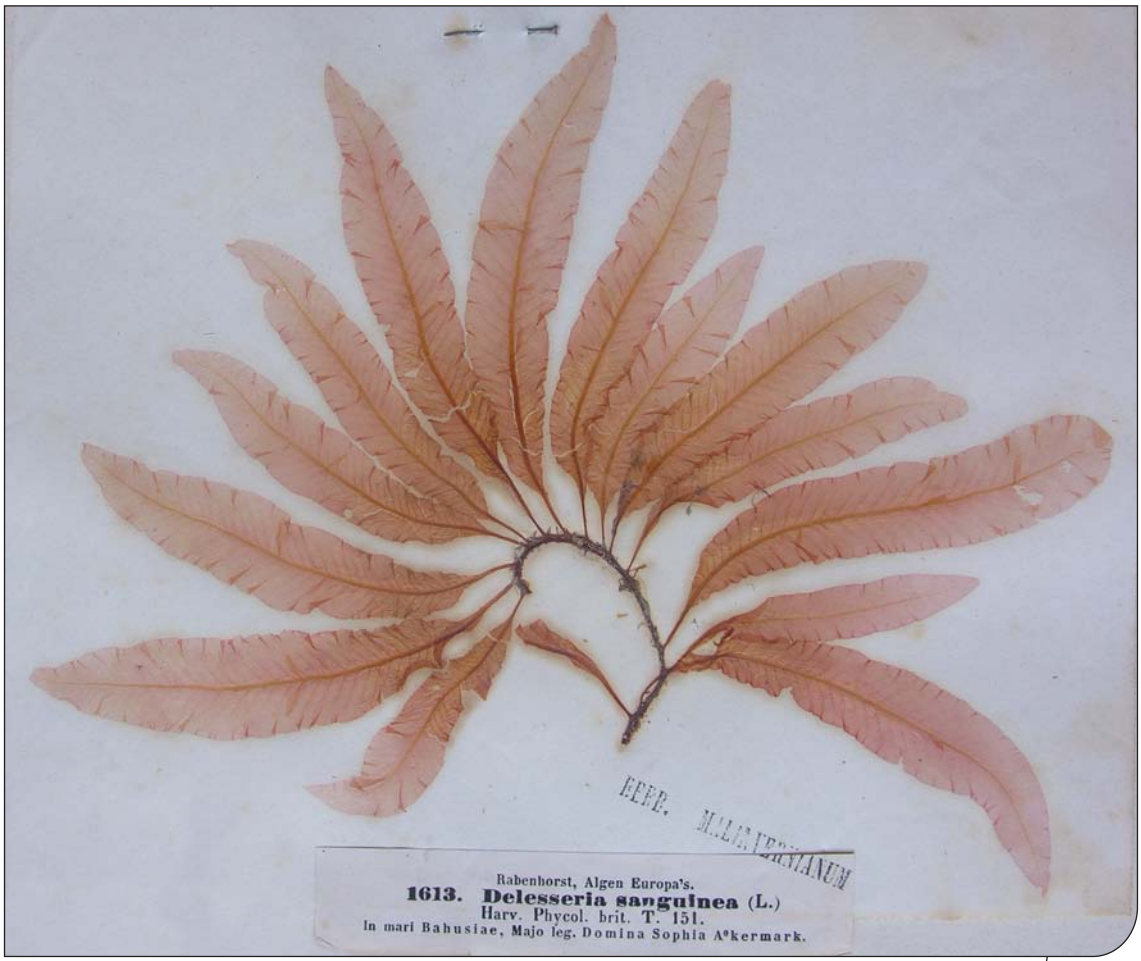

Fig. 2. Sheet from Algae herbarium. Exsiccatum from Sweden in Rabenhorts Algen Europa's collection.

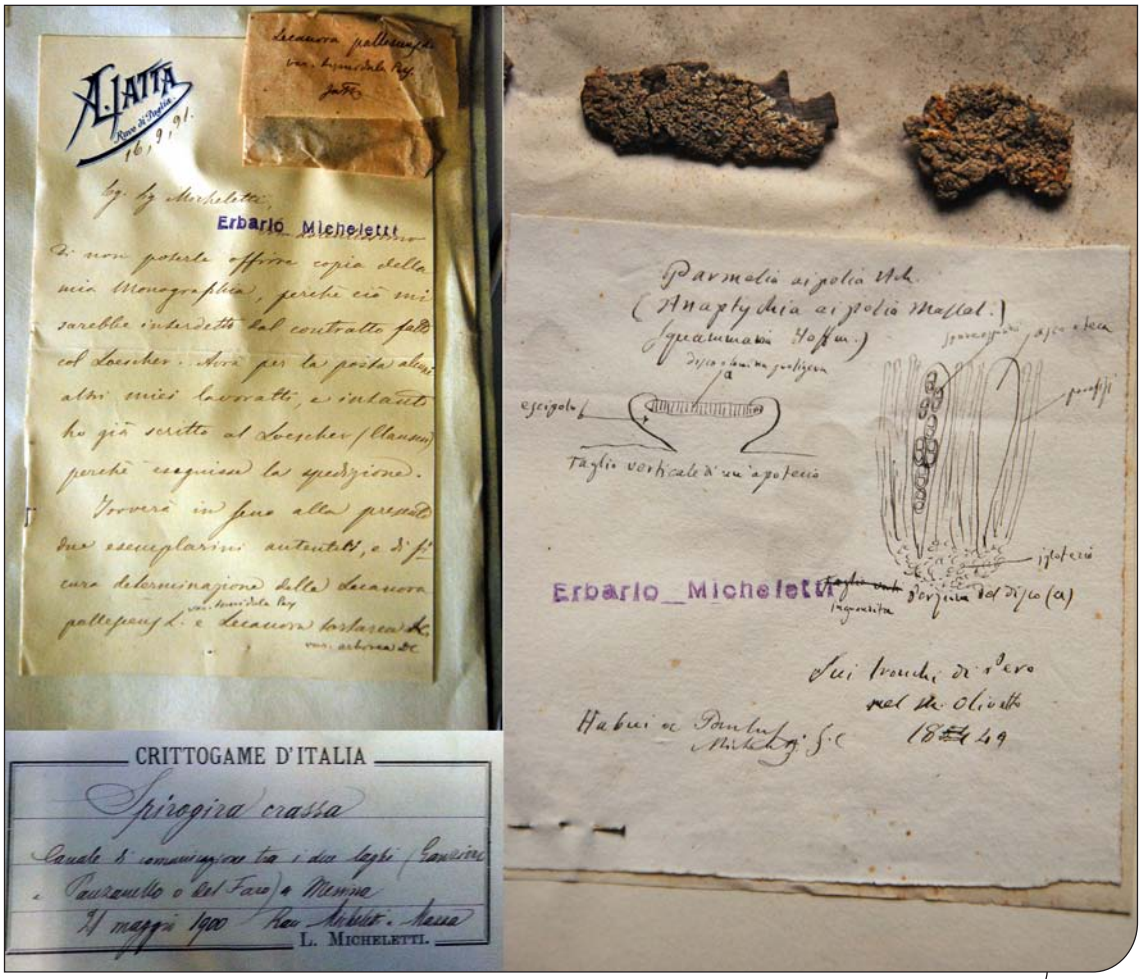

Fig. 3. Examples from Micheletti cryptogamic collections.

herbaria, they have been recognized mainly on the basis of the handwriting on the labels.

Non vascular plants in the TO herbarium: cryptogamic herbaria

The Algae herbarium (fig. 2) contains approximately 10.000 specimens of freshwater, marine, and terrestrial algae from all of the main divisions. Over 50 nuclei have been recognized. The herbarium includes micro- and macroalgae, most mounted on herbarium sheets or in packets. Some specimens, mainly assembled in 1800, also includes a set of permanent slides. It contains scientifically and historically significant material such as: Wittrock V. B., Nordstedt O. *Algae aquae dulcis exsiccatae*, Piccone Florula algologica della Sardegna (330 specimens collected in Sardinia around 1878, included in Patrizio Gennari's herbarium), Hauck et Richter, *Phykotheka universalis* (800 specimens from 1886 to1894 collected worldwide).

At present, the Fungi herbarium housed in TO is the less investigated. It comprises approximately 30.000 samples (estimated datum). The Herbarium hosts also the dried collections of O. Mattirolo and A. Cerruti. These collections, of extraordinary museum interest, are a fundamental reference for mycologists as they contain numerous type specimens of hypogeous fungi, often complete with the original micrographs.

The lichen collection numbers around 30.000 samples. More than 50 nuclei have been recognized. It comprises original collections that attest the activity of some scientists in the "golden period" of the Italian Lichenology (e.g. Anzi, Baglietto, Carestia, De Notaris) as well as many important European herbaria (e.g. Philipp Hepp Die Flechten Europas, G. W. Koerber *Lichenes selecti Germanici*, Leighton *Lichenes britannici exsiccati*, the Rabenhorst's collections).

The bryological herbaria comprises hornworts, liverworts and mosses and it is, at present, the only one for which published data exist. It contains over 30,700 specimens including some interesting material concerning "types" and documentation of extra European expeditions (Pistarino & Forneris, 2008). Interesting also the contribution to the local

knowledge: many specimens as those of Balbis, Lisa (180 specimens collected around Turin) and Carestia (950 mosses from Pennine Alps) are valuable data for time comparisons regarding North Italy flora.
In all the cryptogamic herbaria we identified over 100.000 specimens and more than 80 nuclei (as defined in Methods section) many of these not previously recognized as being part of our herbarium. The specimens, on the whole, have a global coverage. Italy is particularly well represented, with a timeline of specimen data going back over 250 years. The herbaria of Martino Anzi (1812-1883) and those of Antonio Carestia (1825-1898), both personal collections and specimens received as gifts, can be considered as the core of non-vascular herbaria in TO. As for the other Italian collections, very important are the nuclei of Giovanni Battista Balbis (1765-1831), a pupil of the famous Piedmontese botanist Carlo Allioni (1728-1804) that comprises over 3000 specimens (1125 bryophytes, 1083 fungi, 502 algae, 983 lichens) and the Erbario Crittogamico Italiano (1858-1885) the most important collection of Italian cryptogams.
The nucleus referred to Luigi Micheletti (1844-1912) is also significant for the Italian flora. He was an Army Captain from Lombardy, who was in correspondence with renowned botanists (many revised specimens and letters found attached to sheets). His herbarium (fig. 3), which also includes phanerogams, preserves specimens from 15 out to 20 Italian regions.

CONCLUSION

This work sheds light on the true extent of the non vascular plant collections in TO, collecting data on their consistency and history and will serve as a basis for future actions for the enhancement of this heritage. The collected data, incomplete though it may be, will be of interest to botanist engaged in taxonomic and nomenclatural research. The digitisation process, currently underway, will allow for our collections to be queried and analysed in ways not previously possible, and enables access by 'virtual visitors' unable to visit the collections in person.
During this first analyses several "typus" samples have been discovered. This types is a priceless treasure that should be enhanced in the next future: at present less than 5% of the typical material hosted in TO has been listed or revised.
The collections also hold a great historical value, as they reflect devoted interest in botany and local plant knowledge of earlier Italian botanist and their relationships with the most important European botanist in the XIX century. The oldest cryptogamic exsiccata refer to botanist that work in Piedmont or botanist that have been part of the Botanical Garden (e.g. Allioni, Balbis, Bellardi, Colla, Moris). They were included in vascular plants herbaria, and sometimes they lack identification at specific levels or relevant geographical information. Their interest is mainly historical and documentary, although samples (such as those relating to the hill of the city of Turin), being permanent record of botanical diversity, may provide interesting data on the presence of species now extinct or endangered. This role of old samples is increasingly important as the rate of habitat destruction increases and anthropic factors can cause rapid changes in species' ranges.

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