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Asplenium pseudofontanum Kossinsky (Aspleniaceae, Pteridophyta)

Studies in Asplenium for "Flora Iranica" 3.

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&
JAKOB SCHNELLER

ABSTRACT

REICHSTEIN, T. & J. SCHNELLER (1982). Asplenium pseudofontanum Kossinsky (Aspleniaceae, Pteridophyta). Studies in Asplenium for "Flora Iranica" 3. *Candollea* 37: 117-128. In English, German abstract.

The Asiatic *Asplenium pseudofontanum* Kossinsky is compared with European *A. fontanum* (L.) Bernh. and also the chromosome number of four specimens (two from Afghanistan and two from Pakistan) reported. Contrary to an old report by BIR (1962) for a plant from N. India (Simla), all our plants were diploid like European *A. fontanum*. The two taxa are primarily separated geographically. As their morphological differences are very small and the chromosome numbers are identical, we think that *A. pseudofontanum* does not merit the rank of a distinct species and is best treated as *A. fontanum* subsp. *peudofontanum*.

ZUSAMMENFASSUNG

REICHSTEIN, T. & J. SCHNELLER (1982). Asplenium pseudofontanum Kossinsky (Aspleniaceae, Pteridophyta). Untersuchungen an Asplenium für die "Flora Iranica" 3. *Candollea* 37: 117-128. Auf English, deutsche Zusammenfassung.

Asplenium pseudofontanum Kossinsky aus Asien wird mit europäischem *A. fontanum* (L.) Bernh. verglichen und auch die Chromosomenzahl bei vier Proben (je zwei aus Afghanistan und Pakistan) bestimmt. Im Gegensatz zu einem älteren Befund von BIR (1962) für eine Pflanze aus Indien (Simla), erwiesen sich alle unsere Pflanzen als diploid, wie europäisches *A. fontanum*. Da die zwei Taxa vor allem geographisch getrennt sind, sich morphologisch nur sehr wenig unterscheiden und dieselbe Chromosomenzahl besitzen, glauben wir, dass *A. pseudofontanum* nicht den Rang einer selbständigen Art verdient und besser als Unterart, also als *A. fontanum* subsp. *pseudofontanum* zu behandeln ist.

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1. Introduction

Asplenium fontanum (L.) Bernh. (= *A. halleri* (Roth) DC.) in the broad sense occupies two geographically widely separated areas. The western range is restricted today to the calcareous mountains (at ca. 100-1600 m alt.) of western and central Europe from Mediterranean Spain (including the Pyrenees), France, Italy, Switzerland and two localities in S. Germany. A small population detected in the Vértes mountains in Hungary (JÁVORKA, 1940), where in 1966 still 1-2 plants survived, is most probably extinct today (G. Vida in litt.). Old records from England, Belgium, N.W. Germany, Austria and Greece could not be confirmed by recent collections. European plants comprise the Linnean type *(Athyrium fontanum)* and represent *A. fontanum* sensu stricto. Like other species of ferns, they show quite a wide range of variation in gross morphology, mainly due to different growing conditions, but small differences persist when plants raised from Spanish and Swiss spores are cultivated under similar conditions. Nevertheless, such slightly different forms, in our view, do not deserve even a varietal rank. All plants from Europe so far checked have been found to be diploid and sexual ($n = 36$; $2n = 72$. MANTON, 1950; MEYER, 1957; SLEEP, 1967). It is an old ancestral species and has been recognized by SLEEP (1966, 1967), LOVIS & REICHSTEIN (1969), LOVIS & al. (1969) as ancestor of three allotetraploid ferns, i.e. *A. foresiacum* (Le Grand) Christ (= *A. forisiense* Le Grand), *A. macedonicum* Kümm. and *A. majoricum* Litard. All three are endemic to Europe and of rather restricted distribution (see JALAS & SUOMINEN, 1972).

The eastern area comprises mountains in Turkestan SSR, Usbekistan SSR, Afghanistan, Pakistan and N. India (incl. Kashmir) and Nepal. These Asiatic plants are slightly distinct in gross morphology and spore ornamentation and have been described as a distinct species *A. pseudofontanum* KOSSINSKY (1922). We agree with the author that the differences between *A. pseudofontanum* and European *A. fontanum* are small (see Figs. 1 and 2 and the excellent figures in HOPE, 1901 (Plate XIX p. 133 of reprint)). They can be summarized as follows (see also Table 1): in *A. pseudofontanum* the pinnae are slightly more pointed, the pinnules (or last segments) less lobed (the smaller onces entire) and the perispore (on the otherwise similar spores) less protruding. In our opinion these differences alone are not sufficient to justify separating the two taxa specifically, and subspecific rank would be more appropriate. Before suggesting this, we had to investigate chromosome numbers.

2. Cytology

As far as we are aware, there is only one report of a chromosome number for the Asiatic taxon, not quoted by LÖVE & al. (1977). BIR (1962: 249

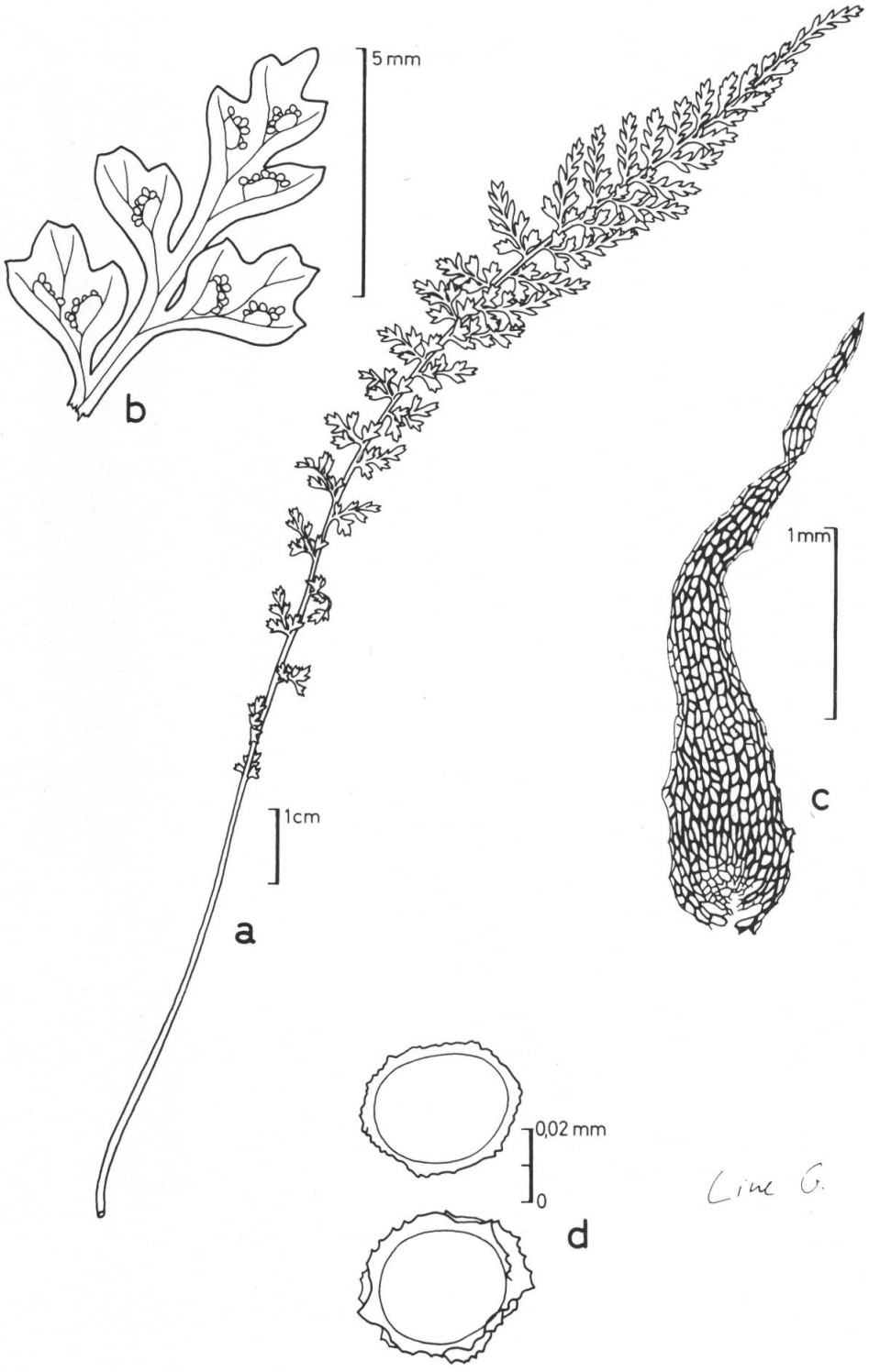

Fig. 1. — *A. fontanum* subsp. *pseudofontanum*
a, whole frond; **b,** pinna from middle part of frond; **c,** rhizome scale; **d,** spores. All from W. Frey-604 (see at 7., from which living progeny (TR-3902) was raised). Drawing Line Guibentif.

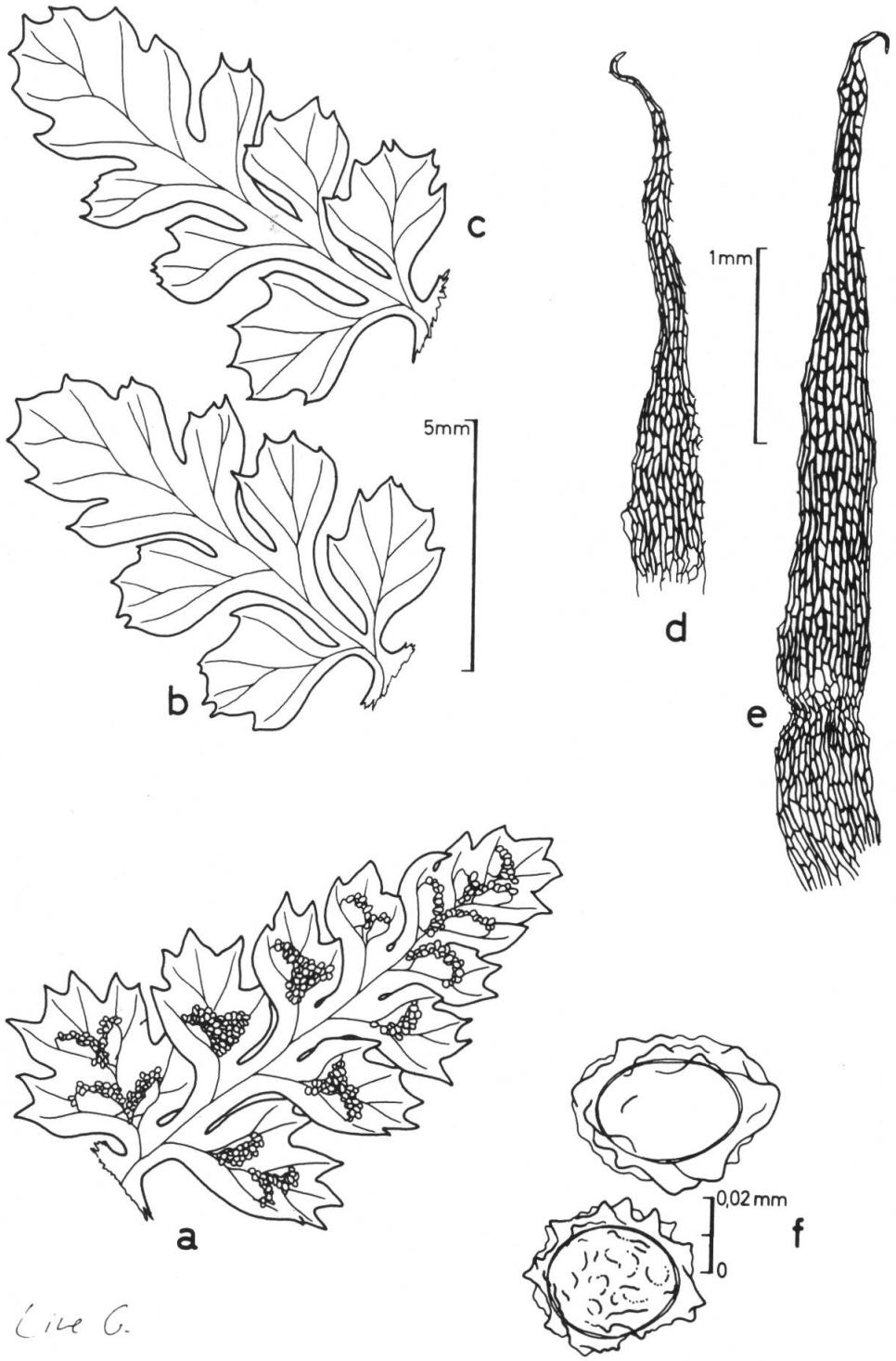

Fig. 2. — *A. fontanum* subsp. *fontanum* from Europe for comparison
a, pinna from big frond (TR-1484, Spain); **b, c**, pinnae from big fronds (TR-883, Switzerland); **d, e**, rhizome scales from TR-883; **f**, spores from TR-4445 (Switzerland) with exospore (30-)32-36(-39) μm. Drawing Line Guibentif.

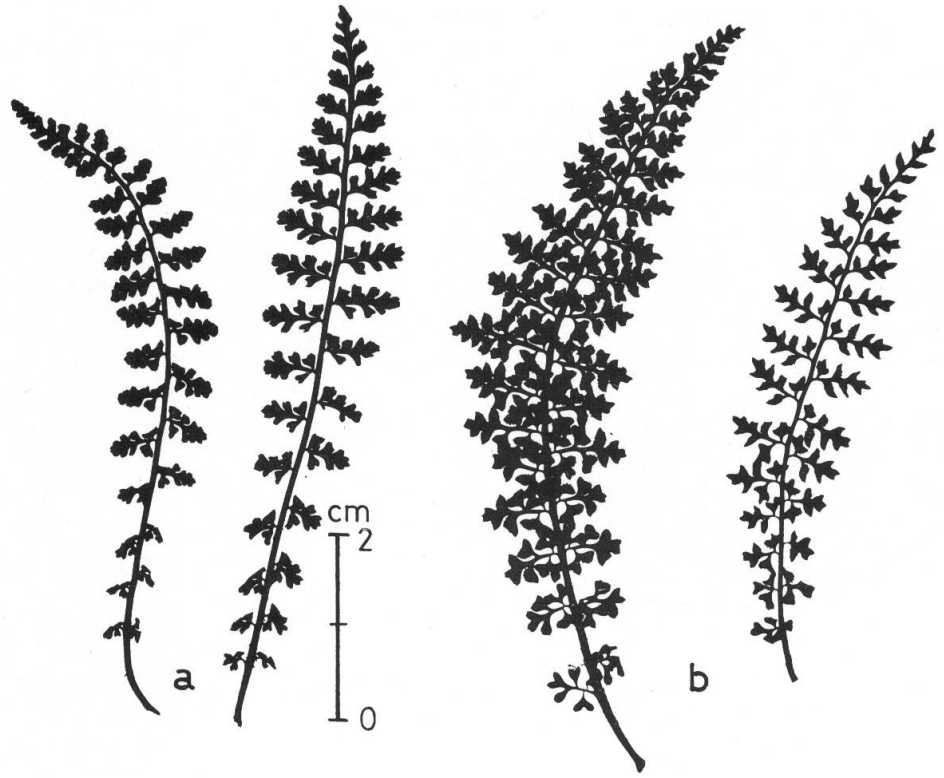

Fig. 3. — Silhouettes of fronds from cultivated plants each
a, *A. fontanum* subsp. *fontanum* (TR-4013). Spores sown 6.8.1976, fronds pressed 13.8.1979. **b**, subsp. *pseudofontanum* (TR-3902) = progeny of W. Frey-604 from Afghanistan. Spores sown 19.6.1976, fronds pressed 13.8.1979. *NB.* Fronds of plants cultivated under appropriate conditions in pots have much shorter stipes than the wild ones, which usually grow in rock crevisses, but the morphology of the blades is much the same. The small differences between the two taxa remain unaltered.

footnote) reported for a plant collected N. of Simla (India): "En route Shali 2 700 m, $n = 72$, tetraploid" (under *A. fontanum* (L.) Bernh.). A voucher specimen (2 sheets) is deposited in Chandigarh (PAN). Thanks to the valuable help of Dr. S. P. Khullar, we obtained it on loan (in 1977) for examination by the senior author. The label was: "S. S. Bir (no number) *Asplenium fontanum,* below Shali, Simla 9000 ft., Sept. 1960, on moist rocks abundant, $n = 72$ tetraploid". The specimen was not in good state, but sufficient to confirm that on morphology it represents correct *A. pseudofontanum.*

If Bir's specimen and count were representative for *A. pseudofontanum* through its whole Asiatic range, the tetraploid state would add another, rather important character to differentiate it from European *A. fontanum.* For this reason we tried to check the ploidy level for as many plants as we could get in living state raised from spores, particularly those from the area of Flora Iranica. So far we have been successful in obtaining progeny from one sample from Afghanistan (TR-3902) and two from Pakistan (Hazara TR-4487; Swat TR-5043). All three samples proved to be diploid and sexual ($n = 36$; $2n$

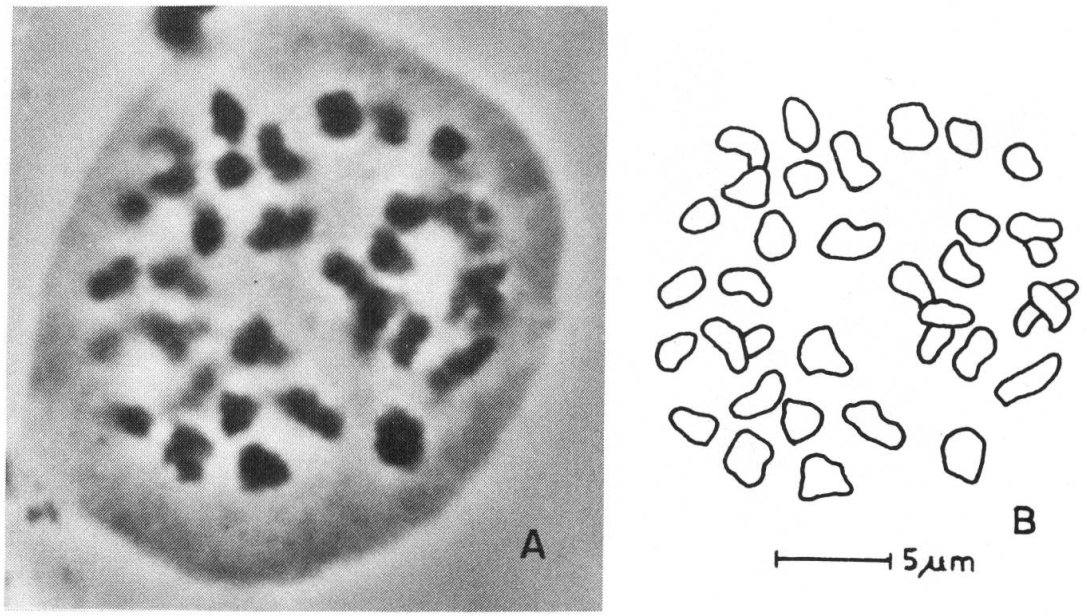

Fig. 4. — Spore mother cell of *A. fontanum* subsp. *pseudofontanum* (TR-3902). **A**, photography; **B**, explanatory diagram with $n = 36$ bivalents.

= 72, see Fig. 4 as example). Independently, J. D. Lovis in 1960, when still in Leeds, had raised progeny of a specimen from Afghanistan *(Neubauer 893)* and found it diploid (in litt.). Spores of other specimens, including some from India (Kashmir and Darjeeling area), gave no growth; they were either too old or may have been heated for drying, or poisoned.

3. Spore size

We tried to obtain further information by spore measurements. All specimens of *A. pseudofontanum* with confirmed diploid state showed a rather wide variation in spore size with exospore length (30-)33-39(-42) µm, i.e. at least 90% showed exospore length of 33-39 µm. This is rather high for a diploid *Asplenium,* but is exactly the same as that found for European *A. fontanum.* An autotetraploid derived from either of these two taxa should be expected to show distinctly (ca. 10%) bigger spores. We were able to check spore size of ten other samples, six from Afghanistan and four from India (two from Kashmir and two from Darjeeling area). They all showed sizes in the same range and we are confident that *A. pseudofontanum* within the limits of "Flora Iranica" and perhaps most parts of India is most probably diploid throughout. We were, of course, anxious to compare the tetraploid. Dr. S. P. Khullar made a special effort to search for it in the place where Bir

collected it, below Shali peak (N. of Simla) — a rather long and strenuous expedition. Unfortunately he was not successful in finding *A. pseudofontanum* there.

4. Potential ancestor of allotretraploids

The diploid state of *A. pseudofontanum* opens the possibility that it, like its European relative, may have functioned as an ancestor in the formation of some Asiatic (mainly Himalayan) allotetraploid *Asplenium* species. We are currently searching for such relatives, and are willing to send living material on request to colleagues who would be interested in such work.

5. Description

This has been slightly changed from that of Kossinsky, to cover plants from the area of "Flora Iranica".

Rhizome short, ascending when young, forking and becoming caespitose later, its tip, like the stipe bases, covered with clathrate, dark grey, long ovate-lanceolate scales, ca. 3-4 mm long and up to 0.5-0.6 mm wide at base, gradually narrowing to tip. Fronds tufted, numerous, ca. 4-20(-30) cm long in ripe state and ca. 1-3 cm wide, ± soft but standing frost and wintergreen if not damaged too much. Stipes ca. 1-8(-10) cm long, ca. 0.5-1 mm thick, brown or blackish at base on adaxial side usually only for 0.2-2 cm, but on abaxial side often the whole stipe and the lower part of the rachis is dark with green borders, green higher up; with a tuft of scales like those on the rhizome at base and increasingly narrower and less numerous scales higher up when young, glabrous later. Blades glabrous, light to greyish green, long lanceolate in outline, widest usually a little above the middle, gradually tapering to both ends, bipinnate, tripinnatifid in lower part. Pinnae 10-20(-30) pairs, mostly alternate, mostly stipitate with stalk of ca. 0.2-1 mm, only smallest pinnae sessile; inserted at an angle with the rachis of ± 90° in lower part, ± 60° in median and ± 40° in upper part; lowest pairs of pinnae very small and remote from each other, becoming gradually closer and sometimes overlapping higher up. The median pinnae 0.5-1.5(-2.5) cm long, elongate-ovate and slightly pointed in outline, 2-8(-12) mm wide, anadromically pinnate at base, pinnatifid versus the tip. Basal pinnules the biggest, ca. 2-4(-7) mm long and ca. 0.05-0.1 mm thick; these basal pinnules divided into 3-5(-7) irregular triangular-ovate, pointed lobes or teeth, the subsequent pinnules narrower, less or not divided, becoming decurrent and confluent at the end. Teeth of the last segments mostly pointed, a few sometimes obtuse. Sori oval, 1-3 per pinnule, ca. 1 mm long. Spores relatively big with exospore (30-)33-39(-42) μm

long and irregular perispore protruding up to ca. 6(-8) μm in equatorial view. Diploid and sexual ($n = 36^{II}$, $2n = 72$) within the area of "Flora Iranica".

	A. fontanum (Europe)	*A. pseudofontanum* (Asia)
Pinnae of middle and upper part part of frond in outline	Usually more obtuse	Usually more pointed
Pinnules resp. last segments (2. order)	Biggest segments usually with 3-5(-10) lobes with short acute teeth, corresponding to 2-4(-9) emarginations	Biggest segments usually with 2-3(-5) lobes or entire with longer teeth, corresponding to 0-2(-4) emarginations
Perispore protruding the exospore in equatorial view	ca. 10 μm	ca. 6(-8) μm
Habitat	Europe, limestone rocks, ca. 100-1600 m alt.	Asia, limestone and silicate rocks, ca. 1400-3700 m alt.

Table 1. — Summarizing the few differences between A. fontanum and A. pseudofontanum

6. Nomenclature

The morphological differences between *A. fontanum* and *A. pseudofontanum* are minute (see Table 1), and so small that in some cases even the expert would not be able to differentiate the two taxa with confidence; since even the chromosome number turned out to be the same, we see no reason to accept *A. pseudofontanum* as a distinct species and suggest that it be treated as a subspecies of *A. fontanum* as *A. fontanum* (L.) Bernh. subsp. *pseudofontanum* (Kossinsky) Reichstein & Schneller **comb. nova** (basionym *A. pseudofontanum* Kossinsky, Not. Syst. Herb. Hort. Bot. Petrop. 3: 122 (1922), type in LE). This is in agreement with genome analysis by M. Gibby (see p. 235) where she showed that the two taxa have homologous genomes and are mainly geographically separated.

7. Origin of plants used in this study

7.1. A. fontanum (L.) Bernh. subsp. fontanum

TR-16. France, Dép. Pyr. Or., Val di Llo (S.E. of Saillagouse), ca. 1500 m alt., leg. H. Kunz & T. Reichstein, 12.VIII.1957. Spores with exospore (30-)33-36(-39 μm long.

TR-592. Switzerland, Ct. St. Gallen, limestone rocks along the path from Betlis to Quinten (N.-side of the Walensee), ca. 630 m alt., leg. E. Oberholzer & T. Reichstein, 29.X.1961.

TR-883. Switzerland, Ct. Aargau, Ramsfluh near Erlinsbach, ca. 650 m, shady limestone rocks, H. U. Stauffer & T. Reichstein, 29.VI.1963.

TR-1002. France, Dép. Isère, Défilé du Grand Crossey (E. of Voiron), limestone rocks, ca. 450 m, H. L. & T. Reichstein, 30.IX.1963.

TR-1064. Raised from spores from: Hungary, Fanien valley, Vértes Mountains, leg. G. Vida, 10.X.1961, obtained in Basel 24.XII.1963, diploid (det. G. Vida).

TR-1171. France, border between Dép. Basses-Alpes and Var, Gorge du Verdon, ca. 550 m, limestone rocks, leg. G. J. de Joncheere & T. Reichstein, 23.V.1964. Diploid ($n = 36^{II}$, det. G. Vida). Spores with exospore (30-)33-36(-39) μm long.

TR-1484. Spain, Prov. Alicante, Mongo E. side, S. of Denia, ca. 350 m, limestone rocks, H. Kunz & T. Reichstein, 8.IV.1965.

TR-2254. France, Dép. Vaucluse, N. side of the Mt. Ventoux, limestone rocks at ca. 1000 m alt., leg. G. Hügin, H. Kunz, H. Melzer & T. Reichstein, 26.VII.1968.

TR-2262. France, Dép. Alp. Mar., Cluses du Riolan between Puget-Théniers and Roquerteron at ca. 500 m alt., leg. G. Hügin, H. Kunz, H. Melzer & T. Reichstein, 30.VII.1968.

TR-4013. Switzerland, Ct. Baselland, limestone rocks, W. of Schlossruine above Waldenburg, ca. 680 m, T. Reichstein, 31.VII.1976.

TR-4445. Switzerland, Ct. Valais, Rhone valley, Collonges along road to Montagne de Collonges, rocks at ca. 700 m, R. Sutter, 29.IX.1976.

TR-4755. Switzerland, Ct. Vaud, limestone rocks, E. of Roche, Rhone valley, ca. 400 m alt., leg. T. Reichstein, 7.IX.1978, spores with exospore (30-)33-36(-39) μm long.

7.2. A. fontanum (L.) Bernh. subsp. pseudofontanum Reichstein & Schneller

a) For checking cytology

TR-1644 = progeny ex spores of H. F. Neubauer-893 (W, 10 652). Afghanistan, Nuristan: zwischen Kotal-e-Agok (Agog-Pass) und dem Ort Waigal, ca. 3000 m alt., 10.VIII.1951 (Neubauer in litt. 12.II.1977). Spores of original collection with exospore (30-)33-36(-39) μm long. Progeny raised by J. D. Lovis in Leeds was diploid (det. J. D. Lovis), and cult. in Basel.

TR-3902 = progeny ex spores of W. Frey-604 (Tübingen). Afghanistan, Prov. Kapisa, Spe-Tal (Alasoy), 2200 m, feuchte Felsen, leg. W. Frey, W. Probst & A. Shaw, 7.IX.1974. Spores of original collection with exospore (30-)33-36(-40) μm long, sown 19.VI.1975, gave ample progeny which was diploid (det. J. Schneller, Fig. 4).

TR-4487 = progeny ex spores of C. R. Fraser-Jenkins-6439 and 6440. N. Pakistan, Hazara, lower Kunhar valley, calc. rocks, ca. 1400 m alt., above Balikot, below Kagan, 10.IX.1977. Spores of original collection with exospore (30-)33-39(-42) μm long, sown 2.XII.1977 gave ample progeny which was diploid (n = 36, J. Schneller, 12.IV.1979).

TR-5043 = progeny ex spores of C. R. Fraser-Jenkins 7965. Pakistan, Swat, upper Swat valley, slate rocks, N.W. side of mountain, W. of Kulam, E. of Urot, 2.X.1978. Spores or original collection with exospore (30-)33-36(-42) μm long, sown 19.V.1979 gave ample progeny which was diploid (det. J. Schneller, 8.VIII.1980).

b) For spore measurements

TR-3943, spore prep. from: O. Anders-11 097. Herb. Ḳabulense (W, s.n.). Konar: Dewagal, Pass zum Darrah-e Mazar (70/50-34/47), 1700-1900 m alt., 31.VIII.1973, spores with exospore (30-)33-36(-39) μm long, did not germinate.

TR-4015, spore prep. from: P. Wendelbo & L. Ekberg-9712 (E). Afghanistan, Prov. Laghman: Alishang, upper part of Darrah Rastyon, rock crevisses, alt. 2500 m, 15.VII.1969. Spores with exospore (30-)33-36(-39) μm long.

TR-4021, spore prep. from: H. Freitag-6934 (Göttingen). Afghanistan, E. Kotai, between Quimatai-pass and Pathan, 2800 m alt., N. exposed limestone rocks in *Quercus semecarpifolia* forest, 4.IX.1969. Few spores with exospore 30-36 μm long.

TR-4438, spore prep. from: H. F. Neubauer-1032 (W, No. 10 651). Afghanistan, Nuristan: am Aschpi-Pass 17.VIII.1951. Few spores with exospore ca. 33 μm long.

TR-4439, spore prep. from: H. F. Neubauer-638 (W, No. 10 650). Afghanistan, Nuristan: Urura-Pass, in der Umgebung der Alm ober Kuschtos, ca. 3000 m, 8.VIII.1951. Spores with exospore (30-)33-36(-37.5) μm long.

TR-4440, spore prep. from: Deutsche Hindukusch Exp. 1935 No. 995 (W, No. 11 112). Afghanistan, W. Nuristan, zwischen Mamgol-Pass und Aberschuker, ca. 3400 m, 21.VI.1935, leg. G. Kersten. Spores with exospore (30)-33-36(-37.5) μm long.

TR-4441, spore prep. from: R. R. Stewart-19 600. Gordon Coll. Herb. (RAW). Kashmir, Badwan, Kishenganga valley, 8000 ft. Spores with exospore (30-)33-36(-39) μm long.

TR-4442, spore prep. from: R. R. Stewart-3419. Gordon Coll. Herb. (RAW). Kashmir, Sonamarg, rock crevisses by river, ca. 8000 ft., 30.VIII.-1919. Spores with exospore (30-)33-36(-39) μm long.

TR-4945, spore prep. from: S. P. Khullar-29(76) (PAN). India, Darjeeling (W. Bengal), E. Himalayas, Birch Hill near Govt. College, on sunny side of hill, ca. 2100 m alt., July 1976 (in litt. 30.I.1979). Spores with exospore (30-)33-36(-39) μm long, did not germinate.

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REFERENCES

AITCHISON, J. E. T. (1881). On the Flora of the Kuram valley & c., Afghanistan. *J. Linn. Soc. Bot.* 18: 1-113.

BIR, S. S. (1962). Cytological observations on some ferns from Simla (Western Himalayas). *Curr. Sci.* 31: 248-250.

HOPE, C. W. (1880-1904). The Ferns of North Western India, including Afghanistan, the Trans-Indus Protected States, and Kashmir. *J. Bombay Nat. Hist. Soc.*, vol. 12-15. Reprint 1977, Intern. Book Dist. Dehra Dun (India). The pagination of this reprint is used here.

JALAS, J. & J. SUOMINEN (1972). *Atlas Florae Europaeae, 1. Pteridophyta.* Helsinki.

JÁVORKA, S. (1940). Az Asplenium fontanum (L.) Bernh. feldedezése Magyarországon. Die Entdeckung des Asplenium fontanum in Ungarn. *Math. Naturwiss. Anz. Ung. Akad. Wiss.* 59: 998-1003.

KOSSINSKY, C. (1922). Asplenium pseudofontanum sp. n. *Not. Syst. Herb. Hort. Bot. Petrop.* III(31): 121-124 + map.

LÖVE, A., D. LÖVE & R. E. G. PICHI SERMOLLI (1977). *Cytotaxonomical Atlas of the Pteridophyta.* Vaduz.

LOVIS, J. D. & T. REICHSTEIN (1969). Der Farnbastard Asplenium × orellii hybr. nov. = Asplenium majoricum Litard. × A. trichomanes L. subsp. quadrivalens D. E. Meyer und die Abstammung von A. majoricum. *Ber. Schweiz. Bot. Ges.* 79: 335-345.

— A. SLEEP & T. REICHSTEIN (1969). Der Farnbastard Asplenium × sollerense hybr. nov. = Asplenium majoricum Litard. × A. petrarchae (Guérin) DC. subsp. petrarchae. *Ber. Schweiz. Bot. Ges.* 79: 369-376.

MANTON, I. (1950). *Problems of cytology and evolution in the Pteridophyta.* Cambridge Univ. Press.

SLEEP, A. (1966). *Some cytotaxonomical problems in the fern genera Asplenium and Polystichum.* Ph. D. thesis, University of Leeds (unpublished).

— (1967). A contribution to the cytotaxonomy of Asplenium majoricum. *Brit. Fern Gaz.* 9(8): 321-329.

— (1982). On the genus Asplenium in the Iberian Peninsula. *Acta Bot. Malacit.* (in press).

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