

DIATOM COLLECTION IN THE HERBARIUM OF THE HUNGARIAN NATURAL HISTORY MUSEUM

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Abstract: The diatom collection is housed in the Department of Botany of the Hungarian Natural History Museum in Budapest and is considered one of the most important diatom collections worldwide. It is rich in type material and specimens of historical and scientific significance. The collection comprises approximately 30,000 items, including microscope slides, vials with wet raw samples, fossil material (diatomite), SEM stubs, and various forms of associated documentation, such as drawings and light- and electron-microscope images. Here we shortly present the Pantocsek's collection, which forms the foundation of the diatom holdings, together with the collections of Judit Padisák and László Vida, both of which were revised in 2024–2025. We provide a detailed overview of the slides prepared by Judit Padisák, on the occasion of her 70th birthday in 2025, celebrating her outstanding achievements as a renowned limno-ecologist. Notably, *Frustulia creuzburgensis* (Krasske) Hustedt represents a new record for the Hungarian diatom flora from her collection, published herein.

Key words: collection, diatoms, historic data, József Pantocsek, Judit Padisák, László Vida

INTRODUCTION

The Collection of Algae is housed in the Department of Botany of the Hungarian Natural History Museum in the Hungarian National Museum Public Collections Centre in Budapest (Index Herbariorum code BP) is considered as an important and old collection worldwide. The collection (as well as the “algae” themselves) is heterogeneous, consisting of several subunits, including herbarium sheets, vials, microscopy preparations, and materials prepared for scanning electron microscopy. The Collection of Algae is international in scope and contains marine, freshwater, and terrestrial algae as well as cyanobacteria.

The structure of the Collection of Algae comprises three main parts: (1) the herbarium section, which includes dried materials and capsules. The inventory list of this collection part is available upon request, since it is continuously

being revised and updated; (2) the collection of liquid samples, which contains preserved water samples; and (3) the diatom collection.

The most widely used and scientifically important part is the diatom collection, which has remained a focus of international interest (BUCZKÓ 2012). The significance of diatom collections worldwide is well demonstrated, and numerous recent studies address their importance (ALERS-GARCÍA *et al.* 2021, B-BÉRES *et al.* 2023). Diatoms are among the most abundant aquatic organisms. Diatom collections are fundamental resources for studies in taxonomy, phylogeny, ecology, biogeography, applied biology, monitoring, and conservation. They provide essential material for examining morphological variation, reconstructing phylogenetic relationships, and understanding the distribution and ecology of diatom species. Containing both fossil and recent specimens from freshwater, brackish, and marine habitats, these collections form an irreplaceable archive of diatom diversity (LJUBEŠIĆ *et al.* 2025).

The aim of this paper is to summarise the recent activities related to the diatom collection of the Hungarian Natural History Museum and to draw the attention of experts working in different parts of the world to this valuable resource. Museums are the institutions of preservation, conservation, and long-term safeguarding. An explicit goal is to convince colleagues that the diatom material (slides, samples, catalogues) is best preserved and most usefully applied here, where both current and future phycologists may access and utilise it.

Although diatoms are among the most suitable organisms for preparing long-lasting collections, the Department of Botany had no expert for this group for a long period of time, and the possible loss of old slides also was an additional difficulty. However, the former curators, distinguished by their outstanding expertise, achieved significant success in various fields of algological research. The following is a list of the curators associated with the collection of algae (Table 1).

MATERIAL AND METHODS

The most important parts of the collection are well organised and have already been revised, but a comprehensive revision of the diatom collection is currently underway. In 2009, we began assigning continuous catalogue numbers.

ENUMERATION

The Diatom Collection is an extensively documented main part of the Collection of Algae. The foundation of the diatom collection, the Pantocsek Collection, was completed in the 1980s (KRENNER 1981).

Table 1. The staff of the Collection of Algae (including diatom collection) in the Department of Botany.

Curator	Tenure as curator (period of service)	Personal data (year of birth)	Some specialities
Gyula Csíkmádéfalvi Istvánffi (before 1886 Gyula Schaarsmith)	1889–1898	1860–1930	algal flora of Lake Balaton
Nándor Filarszky	1899–1929	1858–1941	charophyta
Márta Halász	1938–1963	1905–1971	mires, bogs, algae of river Danube
Gábor Szemes	1947–1951	1907–1993	diatoms
Erzsébet Kol	1948–1969	1897–1980	soft algae, snow and ice algae
Zsuzsanna Páricsy-Komáromy	1967–1985	1942–1985	soil algae
Lajos Hajdu	1971–1982	1946–	numeric analysis
Judit Padisák	1982–1993	1955–	limnoecology, chrysophytes
Éva Ács	1987–1995	1964–	diatoms
Krisztina Buczkó	1985–	1962–	diatoms
Luca Viktória Kardos	2025–	2003–	

BP-HNHM-ALG-D-0001 and BP-HNHM-ALG-D-1049

The first and well-known part of the diatom collection is Pantocsek's herbarium containing 1049 slides.

József Pantocsek (1846–1916) was a physician and medical director who, in addition to his primary profession, developed a strong interest in plant science, becoming a prominent botanist. He devoted much of his remaining time to the study of diatoms. Pantocsek described more than 1,300 new diatom taxa and amassed a rich diatom collection, which was purchased by the Department of Botany of the Hungarian Natural History Museum after his death in 1917. Unfortunately, the collection suffered heavy losses during the Second World War, when many of the specimens were either completely destroyed or severely damaged. Despite this, the surviving portion – now only about one-fifth of the original size – remains of international scientific interest. The remnants of the collection were restored by József Krenner (KRENNER 1981). In addition to cleaning and restoring the material, Krenner identified the diatoms on the slides and provided detailed descriptions of the preparations. Thanks to his dedicated work, the surviving Pantocsek's collection retains its deserved scientific prominence.

Fortunately, associated cleaned samples are also available from 78 localities, which can be used for scanning electron microscopy. This part of the diatom col-

lection has a special designation: BP-HNHM-ALG-DC, where “DC” refers to the Diatom Cleaned material. Recently, several new slides have been prepared from Pantocsek’s cleaned material, which are being used for typification and the emended description of taxa (KOCIOLEK *et al.* 2025a, b).

BP-HNHM-ALG-D-1058 and BP-HNHM-ALG-D-1286

In chronological order, the next part of the collection consists of slides that can be connected to the scientific activity of Judit Padisák in the Botanical Department. Between 1982 and 1993, she served as the curator of the Collection of Algae. In total, we reviewed 229 of her slides, representing 120 taxa. She followed Pantocsek’s noteworthy method for marking a taxon of interest. A small metal ring was attached to the slide around the specified taxon, making it easy to locate. As shown in Figure 1, this was a highly distinctive technique. The water samples from which the slides were prepared were collected primarily by other researchers. Most of them were obtained by György Dévai, who contributed 105 samples to the collection. 44 slides were prepared from samples collected by Zsuzsanna Páricsyné-Komáromy (BUCZKÓ 1986, SZUJKÓ-LACZA 1986). Mycologists János



Fig. 1. Diatom slides identified by Judit Padisák during her curatorial work at the Hungarian Natural History Museum (1982).

Gönczöl and Ágnes Révay (MAGYAR and LŐKÖS 2021) provided 35 samples to Judit Padisák, while László Forró (ZSUGA and KORPONAI 2023) contributed 22 samples. Júlia Szujkóné Lacza, former head of the Botanical Department, is listed as the collector of 14 samples. László Tóth collected 6 samples, whereas only two specimens can be regarded as Judit Padisák's own collections (one from Lake Mondsee and another from tap water in Szolnok).

The collectors covered a wide range of localities and habitats. Lake Balaton (particularly Keszthely Bay), sodic pans (Hattyúszék, Szívósszék, Lake Kondor, Lake Kerek), karstic areas of the Bükk Mountains (Bükk National Park; Jávorkút, Bolhási sinkhole, Csipkés-kút sinkhole, Garadna stream, Szinva brook), and Lake Kolon in Kiskunság National Park were sampled repeatedly between 1979 and 1982. As a result, these sites are especially well represented in the collection.

The taxonomic composition is dominated by the widespread freshwater taxa of Hungary. Among these, *Gyrosigma wansbeckii* (Donkin) Cleve 1894 deserves mention: although not a rare species (GUIRY and GUIRY 2025), records from Hungary are scarce (SZABADOS 1952, 1957, SZEMES 1959). Judit Padisák observed it at Kerek Clearing. Another notable find is *Frustulia creuzburgensis* (Krasske) Hustedt 1957 (formerly *Navicula creuzburgensis* Krasske 1927), which appears to represent a new record for the Hungarian diatom flora (BP 1131).

BP-HNHM-ALG-D-1287 and BP-HNHM-ALG-D-2196

The next important contributor to the diatom collection was László Vida, whose slides are listed between numbers 1287 and 2196, adding 909 items to the core of the collection. Although Vida worked as an engineer, botany – first plants in general and later diatoms – remained at the centre of his interests throughout his life. He had a strong enthusiasm for diatoms, and his contributions to species identification were remarkable, ultimately proving of greater importance than his slide collection itself. After his death, his slides were donated to the Museum by his brother, Gábor Vida, the renowned botanist and geneticist, and member of the Hungarian Academy of Sciences (Web1).

The significance of this contribution is closely tied to the 'Bakony Research' project, within the framework of which (1971–1979) L. Vida conducted intensive studies of diatom assemblages (BAUER and KENYERES 2004). He received 350 samples from Erzsébet Kol, the eminent algologist of the Botanical Department, who investigated the soft algae but left the diatoms unstudied (KOL 1968a, b). Vida filled this gap by systematically working on the diatoms. A detailed – though largely unpublished – list was handed over to the Bakony Museum and was later incorporated into the Hungarian Natural History Museum as part of his legacy. Another part of Vida's diatom collection originated from various locali-

ties across Hungary. A detailed taxonomic enumeration of this material – excluding the ‘Bakony Research’ project – was published by Krisztina Buczkó (1989).

From BP-HNHM-ALG-D-2197

The remainder of the diatom collection is currently under revision, which includes discarding unsuitable slides. Many of the samples and slides originated from the Szigetköz section of the Danube, Aggtelek National Park, mountain lakes, ponds, and mires of Romania. Since 2003, several core samples have been deposited in the collection; these were drilled for palaeoecological reconstruction purposes. The estimated number of diatom slides prepared between 1985 and 2025 is around 2,000, while the number of core samples is about 2,200.

In 2024 and 2025, the Collection of Algae of the Hungarian Natural History Museum received a substantial number of diatom samples from the Pest County Government Agency. Nearly 2,000 slides were transferred, the majority of which have already undergone revision. The diatom samples are in excellent condition,

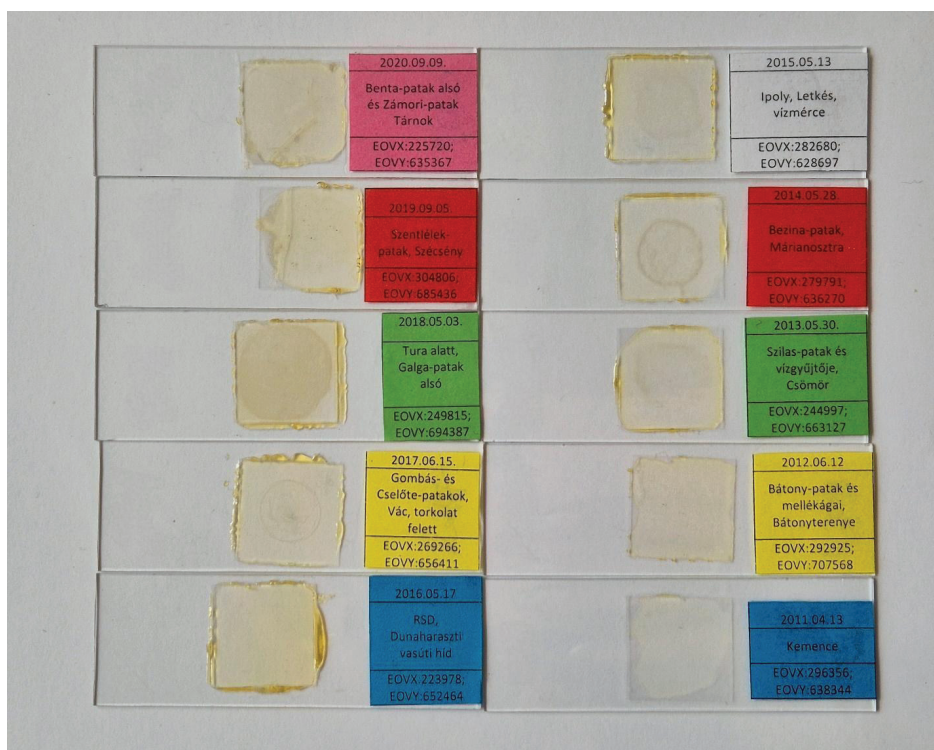


Fig. 2. Diatom slides received from the Pest County Government Agency, representing material under revision from 10 different years.

carefully organized, and accompanied by precise collection data (e.g., date, coordinates, etc.). The annual water quality surveys conducted by the Pest County Government Agency were implemented within the framework of the Water Framework Directive (WFD) (EUROPEAN COMMUNITY, 2000) program. For this purpose, regular sampling was carried out at designated sites with precisely defined coordinates. The collected samples were prepared as microscope slides and evaluated by the Agency; however, their transfer to the Hungarian Natural History Museum has provided an exceptional opportunity for further research. In addition to the slides, the associated cleaned samples were also made available, which can be used for scanning electron microscopy. The wealth of information potentially derived from these materials, along with the broad research opportunities they offer, is of great scientific importance. Because the sampling was carried out annually at fixed locations, these materials provide a unique opportunity to study the temporal dynamics of diatom communities in Hungarian waters. Such long-term datasets are invaluable for detecting ecological changes, including the appearance of invasive species or the decline of native taxa, thereby contributing to biodiversity monitoring and conservation efforts. Altogether, the collection comprises 16 years' worth of samples from 2008 to 2024, derived from 190 sites across the country, covering 112 water bodies, and corresponding to an average of 112 slides per year.

DISCUSSION

The importance of diatom collections is becoming increasingly evident, and accordingly, they are continuously expanding both worldwide and in our region (B-BÉRES *et al.* 2023, DE WOLF and STERRENBURG 1991, LJUBEŠIĆ *et al.* 2025, WEB2).

The Collection of Algae housed in the Hungarian Natural History Museum can be regarded as consisting of three principal parts: the herbarium section (with dried materials and capsules), the collection of liquid samples (preserved water samples), and the diatom collection. The slides deposited in the diatom collection are owned by collection numbers; the first 2300 slides were given to the Pantocsek, Vida and Padisák collections. József Pantocsek's collection starts from number 1 and ends with 1049. Numbers up to 1057 had been allocated upon request primarily for type material. Samples numbered 1058 to 1286 belong to Judit Padisák's collection, followed by László Vida's collection from 1287 to 2196. These constitute the core of the diatom collection, which continues to grow in number as new material is added, and taxonomic revisions take place. The continuous numbering makes the collection size clear-cut and easily reviewable, therefore this practice will be retained. The slides, deposited after 1985 have re-

cently been marked by collecting numbers that refer to the collecting year. Even though this overview has drawn attention to some key parts of the collection, it is important to note that the Collection of Algae holds substantial significance of scientific value.

At the Hungarian Natural History Museum, we carry the responsibility of preserving knowledge of the past, protecting it for future research, and sharing it as a legacy with the generations to come. We also gladly welcome new collections, which become part of our shared heritage and enduring memory.

CONTRIBUTION OF JUDIT PADISÁK TO THE DEVELOPMENT OF COLLECTION

Judit Padisák is a highly recognized limnoecologist whose outstanding scientific achievements have been acknowledged with numerous national and international awards. Throughout her career, she has approached the study of phytoplankton with a unique perspective, applying ecological theories originally developed for terrestrial systems to aquatic microbial communities. This innovative framework has allowed her to reveal fundamental patterns in phytoplankton succession and diversity, significantly advancing our understanding of freshwater ecosystems. Beyond her scientific achievements, she has played an important role as a collection developer and provider of fundamental baseline data.

In 2025, as she celebrates her 70th birthday, we pay tribute to Judit Padisák's remarkable scientific career and her lasting contributions to limnology.

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Acknowledgements – The development of the Algae Collection has involved, in addition to researchers, the contribution of numerous colleagues, preparators, assistants, and external collaborators. We would especially like to acknowledge the work of Erika (Mrs Frigyesné Lehoczy), Emike (Dr Jánosné Ackermann), Valika (Valéria Pálházi) and Zsóka (Erzsébet György) who worked as preparators at Department of Botany.

Összefoglaló: A Magyar Természettudományi Múzeum Növénytárának Algagyűjteményén belül a kovaalga-gyűjtemény a legfontosabb és leggyakrabban használt egység, amely jelenleg mintegy 30 000 tételt foglal magában. A gyűjtemény alapját a világszerte ismert Pantocsek-gyűjtemény adja, amely a második világháborús pusztítások ellenére is kiemelt nemzetközi tudományos jelentőséggel bír. Ehhez járulnak hozzá Padisák Judit és Vida László gyűjteményei. Ez a három gyűjteményrész 2300-ig folyamatos sorszámmal ellátott, az 1980-as évektől bekerült minták évenkénti újrainduló számokon vannak nyilvántartva. A revízió során számos új vagy ritka előfordulás került megerősítésre, köztük a *Frustulia creuzburgensis*, amely Padisák Judit gyűjteményéből származik, és elsőként dokumentált előfordulást jelent a magyar kovaalga-flórában. A tanulmány célja, hogy bemutassa a gyűjtemény történeti alapjait és újabb gyarapodásait, valamint felhívja a figyelmet annak kutatási potenciáljára. A kovaalga-gyűjtemény kiemelkedő forrás a taxonómiai, ökoló-

giai, filogenetikai és biogeográfiai vizsgálatokhoz, s hozzájárul a hazai vizek biodiverzitásának nyomon követéséhez, az inváziós fajok azonosításához és az eltűnőben lévő taxonok dokumentálásához. Írásunkat a 70. születésnapját ünneplő Padisák Judit akadémikusnak ajánljuk, aki kiemelkedő szerepet játszott a gyűjtemény fejlesztésében és a limnóökológiai kutatások nemzetközi szintű előmozdításában.

REFERENCES

- ALERS-GARCÍA, J., LEE, S. S. and SPAULDING, S. A. (2021). Resources and practices to improve diatom data quality. – *Limnol. Oceanogr. Bull.* **30**(2): 48–53. <https://doi.org/10.1002/lob.10433>
- BAUER, N. and KENYERES Z. (eds) (2002): *40 éves a Bakony Természeti Képe program – Tények, képek, emlékek.* – Bakonyi Természettudományi Múzeum, Zirc, 215 pp.
- B-BÉRES, V., STENGER-KOVÁCS, Cs., BUCZKÓ, K., PADISÁK, J., SELMECZY, G. B., LENGYEL, E. and TAPOLCZAI, K. (2022): Ecosystem services provided by freshwater and marine diatoms. – *Hydrobiologia* **850**: 2707–2733. <https://doi.org/10.1007/s10750-022-04984-9>
- BUCZKÓ, K. (1989): The diatom collection of László Vida. – *Studia bot. hung.* **20**: 77–94.
- BUCZKÓ, K. (2012): The Pantocsek diatom and photomicrograph collection from 19th to the 21st century. – *Beih. Nova Hedwigia* **141**: 535–546.
- BUCZKÓ, K. (1986): In memoriam Dr. Zsuzsanna P.-Komáromy (1942–1985). – *Annls hist.-nat. Mus. natn. Hung.* **78**: 11–14.
- DE WOLF, H. and STERRENBURG, F. A. S. (1991): International survey of diatom collections. – *Diatom Res.* **6**: 205–206. <https://doi.org/10.1080/0269249x.1991.9705161>
- EUROPEAN COMMUNITY (2000): Directive 2000/60/EC of the European Parliament and of the Council of 23 October 2000 establishing a framework for Community action in the field of water policy. Official Journal of the European Communities L327, 1–72. <https://doi.org/10.1017/cbo9780511610851.056>
- GUIRY, M. D. and GUIRY, G. M. (2025): *AlgaeBase* [Internet]. – World-wide electronic publication, National University of Ireland, Galway. [cited 2025 Sept 08]. Available from: www.algaebase.org https://www.algaebase.org/search/species/detail/?species_id=33642
- KOCIOLEK, J. P., BUCZKÓ, K., GREENWOOD, M., HAMSHER, S. E., MILLER, S. R. and LI, J. (2025a): Observations and typification of diatoms of the order Rhopalodiales (Bacillariophyta) in the Josef Pantocsek Collection, Hungarian Natural History Museum. I. Epithemia species from Élesd. – *Diatom Res.* (accepted). <https://doi.org/10.1080/0269249x.2025.2480138>
- KOCIOLEK, J. P., BUCZKÓ, K., GREENWOOD, M., HAMSHER, S. E., MILLER, S. R. and LI, J. (2025b): Observations and typification of diatoms of the order Rhopalodiales (Bacillariophyta) in the Josef Pantocsek Collection, Hungarian Natural History Museum. II. Epithemia species from Kerch: significant morphological variation across taxa referred to the genus Rhopalodia and the description of a new genus. – *Diatom Res.* (accepted).
- KOL, E. (1968a): Algológiai és hidrobiológiai forrásvizsgálatok az Északi-Bakonyban – *A Veszprém Megy. Múz. Közlem.* **7**: 131–146.
- KOL, E. (1968b): A Szigligeti Arborétum algái. – *A Veszprém Megy. Múz.k Közlem.* **7**: 221–228.
- KRENNER, J. A. (1981): The post-war remains of the diatom collection of dr. József Pantocsek. – *Studia bot. hung.* **14**: 9–28.
- LJUBEŠIĆ, Z., JURINA, D., PAVLOVIĆ, T., ŽIVOLIĆ, M., LEVKOV, Z., MUCKO, M., BOSAK, S. and GLIGORA UDOVIĆ, M. (2025): The Croatian National Diatom Collection – an overview and future challenges. – *Acta Bot. Croat.* (accepted). <https://doi.org/10.37427/botcro-2025-025>
- MAGYAR, D. and LÖKKÖS, L. (2021): In memoriam Dr Ágnes Révay (1952–2018). – *Studia bot. hung.* **52**: 5–16. <https://doi.org/10.17110/StudBot.2021.52.1.5>

- SCHUSTER, T. M., WILLIAMS, D. M. and VAN DE VIJVER B. (2023): The diatom collection of Albert Grunow (1826–1914) at the herbarium of the Natural History Museum Vienna (W). – *Ann. Naturhist. Mus. Wien, Ser. B, Bot. Zool.* **124**: 331–362.
- SZABADOS, M. (1952): A diósjenői Szőlőhegyaljai-patak algái. (Die Algen des Szőlőhegyaljai-Baches bei Diósjenő). – *Ann. bot. univ. hung.* **1**: 413–418.
- SZABADOS, M. (1957): Das Leben der Tisza II. Beiträge zur Kenntnis der Algen der oberen Tisza. – *Acta Biol. (Szeged), nov. ser.* **3**: 189–206.
- SZEMES, G. (1959): Die horizontale und vertikale Verbreitung der Bacillariophyceen im offenen Wasser des Szelider Sees. Systematische und floristisch-ökologische Bearbeitung von Bacillariophyceen des Szelider-Sees. — In: DONÁSZY, E. (ed.): Das Leben des Szelider Sees. Die Binnengewässer Ungarns I. Limnologische Studien an einem natriumkarbonathaltigen See des ungarischen Alföld. Akadémiai Kiadó, Budapest.
- SZUJKÓ-LACZA, J. (1986): In memoriam Zsuzsanna Páricsy-Komáromy (1942–1985). – *Studia bot. hung.* **19**: 5–6.
- VIDA, L. (1974): A Gaja-patak bakonyánai szurdokának kovamoszattársulásai. (The diatom communities of ravine of Gaja brook near Bakonyána). – *Bot. Közlem.* **61**: 157–167.
- ZSUGA, K. and KORPONAI, J., (2023): Egy kiváló muzeológus, limnológus emlékére Dr. Forró László (1954–2023). (In memory of an excellent museologist and limnologist, Dr. László Forró (1954–2023)) – *Állatt. Közlem.* **109**: 99–107.
<https://doi.org/10.20331/AllKoz.2024.109.1-2.2>
- WEB1: [https://hu.wikipedia.org/wiki/Vida_G%C3%A1bor_\(biol%C3%B3gus\)](https://hu.wikipedia.org/wiki/Vida_G%C3%A1bor_(biol%C3%B3gus)).
- WEB2: *Diatom collection* - AWI

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