

## A brief history of the bryological exploration of the Azores

Jan-Peter Frahm

Nees Institut für Biodiversität der Pflanzen, Rheinische Friedrichs-Wilhelms Universität,  
Meckenheimer Allee 170, D 53115 Bonn, Germany, Frahm@uni-bonn.de

**Abstract:** An account of the bryological activities on the Azores is given. Three phases can be distinguished: one at the end of the 19. century, when first collections of non-bryologists were made, which resulted in the discovery of less than one third of the presently known species and the description of many so called endemics. A second phase in the thirties of the 20. century is characterized by an intensive collecting activity of some bryologists, which enormously raised the species numbers. In a third phase at the end of the 20. century, tourism as well as activities of local bryologists raised again the species numbers. Revisions of genera reduced the number of endemic species and revisions of herbarium specimens of doubtful records even reduced the species numbers of hepatics.

The history of the bryological exploration of an archipelago is a nice case study. It shows how and how much the knowledge of the bryoflora accumulated over the time, and how travellers, expeditions, bryologists, tourists and local botanist contributed. Short accounts of the history of the bryological research on the Azores were already given by previous authors, which were usually incomplete and very short, almost confined to the citation of publications. The latest update concerns the hepaticological research (Schumacker 2001). Therefore a first attempt has been made to describe the bryological exploration of the Azores. The chronological reconstruction was, however, sometimes not easy. Sometimes the collections were made many years before the publication, furthermore the

same collections were sometimes published several times and the sometimes inaccurate or even incorrect citation of references in earlier times raised confusions.

Three phases of the bryological exploration of the Azores can be distinguished: the second half of the 19. century, which provided only a rough knowledge of the bryoflora, the first half of 20. century with an intensive collecting activity especially in the late thirties, which provided the basic knowledge of the bryoflora, and the end of the 20. centuries, which resulted in still numerous additions of species and especially a better knowledge of the smaller islands, which were formerly not often visited.

The earliest collection of bryophytes was made on the Acores by Carl Hochstetter. Hochstetter was pharmacist and the son of C.F.F. Hochstetter, a priest and professor for natural history at a priest seminar in Esslingen, Germany. His father was founder of the "Botanischer Reiseverein" in Esslingen, a society, which equipped travels to collect botanical specimens. The costs were paid by deposits by the members, who received back herbarium specimens. Hochstetter travelled in **1838** by order of the Reiseverein to the Azores, where he collected a moss, which Schimper (in Seubert 1844) described after him as *Hypnum hochstetteri*. (Tragically, this first moss from the Azores was later described again by Schimper under the name of a different archipelago as *Myurium hebridarum* and was known most of the time under this name until Long discovered the earlier name.).

The second collection of bryophytes was made by Rev. Thomas W. Higginson, who spent a winter on Faial, where he collected mainly lichens but also bryophytes. His collections were determined and published by Russel (**1862**), who listed 5 hepatics and 32 mosses. The determinations were made in part only on the genus level, others with question marks (*Campylopus brevipilus*, *C. setifolius*) and others (for example *Leucodon [Lepyrodon] lagurus*) were misidentified (the latter was probably *Myurium hochstetteri*). *Leucobryum junioeroideum* was still called *L. glaucum*, and interestingly, he indicated *Campylopus setifolius*. The latter is very closely related to *C. shawii*, which was 40 years later described by Cardot as new from the Azores as *C. carreiroanus*, until 80 years later the identity with *C. shawii* was discovered.

In general, the Azores were bryologically much less explored than the other Macaronesian islands. For example, Mitten (**1865**) described many new species from Madeira but only one (*Leskea [Echinodium] spinosa*) collected by H.C. Watson.

Sometimes Mitten (1877. Musci and Hepaticae collected by N. Mosely, naturalist to H.M.S. Challenger. Journ. Linn. Society Botany 15: 59-73.) is cited in the literature for the Azores, but

this publication concerns many atlantic islands but not the Azores. The geographical situation of the Macaronesian islands have partly contributed to the knowledge of the flora, because these islands were used as stopover by ships sailing to southern hemisphere, also by scientific expeditions. The naturalists on board used also these small stops to collect. This is, however, not the case for bryological collections on the Azores but Tenerife or Madeira.

The first larger collections of bryophytes were recorded from the Azores by Mitten (**1870**). Mitten published a list of bryophytes in Godman's Natural History of the Azores collected by Hunt, Watson and Godman on the Azores as well as on Madeira and the Canaries. For the Azores, 47 mosses and 18 hepatics were listed.

It took almost 30 years, that bryophytes were again collected on the Azores. Between 1894 and 1896, William Trelease, director of the Missouri Botanical Garden, accompanied by C.S. Brown, Bruno Carreiro and C. Machado collected 52 mosses, which were identified by Cardot (**1897**). Thirty of the species were new records, raising the total number of known species to 77. Eight species and three varieties were described as new. Cardot was the first who made a rough phytogeographical analysis and stated that of the species are composed of those occurring on other Macaronesian islands, in Europe or in North America. For the first time he indicated neotropical elements (*Fissidens asplenioides*, *Philonotis obtusata*) as well as species which are rarely found in Ireland or Scotland (*Myurium hochstetteri*, *Hypnum uncinulatum*) or which he considered as endemic to the Azores or Macaronesian Islands. Only few of the species which he described as new remained (*Echinodium renauldii*, *Bryum pachyloma*); others (e.g. *Campylopus setaceus*) were later synonymized, others (e.g. *Hyophila treleasii*) remain doubtful. Most species were known at that time from Sao Miguel (49) and Santa Maria (36), whereas only 9 species were known from Pico, 6 from Terceira, 3 from Corvo and 1 from Sao Jorge. The hepatics of the expedition of the Missouri Botanical Garden were published by

Trelease (1897). Trelease listed 32 species. All collections in the 19. century were made by non-bryologists.

In the following time, there were only several minor contributions to the bryoflora of the Azores. Kindberg (1898) reported few mosses, which C.M.G. Machado had collected in the surroundings of Coimbra (Portugal) and two species from S. Miguel, *Campylopus introflexus* var. *sublaevipilus* Kindbg. and *C. subintroflexus* Kindbg., which both belong to *C. pilifer*.

Dixon (1909) identified collections of bryophytes gathered in the same year by Miss Armitage on Madeira and by Mr G.C. Druce on the Azores (all from S. Miguel). The latter comprised 12 species, including one *Bryum* new to science and one new record. Two years later, the species were again listed by Druce (1911) himself in a report of his travel.

A first survey of the mossflora of the Azores was given by Geheeb in his "Bryologia atlantica", posthumously edited by Herzog (Geheeb & Herzog 1910). It covers only mosses, of which 108 species were enumerated, but is just a compilation of the previous collections (Mitten, Cardot, Kindberg, Dixon) without any new additions.

A small collection of bryophytes were added by Miss Armitage (1931), who travelled around a lot (even to Spitsbergen) and always collected also bryophytes.

In 1929, the British botanists T.G. Tutin and E.F. Warburg collected also bryophytes, which were published eight years later by Richards (1937). Except for Hochstetter and the expedition of the Missouri Botanical Garden, all collections of bryophytes made so far on the Azores were made by British.

In 1926, 1929 and 1935, Alfred Ade made holiday trips to the Iberian Peninsula and the Macaronesian Islands, during which he collected flowering plants and bryophytes, but the results were not published before 1942 (Ade & Koppe 1942). Ade was veterinary in Bavaria, but was interested in all kind of plants as well as fungi. He participated in a cruise in 1926 and visited

Tenerife, Gran Canaria and also Madeira. In 1929 he travelled by train through Spain and Portugal and took a ship again to Madeira. In 1935, Ade made again a cruise which took him to Sao Miguel and again to Madeira, but his visit on Sao Miguel took only a few hours, during which he "gathered all botanical valuables" at the eastern slope of Pico da Cruz, along lava walls near Arrifes and in a *Cryptomeria* forest. He collected not only bryophytes but also flowering plants, and the bryophytes were determined by various contemporary bryologists such as Hooek, Loeske, Koppe, Schumacher and Burgeff. Koppe had apparently done most of the work and was included as co-author. As expressed in the preface, Koppe had considerable problems with the identification due to the lack of literature. The bryophyte flora of the Azores was at that time not included in any of the European floras, that Koppe based his identifications on herbarium specimens, which he received for comparison from bryologists having collected before on the islands (Winter, Persson, Luisier) or from the herbaria in Berlin and Paris. Ade collected 35 hepatics and 31 mosses, of which numerous species were new to Macaronesia, the Canaries or Madeira. On S. Miguel (within few hours of a land trip during the cruise !) he listed seven species as new to the Azores and six species as new to Macaronesia, although this list is not even complete, since he indicated in the text also *Campylopus flaccidus (ampliretis)* as new to Macaronesia, which was so far only known from South Africa. Of these 13 species listed as new, nine were liverworts, which indicates that these had so far received not too much attention.

There was some kind of "run" on the Azores at the end of the Thirties, which doubled the number of known moss species and raised the species of hepatics from 18 to 159. And for the first time, almost 100 years after the first collections of bryophytes, the collections were made by bryologists.

Teotonio da Silveira collected bryophytes on the Azores since 1928. He was the first local bryologist on the Azores and published his records in 1937, the year when Persson and the

Allorges stayed on the archipelago. His list comprises 54 species of mosses and 29 species of hepatics (Silveira Moniz 1937), of which 10 were new to the atlantic islands. The new species included still trivial species such as *Pleurozium schreberi*, *Rhytidiadelphus loreus* or *Brachythecium populeum*. It seems as if he has compiled his results with regard to the forthcoming publication by Allorge and Persson. Part of his specimens were identified by Luisier. To make the situation more obscure, Teotonio da Silveira included records of Persson and Allorge. In fact, most of the records were made by Persson and Allorge. It is obvious from his list that Teotonio accompanied both, Allorge and Persson, on S. Miguel and published their collections. Both, the 11 species new to Macaronesia based on the collections of Teotónio da Silveira as well as of Tutin and Warburg were again published by Luisier (1938a). Father Luisier, who published numerous papers on the “bryoflore des îles atlantiques”, especially many on Madeira, has apparently never personally been on the Azores. It could be that his order (Luisier was Jesuit) was engaged on Madeira but not the Azores, and Luisier had thus a chance to go to Madeira but not to the Azores. Also his second publication dealing with the Azores (Luisier 1938b) contains lists of species, which other botanists had collected before. The hepatics new to the Azores were cited by Luisier (1938b) without regard to Teotonio, because all except for *Trichocolea tomentella* were collected and published by Allorge and Persson (1938).

The two most important contributions to the bryoflora of the Azores were curiously made in the same year: in 1937, Herman Persson was from March to May on S. Miguel, Terceira, Fayal, Pico and S. Jorge, and Pierre and Valia Allorge were from May to August on S. Miguel, Santa Maria, Fayal, S. Jorge and Flores. A year later, Allorge and Persson published a first list of their new records, of which 45 were new to the Azores and 15 new to the atlantic islands. This raised the number of hepatics known to the Azores to 190. The results of the Allorges were published much later, the hepatics in 1950 (Allorge & Allorge 1950) and the mosses in 1952 in (Allorge & Allorge 1952), after the death of

Pierre Allorge. The publications of the Allorges was what they called a catalogue preliminaire, but somehow chaotic. In contrast to the title (Hépatiques viz. mousses récoltées par P. et V. Allorge aux îles Açores en 1937), it included previously made collections, for instance the collections of Hunt, Godman, Trelease, Carreiro, Machado (already compiled by Geheeb & Herzog, 1910) and Persson., for which the references were not given in the bibliography. And from the abbreviation A. & K. it can be concluded, that also the publication by Ade & Koppe was considered. The citation of Persson seems also to include previously not published collections by Persson. And the total number of species was given partly with 233 mosses plus 12 species Sphagnum or 233 including Sphagnum. Many specimens of their collections were distributed in an exsiccate series “Bryophyta Azorica”.

In 1938, C. Cedercreutz made a fieldtrip to Madeira as well as S. Miguel, Terceira, S. Jorge, Pico and Faial. Included in the later publication were bryophytes collected by R. Stora on Flores. They collected 104 species on the Azores and 38 species on Madeira. The collections were handed over to Hans Buch, who forwarded two thirds (presumably the liverworts) of the specimens to Herman Persson. Both published their results three years later (Buch & Persson 1941). Buch and Persson described *Bazzania azorica*, *Lepidozia azorica*, *Calypogeia allorgei*, *Mylia azorica*, *Euosmolejeunea cedercreutzii*. The publication includes much more liverworts than mosses (all species newly described were liverworts), which shows the higher portion of Persson’s work, who had the advantage having been on the Azores before. Interestingly, relatively common species such as *Bazzania azorica* and *Lepidozia azorica* have not been described (or recognized) before. Buch & Persson listed 60 hepatics and 64 mosses. After 1938 (or the later publications of collections made until 1938), 392 bryophyte species were known from the Azores, which is about 90% of the number of species known today.

In 1942, Gonvalves da Cunha & Georgette de Barros published a list of species (Cunha &

	Mosses	Liverworts
Russel (1862)	32	5
Mitten (1870)	47	18
Cardot (1897), Trelease (1897)	77	40
Geheeb & Herzog (1910)	108	-
Allorge & Allorge (1950)	-	159
Allorge & Allorge (1952)	233	-
Sjögren (2001)	284	154
Schumacker (2001)	-	153

**Table 1:** Increase of species numbers of mosses and hepatics recorded from the Azores over the last 140 years.

Barros 1942), which they had collected in 1937 and 1938 on Terceira during fieldtrips of the Botanical Institute of Lisbon. They indicated six species a new to Terceira and seven species as new to the Azores. The records are in part doubtful, for example the record of *Campylopus atrovirens*, which could later never be confirmed. A second intensive phase of the exploration of the bryoflora of the Azores started in the Eighties of the last century. Twenty years ago, Crundwell et al. (1994) stated that “nearly all the published work on the bryophytes of the Azores has been done by non-residents.” Carreiro and Machado were amongst the first collecting bryophytes on the Azores (during a North American project), however, there were only 2 publications by Portuguese bryologists before 1976 and 5 publications before 1994, but this has substantially changed since. Meanwhile the number of bryologically active botanists is relatively high as compared with the low number of inhabitants or the size of the islands. From **1994 on**, Portuguese bryologists such as Fontinha, Gabriel, Sergio, Dias, Sim Sim and other added many species in many small publications to the knowledge of the Azores.

During the past 25 years, the increasing tourism enhanced the knowledge of the bryoflora of the Azores: Crundwell, Greven and Stern (1994) listed 21 species as new to the Azores as well as numerous new records for the single islands (for example, each 50 species as new to Terceira and Santa Marta). Sjögren visited the Azores several times and contributed much to the knowledge of the bryophyte flora and vegetation, unfortunately in not easily accessible journals or as reports. He made intensive studies,

apparently with the aim to fill gaps on undercollected islands. So he raised the number of species known from Graciosa from 17 to 107 (Sjögren 1990) and the species known from Corvo from 29 to 134 (Sjögren 1993). Reason is apparently that the exploration of the islands depended on an easy access. Sao Miguel was the first island having a large airport, was therefore more frequently visited and better investigated for a long time. And whereas travels from one island to the other were only possibly by ship, most islands have now airports and Terceira is even directly connected from Lisbon. Sjögren’s studies cumulated in a checklist of all bryophytes from the Azores (Sjögren 2001).

The latest development for the time being is represented by critical evaluations of previous records and so called endemics. Schumacker (2001) enumerates all 153 hepatics known from the Azores and list 28 erroneously recorded or dubious species. The number of endemic hepatic species is reduced to 5, of which three are probably conspecific with tropical ones.

The number of mosses raised from 47 in 1870 to 284 in 2001. At the end of the 19. century, only 27% of the presently known species were recorded. After 100 years from the 150 year period, in which mosses were collected on the Azorean islands, 82% of the species were known (table 1). The situation of the hepatics was much different. At the end of the 19. century, also about a quarter of the present hepatic flora was known. The next collectors (Druce, 1911) and Armitage (1931) made only few additions. The next contribution to the hepatic flora was published 40 years later by Richards (1937), who added

11 species to the Azorean flora. A main problem was that the collections were made by non-bryologists. Persson and Allorge were therefore the first bryologists, who collected hepatics in 1937. In total, no more than 60 species of hepatics were known from the Azores before 1938. Allorge & Persson (1938) added 41 species and raised the total number of species to more than 100. Finally, the number of species reached its maximum in 1952, and although many new species were found afterwards, the total number of species never increased due to revisionary work.

But the bryological exploration of the Azores is still not finished, as shown by the additions given by the author in this volume.

#### Acknowledgements

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