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Cunninghamites ubaghsii (Taxodiaceae?) from the Maastrichtian type area (Late Cretaceous, SE Netherlands) rediscovered

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Abstract

The original material of the Late Cretaceous conifer *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS from the Maastrichtian type area has recently been traced in the collections of the Institut royal des Sciences naturelles de Belgique in Brussels. Together with another, recently collected specimen it provides sufficient data to emend the very brief original description of the species. *Cunninghamites ubaghsii* is remarkable in having very long leaves and conspicuous leaf base cushions. On account of its resemblance to such species as *C. lignitum* (STERNBERG) KVAČEK and *C. oxycedrus* PRESL, it too might belong to the Taxodiaceae.

Keywords: *Cunninghamites*, conifers, Maastrichtian, The Netherlands.

Résumé

Le matériel original du conifère du Crétacé supérieur *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS, issu de la région type du Maastrichtien, a été retrouvé dans les collections de l'Institut royal des Sciences naturelles de Belgique à Bruxelles. Par comparaison avec un second spécimen récemment découvert, il a fourni des informations suffisantes pour améliorer la description originale très pauvre de l'espèce. *Cunninghamites ubaghsii* est une espèce remarquable par ses feuilles très longues et par les coussinets de bases foliaires bien apparents. Etant donné sa ressemblance avec *C. lignitum* (STERNBERG) KVAČEK and *C. oxycedrus* PRESL, cette espèce pourrait appartenir à la famille des Taxodiaceae aussi.

Mots-clefs: *Cunninghamites*, conifères, Maastrichtien, Pays-Bas.

Introduction

The Maastrichtian biocalcarenites in the extended type area of that stage (SE Netherlands, NE Belgium and adjacent parts of Germany; Text-figs. 1, 2) yield relatively few plant macrofossils, in comparison to the rich Santonian deposits of the sandy/clayey Aken Formation in the same area (GÖPPERT, 1842; DEBEY, 1848; DEBEY & VON ETTINGSHAUSEN, 1859a, b; UBAGHS, 1885b, 1887a; LANGE, 1890; STOCKMANS, 1946; KNOBLOCH & MAI, 1986; MEIJER, 2000; KUNZMANN *et al.*, 2003). In 1853, MIQUEL described a few Maastrichtian seed plants, including two conifers, namely: *Cycadopsis cryptomerioides* and *Pinites patens*. To date, eight conifer species are known from the Maastrichtian type area (VAN DER HAM *et al.* 2001, 2003; VAN DER HAM & VAN KONIJNENBURG-VAN CITTERT, 2003, 2004), as follows:

1. *Brachyphyllum patens* (MIQUEL) VAN DER HAM & VAN KONIJNENBURG-VAN CITTERT	Maastrichtian
2. *Brachyphyllum* sp. 1	Maastrichtian
3. *Brachyphyllum* sp. 2	Maastrichtian
4. *Cryptomeriopsis eluvialis* VAN DER HAM	Maastrichtian
5. *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS	Maastrichtian
6. *Elatidopsis cryptomerioides* (MIQUEL) VAN DER HAM	Maastrichtian
7. *Pagiophyllum* sp.	Campanian
8. *Pityophyllum* sp.	Maastrichtian

Cunninghamites ubaghsii was mentioned for the first time by UBAGHS (1885a, p. 28) in a catalogue of his collections as a new species distinguished by Debey:

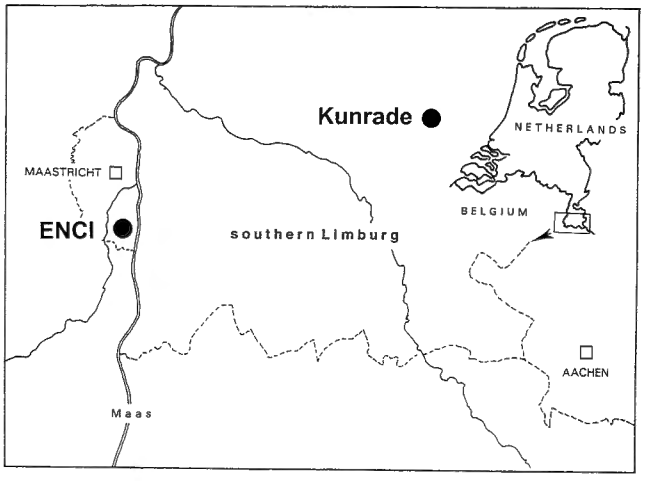

Fig. 1 — Map of the extended Maastrichtian type area, showing the localities (ENCI quarry and Kunrade) where *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS was collected.

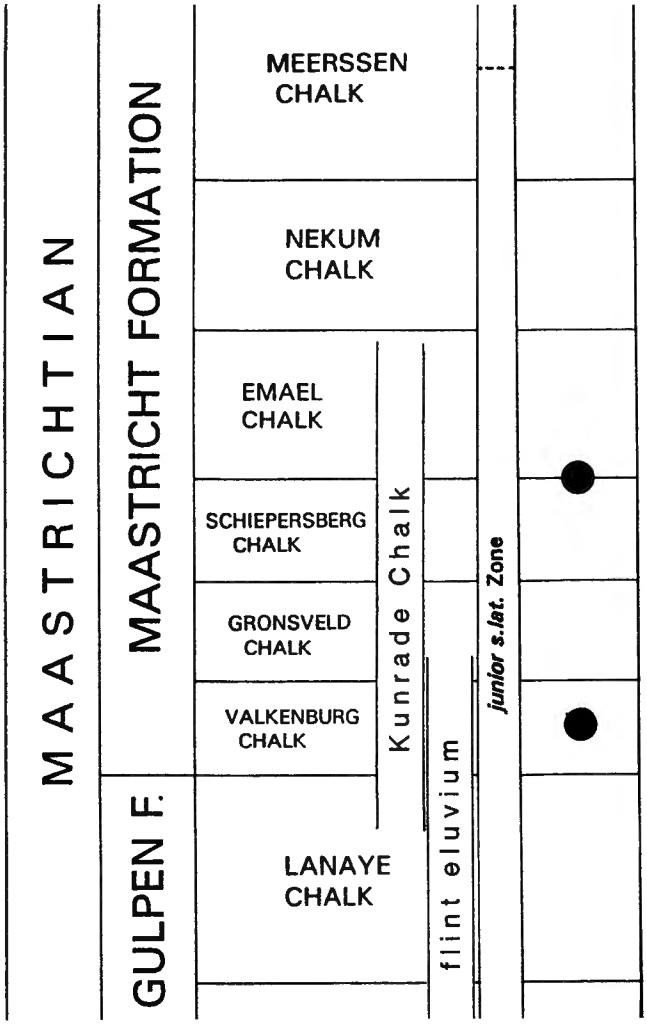

Fig. 2 — Stratigraphy of the uppermost Cretaceous deposits in the extended Maastrichtian type area, showing the approximate origins of the material of *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS. See JAGT (1999) for further stratigraphical details.

"2 exempl. Cuninghamites (*sic*) Ubaghsi nov. sp. De Bey, dernier ouvrage du feu le D^{r} Debeq (*sic*). Il m'écrivait quelques semaines avant sa mort: je viens de terminer le dessin et la description de l'échantillon que vous m'avez prêté; ce cuninghamites, qui est une nouvelle espèce que je vous ai dédiée, est le plus beau et plus grand exemplaire qu'on ait jamais trouvé. Les deux exemplaires ont une longueur de 0,30 m. sur 0,10 m. de larg. de maestrichtien inf. Kunraed". Unfortunately, Debey's manuscript and plates have never been published. Probably, they were sold after his death (19 March 1884) together with the main part of his collection (UBAGHS, 1885b), but now seem to be lost. Ubaghs's narrative, though very brief, should be considered the formal description of *Cunninghamites ubaghsii*. The material has not been considered subsequently and after Ubaghs died (4 February 1894), it appears to have escaped attention in the palaeobotanical world.

Fig. 3 — *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS. Holotype specimen IRSNB-Palaeobot. b 4318 (Ubaghs 310; Kunrade, Kunrade Chalk). Bar = 2 cm.

In 1994, one of us (EAPMN) collected an impression of a magnificent long-leaved conifer branch at the ENCI quarry, south of Maastricht. After several years of trying to identify this specimen, it became apparent that it might represent the same species as the material described by UBAGHS (1885a). Assisted by Dr. F. Damblon and

Fig. 4 — *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS. Specimen NHMM EN 8e (ENCI quarry, Valkenburg Member). Bar = 5 cm.

Dr. A.V. Dhondt we succeeded in tracing Ubaghs's specimens at the Institut royal des Sciences naturelles de Belgique in Brussels. The two impressions turned out to be part and counterpart and looked, closely similar to the ENCI material. Here we (re)describe *Cunninghamites ubaghsii*, thus adding another remarkable element to the conifer flora of the Maastrichtian type area. This paper is part of an ongoing study of fossil plants from the Maastrichtian type area which will be incorporated in a field guide, now in preparation (DONOVAN & JAGT, in prep.).

Material, localities and stratigraphy

The material of *Cunninghamites ubaghsii* mentioned by UBAGHS (1885a, 1887a, b, 1888) comprises two impressions (part and counterpart; the latter broken) of an unbranched leafy shoot in soft limestone in the Institut royal des Sciences naturelles de Belgique in Brussels (Text-fig. 3). It was collected in a quarry near Kunrade, a few kilometres SW of Heerlen (SE Netherlands; Text-fig. 1). The strata exposed there belong to the Kunrade Chalk (Text-fig. 2), which is the easterly (more coastal) facies of portions of the upper Gulpen and lower Maastricht formations (Late Maastrichtian, *Belemnitella junior* Zone; JAGT, 1999).

The new material of *C. ubaghsii* is a single impression (counterpart not found) in soft limestone in the Natuurhistorisch Museum in Maastricht (Text-figs. 4-6). It originates from the Valkenburg Member, a 2-3 m thick unit at the base of the Maastricht Formation, at the ENCI quarry south of Maastricht (SE Netherlands). Probably, the Valkenburg Member is contemporaneous with part of the Kunrade Chalk. A fragment of a detached leaf (38 x 3 mm, probably single-veined) in the private collection of Paul Hille from the base of the Maastricht Formation at the ENCI quarry might belong to *C. ubaghsii* as well.

Description

Axis fragments unbranched, 17 cm (Kunrade specimen, Text-fig. 3) and 18 cm (ENCI specimen, Text-fig. 4) long, 10-12 mm wide. *Leaves* spirally arranged, decurrent. *Parastichy numbers* (calculated from the ENCI specimen) probably 3 and 8 (clockwise) and 5 (counterclockwise), according to the formula given by WATSON *et al.* (1987). *Leaf base cushions* (Text-figs. 5, 6) conspicuous, obovoid-rhomboidal, 5-7 by 4-6 mm. *Free leaf portions* spreading under an angle of c. 45° in all directions, dorsiventrally flattened, linear, up to at least 12 cm long (apices not observed) and 4-5 mm wide (– 7 mm in a few leaves in Kunrade specimen), at the base faintly constricted or not at all. *Margin* entire (matrix too coarse for observing possibly occurring small teeth). *Blade* with a faint abaxial median keel (vein?), which becomes more prominent near the cushion; on the cushion, this keel is decurrent and prominent except for a small part (c. 1 mm) halfway. *Cuticular features* not preserved.

Affinities

DEBEY placed the new species in the genus *Cunninghamites* (UBAGHS, 1885a). The name *Cunninghamites* was given by PRESL (in STERNBERG *et al.*, 1838, p. 203) to leafy shoots resembling those of the extant genus *Cunninghamia* (''Ramuli foliaque illis Cunninghamiae sinensis quam maxime analogi''). However, HALLE (1913) considered such a name undesirable, pointing

Fig. 5 — *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS. Specimen NHMM EN 8e. Portion of twig, showing impressions of leaf base cushions, and some leaf bases; the dark line in the 'leaf' at the left is not a midrib, but the separation between two overlapping leaf fragments. Bar = 1 cm.

out that sterile conifer shoots should not be described under generic names which imply the possession of a certain type of cone. In order to accommodate sterile twigs that do not show characters which permit them to be included in one of the genera erected for forms with reproductive structures, he described the 'catch-all-genus' *Elatocladus*.

SEWARD (1919, p. 435) apparently agreed with HALLE, but still gave a fairly complete description of *Cunninghamites* leaves: ''The vegetative branches assigned by authors to *Cunninghamites* have linear-lanceolate leaves usually showing a distinct midrib and often other parallel lines on the lamina which are probably due to hypodermal fibres. The leaves may reach a length of 6 cm. and are 1-4 mm. broad; the edge is entire and finely serrate as in *Cunninghamia sinensis*. A characteristic feature is the occurrence of persistent decurrent leaf-bases on the branches ...''. SEWARD stated that none of the species assigned to *Cunninghamites* offers real evidence of affinity to *Cunninghamia*. Later, when reproductive structures of some species became known, it appeared that, except for showing taxodiaceous features, these species have indeed little in common with *Cunninghamia*. This, however, does not affect use of the name *Cunninghamites*.

HARRIS (1969, p. 249) presented a modified diagnosis of *Elatocladus*: ''Shoot bearing leaves spirally (rarely opposite). Leaf elongated, dorsiventrally flattened, diverging from the stem, at base strongly contracted and forming a short petiole attaching it to the basal cushion. Lamina with a single vein''. He explicitly excluded the leaf form of *Cunninghamia*, in which the lamina joins the cushion with but little or no constriction. He added that ''if numerous shoots of this kind were found then *Cunninghamites* would be a possible form-genus for them''. Later, he noted that this definition of *Elatocladus* excluded the type species *Elatocladus heterophylla* HALLE, 1913, and provided the following emended diagnosis (HARRIS, 1979, p. 104): ''Fossil conifer shoot bearing elongated, dorsiventrally flattened leaves with a single vein. Leaves divergent from the stem''. According to the latter diagnosis, *Elatocladus* includes *Cunninghamia*-like leaves.

KVAČEK (1999, p. 132) provided an emended diagnosis of *Cunninghamites*: ''Conifer shoots bearing linear-lanceolate, dorsiventrally flattened leaves with 3 or 5 ribs, helically arranged, diverging from shoot, widest at its basal third. Leaf margin bearing minute irregularly spaced teeth; older branches showing conspicuous leaf base cushions ...''. He also added stomatal and reproductive characters, stating that *Cunninghamites* defined in this way is not a form-genus, but his emended diagnosis is based on *C. lignitum*, while it should be based on the type species of the genus. In the type species, *C. oxycedrus*, the female cones are not attached but associated (KUNZMANN, 2001), which means that, in principle, *Cunninghamites* is still available for leafy shoots such as *C. ubaghsii*. At least vegetatively, *C. lignitum* and *C. oxycedrus*, both from the Cenomanian of the Bohemian/German border area, are closely similar. Two characters of these species, also included in the generic diagnosis given by KVAČEK, cannot be demonstrated in *C. ubaghsii*: the minutely serrate leaf margins and the presence of 3 or 5 longitudinal ribs. This might be due to the coarseness of the sediment in which the leaf impressions are preserved, but also in *C. squamosus*, from the Santonian of western Germany, these features seem to be absent (KUNZMANN, 2001). Whether they are good generic characters thus remains to be determined. However, all species of *Cunninghamites* mentioned here have the conspicuous leaf base cushions in common (HEER, 1871; SCHIMPER & SCHENK, 1890; SEWARD, 1919; KVAČEK, 1999; KUNZMANN, 2001). This might be a better character to define the genus than the often problematical ribs on the surface

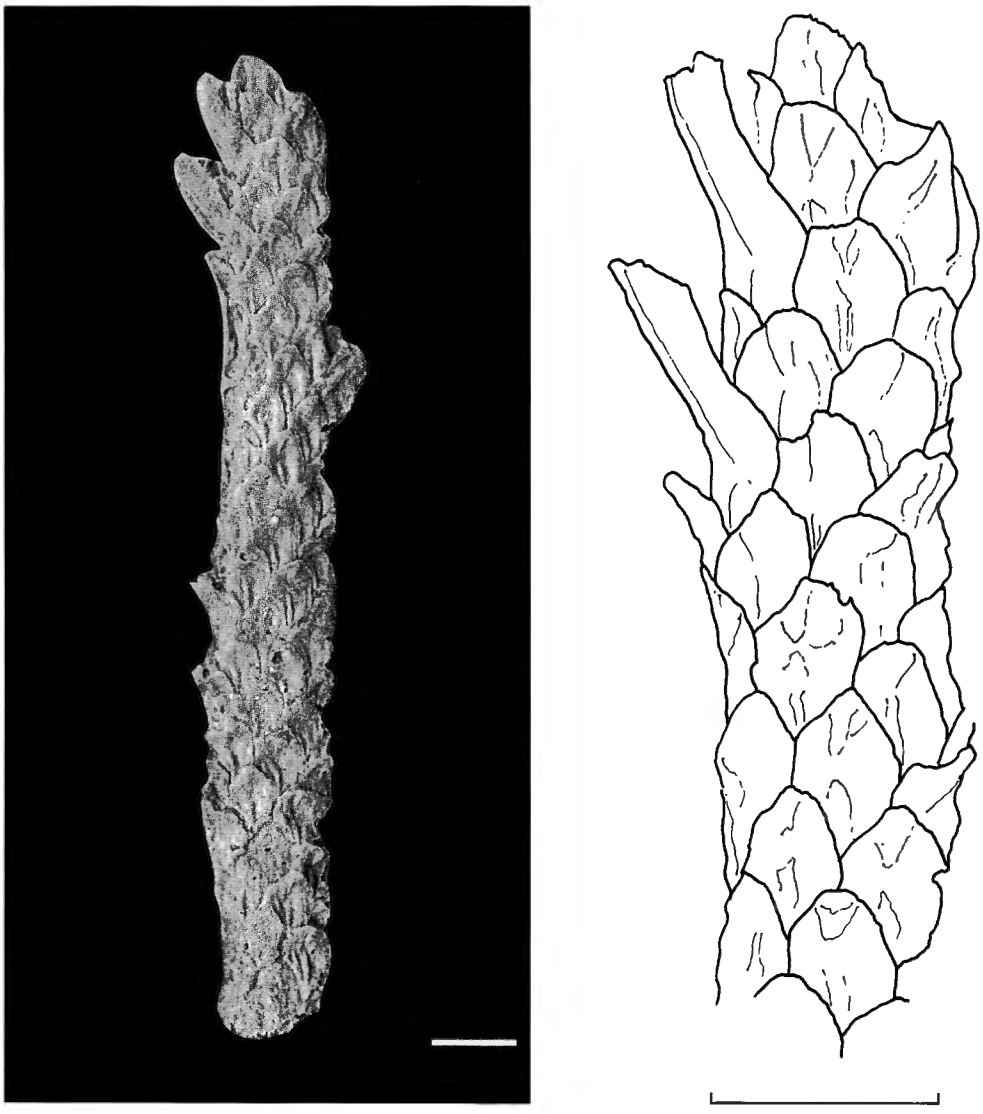

Fig. 6 — *Cunninghamites ubaghsii* DEBEY *ex* UBAGHS. Specimen NHMM EN 8e. Rubber cast (left) of a portion of the twig and camera-lucida drawing (right) of a portion of the rubber cast, showing spirally arranged leaf base cushions and, at the left of the twig, the bases of a few attached leaves. Bar = 1 cm.

and the minutely serrate margins. Clearly, in order to settle the '*Cunninghamites* case' more definitively, a monographic revision is necessary, which is beyond the scope of the present paper. Therefore, and in view of the conspicuous leaf base cushions, the present species is maintained in the genus *Cunninghamites* for the time being.

On account of its resemblance to species such as *Cunninghamites lignitum* (STERNBERG) KVAČEK and *C. oxycedrus* PRESL, *C. ubaghsii* might also belong to the Taxodiaceae.

Comparisons

Our search for species that, at least superficially, resemble *C. ubaghsii*, has only considered records from the Upper Cretaceous and has concentrated on two important features: distinct leaf base cushions and long, free leaf parts. Distinct leaf base cushions occur in *Cunninghamites squamosus* (HEER, 1871, pl. 2, figs. 5-7; SCHIMPER & SCHENK, 1890, fig. 195; LANGE, 1890, pl. 33, figs. 1-3), *Elatocladus elegans* (KRÄUSEL, 1922, p. 12; KRÄUSEL & JONGMANS, 1923, pl. 5, fig. 2) and *Geinitzia elegans* (STOCKMANS, 1946, pl. 2, figs. 10, 15), all from the Santonian of the extended Maastrichtian type area and possibly representing a single species (see also KVAČEK, 1999). However, their leaves are only 15-35 mm long. Similar are also *Cunninghamites lignitum* (see KVAČEK, 1999) and *C. oxycedrus* (see KUNZMANN, 2001) from the Cenomanian of Germany and Bohemia, with leaves up to 22 mm and 30 mm, respectively, *Elatocladus elegans* (HARTUNG, 1940, pl. 5, fig. 2) from the Turonian of Bulgaria, with leaves of 20 mm, *C. recurvatus* (HOSIUS

& VON DER MARCK, 1880) from the "Senonian" of Germany, with leaves of 30 mm, and *C. elegans* (CIEŚLIŃSKI & MILAKOVIĆ, 1962) from the Lower Maastrichtian of Poland, with leaves of 40 mm. SEWARD (1919) gave 6 cm as the maximum length of *Cunninghamites* leaves, but he did not mention a species name. Furthermore, a specimen of a stem referred to as *Cunninghamites elegans* (HOSIUS & VON DER MARCK, 1880, fig. 22), from the Campanian of Germany, is quite similar to the stems of our material. It has conspicuous leaf base cushions, each of which shows a midrib, but the leaves are unknown. Interesting is also *Belodendron* nom. nud. (DEBEY, 1848) from the Santonian of the extended Maastrichtian type area, which has "in ihren Blattpolstern ein ganz lepidodendronartiges Ansehen" (DEBEY, 1877, p. 110; see also GAIPL, 1996, fig. on p. 85, lower right-hand corner). The latter was also said of *Cunninghamites squamosus* from the Campanian of Germany (HEER, 1871, p. 10; HOSIUS & VON DER MARCK, 1880, fig. 20; leaves unknown) and *Elatocladus elegans* (HARTUNG, 1940), which clearly illustrates the prominence of the leaf base cushions in these plants.

So far, the only material to show distinct leaf base cushions as well as long attached leaves was described under the name of *Pinus quenstedti* Heer from the Lower Maastrichtian of Poland (KARCZMARZ & POPIEL, 1971, pl. 1, figs. 4, 5), with leaves of 9-14 cm long. It closely resembles a specimen in the Agterbos collection (no. 1001-01) from the Upper Maastrichtian of Poland, which, unfortunately, does not preserve branch fragments. The leaves described by KARCZMARZ & POPIEL (1971) are certainly not conspecific with the original material of *Pinus quenstedti* described by HEER (1871), which has its leaves in bundles (VELENOVSKÝ, 1885). Further, up to 8 cm (or more) long conifer leaves were described as *Pityophyllum* sp. by STOCKMANS (1946), NĚMEJC (1957), KNOBLOCH (1964) and NĚMEJC & KVAČEK (1975) from the Upper Cretaceous of Belgium and Bohemia, which, however, are all detached. All the *Pinus* and *Pityophyllum* leaves mentioned here are only 1-2 mm wide, i.e. much narrower than in *Cunninghamites ubaghsii* (4-7 mm). This justifies the retention of *C. ubaghsii* as a distinct species.

Taxonomy

Family: Taxodiaceae?

Genus: *Cunninghamites* PRESL, emend. J. KVAČEK, 1999

Species: ***Cunninghamites ubaghsii*** DEBEY *ex* UBAGHS, emend.
(Text-figs. 1-6)

1885a *Cuninghamites Ubaghsi* De Bey – UBAGHS, p. 28
1887a *Cuninghamites Ubaghsi* de Bey – UBAGHS, p. 4
1887b *Cuninghamites Ubaghsi* De Bey – UBAGHS, p. 233
1888 *Cunninghamites Ubaghsi* De Bey – UBAGHS, p. 245
2002 *Cunninghamites* sp. – VAN DER HAM *et al.*, p. 8
2002 *Cunninghamites ubaghsi* – VAN DER HAM *et al.*, p. 8
2002 *Cunninghamites* sp. – VAN DER HAM & VAN KONIJNENBURG-VAN CITTERT, p. 178
2004 *Cunninghamites ubaghsii* – VAN DER HAM & VAN KONIJNENBURG-VAN CITTERT, p. 28, fig. 7

Etymology: The species was named after (Johan) Casimir Ubaghs (1829-1894), amateur archaeologist/geologist/palaeontologist and owner of the 'Musée Ubaghs' and the 'Comptoir d'Ubaghs' (a sales office) in Maastricht during the second half of the nineteenth century (VAN DE GEYN, 1944), who loaned the type material of *Cunninghamites ubaghsii* to Dr M.H. Debey (Aachen) for examination and who should now be considered the formal author of the taxon. The botanical nomenclature rules require the species name '*ubaghsi*' to be changed into '*ubaghsii*', which is in contrast to the zoological nomenclature code.

Emended specific diagnosis: Shoot with spirally arranged leaves spreading in all directions. Free leaf portion dorsiventrally flattened, linear, up to c. 12 cm long and 4-5(-7) mm wide, hardly or not constricted arising from a conspicuous, obovoid-rhomboidal leaf base cushion of 5-7 by 4-6 mm.

Type material: holotype: specimen IRSNB-Palaeobot. b 4318 (Ubaghs 310; Text-fig. 3), Institut royal des Sciences naturelles de Belgique, Brussels; Ubaghs 301 and 319 make up the counterpart of this specimen.

Type locality: Limestone quarry near Kunrade (southern Limburg, SE Netherlands; Text-fig. 1).

Type stratum: Kunrade Chalk (Late Maastrichtian, *Belemnitella junior* Zone; Text-fig. 2).

Additional material: Specimen NHMM EN 8e (Text-figs. 4-6), Natuurhistorisch Museum Maastricht, from the Valkenburg Member, and possibly also specimen Hille 1034 (private collection) from the base of the Maastricht Formation, both from the ENCI quarry near Maastricht (southern Limburg, SE Netherlands; Text-figs. 1, 2).

The detached, needle-shaped leaves occurring in the Kunrade Chalk, mentioned by MIQUEL (1853, p. 42), VAN DER HAM *et al.* (2003, pl. Ib), VAN DER HAM & VAN KONIJNENBURG-VAN CITTERT (2003) and in the present paper (Introduction: *Pityophyllum* sp.) are narrower (c. 2.5 mm), have a rhomboidal cross-section, and are therefore considered not to belong to *Cunninghamites ubaghsii*.

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