

Pteridophyta collected in Northern Nigeria and Northern Cameroon

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Abstract

25 species of *Pteridophyta* were collected in Northern Nigeria (mainly the Lake Chad Basin and the Mandara Mts.) and in the neighbouring parts of Cameroon. 11 of them have not been recorded previously from this area: *Isoetes schweinfurthii* A. Br. in Bak., *Selaginella tenerrima* A. Br. ex Kuhn, *Ophioglossum gomenzianum* Welw. ex A. Br., *Marsilea coromandeliana* Willd., *M. distorta* A. Br., *M. nubica* A. Br., *M. subterranea* Lepr. ex A. Br., *Azolla africana* Desv., *Ceratopteris richardii* Brogn., *Adiantum capillus-veneris* Linn., and *Actiniopteris semiflabellata* Pic. Ser.

Key words: Cameroon, Lake Chad Basin, Mandara Mountains, *Marsilea*, Nigeria, *Pteridophyta*,

INTRODUCTION

Northern Nigeria belongs to those parts of tropical Africa which are only moderately known from the floristic point of view, although a notable progress in this respect has been achieved in the last 20 years (Léonard 1965, Hepper 1978, 1979). No special pteridological research has ever been carried out in this area, which is believed to have a poor and rather uninteresting fern flora (as also suggested for the corresponding parts of Northern Cameroon by Tardieu-Blot et al. 1949). This is by no means true. The innumerable seasonal pools of the Lake Chad Basin offer a unique life opportunity for highly specialized aquatic and amphibious pteridophytes, first of all of the genus *Marsilea*. The granitic range of the Mandara Mts., extending northwards almost to the boundaries of the Sahelian Domain (Brenan 1979), create a contrast between the relatively more humid mountain environment and the dry areas of the surrounding low country. Lithophytic ferns find their shelters in the crevices under overhanging rocks and between boulders of the extensive block fields, and display peculiar adaptations to the seasonal drought.

This makes both, the Lake Chad Basin and the Mandara Mts. worth of detailed pteridological exploration.

In the present paper some results of such an exploration are presented. The field work included a complete yearly cycle of observations, from August 1978 to July 1979. Trips were made to various parts of the Lake Chad Basin and Biu Plateau in the Borno State, and to the Mandara Mts. in the Borno and Gongola States of Nigeria, as well as in the Margui-Wandala Region of Cameroon (Fig. 1). A few occasional observations from the Bauchi Plateau (Yankari Game Reserve) and the Kano and Kaduna States are also added, and some finds of other collectors (M. E. Dyer, B. J. Harris) are reported.

The systematic sequence of species follows Alston (1959). The nomenclature of the pteridophytes is based on various recent sources, with Alston's invalid names quoted always as synonyms. The nomenclature of the phanerogams follows Hutchinson and Dalziel (1954-1972). The herbarium acronyms are those proposed by Holmgren et al. (1981).

For each species a few general remarks on its occurrence in Northern Nigeria and on its habitat requirements are presented. The months denote the collecting dates of spore-bearing specimens (unless otherwise stated). The complete list of localities is included. All specimens cited are deposited in the Herbarium Universitatis Jagellonicae Cracoviensis (KRA), except those indicated by other herbarium acronyms. The general geographical range of the species is discussed, and the reference made to the earlier data on their occurrence in Northern Nigeria (if any such data exist).

LIST OF SPECIES

Abbreviations used:

AJK = J. Kornaś, Plantae Africanae, coll. J. Kornaś and A. Medwecka-Kornaś.

JK = J. Kornaś, Plantae Africanae, coll. J. Kornaś.

n.c. = according to the author's field notes, specimens not collected.

ISOËTES SCHWEINFURTHII A. BR. IN BAK.

In seasonal pools and rice fields in the savanna areas around Maiduguri, rare and easy to be overlooked. October-November.

Borno State: Maiduguri, on Molai Rd., 11°48' N, 13°08' E, alt. 320 m, lg. *I. B. Garrod*, *S. S. Sani*, *JK 6309* (det. A. C. Jermy); between Maiduguri and Gambole Cattle Ranch, 11°42' N, 13°15' E, alt. 320 m, *JK 6272* (det. A. C. Jermy); Jeribole, 13 km NE of Maiduguri, 11°54' N, 13°15' E, alt. 310 m, *JK 6333*.

Known from the Sudan Republic (Pfeiffer 1922, Reed 1953). Not indicated by Alston (1959) for West Tropical Africa.

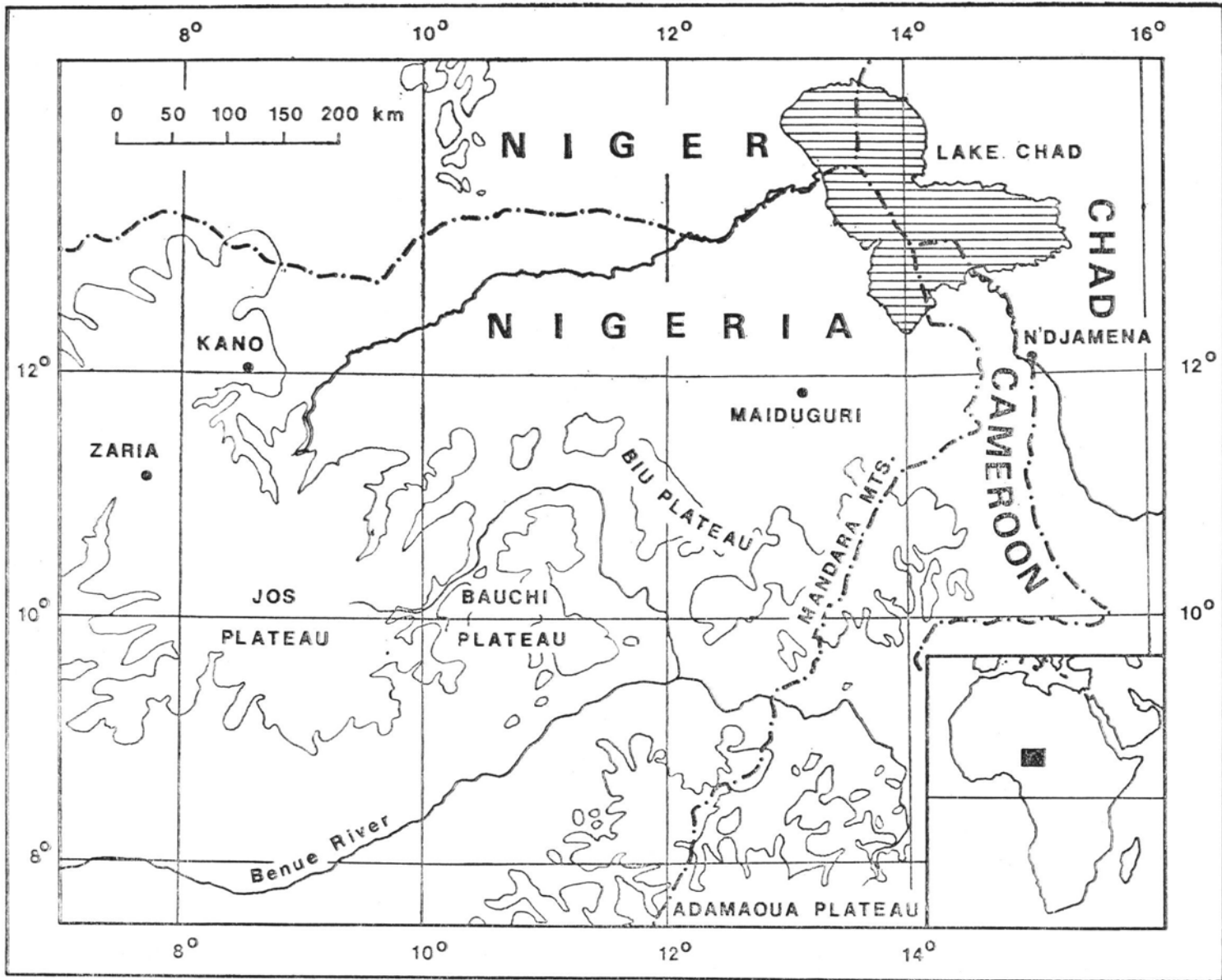


Fig. 1. Map of Northern Nigeria and Northern Cameroon

SELAGINELLA TENERRIMA A. BR. EX KUHN

In crevices under overhanging rocks and between boulders on rocky hills, fairly common in the Mandara Mts. up to their northern end, on the Biu and Bauchi Plateaux, and on residual hills of the Kano and Kaduna States. Also common in North Cameroon. October-November.

Kaduna State: Dumbi Hill S of Zaria, c. 10°55' N, c. 7°35' E, alt. 600-700 m, *JK n.c.*; Samaru near Zaria, 11°10' N, 7°38' E, *B. J. Harris et al. 7168*. **Plateau State, Jos Plateau:** Maraguta Forest Reserve, Dogondutse Hill, 9°58' N, 8°54' E, *Lawlor et Hill FHI 46545*. **K. Kano State:** Kila, 32 km E of Birnin Kudu, 11°20' N, 9°46' E, alt. 500-600 m, *JK n.c.* **Bauchi State:** Yankari Game Reserve, Wikki, 9°45' N, 10°30' E, alt. 250 m, *JK n.c.* **Borno State, Biu Plateau:** Jafi Kwaya Waterfall at Gubi near Kwaya Tera, 33 km SWW of Bui, 10°34' N, 11°52' E, alt. 360 m, *JK 6310*; Zagu Hill, Buratai Forest Reserve, 39 km S of Buni, 10°57' N, 12°05' E, alt. 600-700 m, *JK n.c.* **Borno State, Mandara Mts.:** Takaskara Hills, 11 km S of Gwoza, 10°59' N, 13°40' E, alt. 520 m, *AJK 6214*; Guduf near Gwoza, 11°04' N, 13°43' E, alt. 510 m, *JK n.c.*; Bokko Sato, 9 km S of Pulka, 11°09' N, 13°47' E, alt. 520 m, *JK 6304*. **Gongola State, Mandara Mts.:** Para Hussara near Uba, 10°30' N, 13°14' E, alt. 520 m, *JK 6245*; on Zuwa River near Wuro Dawa, 10°51' N, 13°29' E, alt. 500 m, *JK 6261*. **Cameroon, Margui-Wandala Reg., Mandara Mts.:** Rhoumzou, 25 km S of Mokolo, 10°42' N, 13°36' E, alt. c. 1050 m, *JK n.c.*; Koza, 20 km N of Mokolo, c. 10°40' N, c. 13°40' E, *M. Biholong 120*, **P. Cameroon, Diamaré Reg.,** Pic de Mindif, c. 10°26' N, c. 14°25' E, alt. c. 450 m, *JK n.c.*

A tiny annual with a very peculiar reproductive biology involving apomixis and more or less complete reduction of microsporangia (Kornaš and Jankun 1983). Widely distributed in tropical Africa, especially in the savanna and savanna woodland zones, from Guinea and Mali through Nigeria, Cameroon, the Central African Republic, Congo (Brazzaville) and Gabon to Angola, Zambia and Mozambique. Not recorded previously from Northern Nigeria.

OPHIOGLOSSUM COSTATUM R. BR.

On granitic outcrops in the Kaduna and Kano States and at the foot of the Mandara Mts., rather common. In moss tufts on rocks and in short grassland patches in seasonally wet depressions of the savanna woodlands. July-October.

Kaduna State: Funtuna, Katari Rd., 11°32' N, 7°19' E, *S. O. Oyewole 1391*, ZARIA; Dumbi Hills, c. 10°55' N, c. 7°35' E, alt. 600-700 m, *S. O. Oyewole 090*, ZARIA; Anara Forest Reserve, 10°42' N, 7°37' E, *M. E. Dyer 0109*; Zaria, Kufena, 11°05' N, 7°39' E, *B. J. Harris 6787*, ZARIA. **Kano State:** Kanfulani near Kila, 11°20' N, 9°46' E, alt. 500-600 m, *AJK 7052*. **Borno State, Mandara Mts.:** Takaskara Hills, 11 km S of Gwoza, 10°59' N, 13°40' E, alt. 520 m, *AJK 6185 A* (together with *O. gomezianum* Welw. ex A. Br.), *7071*, *7075 A* (together with *O. gomezianum* Welw. ex A. Br.), *7078* (together with *O. gomezianum* Welw. ex A. Br. and *O. cfr. rubellum* Welw. ex A. Br.). **Gongola State, Mandara Mts.:** on Zuwa River near Wuro Dawa, 10°51' N, 13°29' E, alt. 500 m, in a community of short grasses and annual *Cyperaceae*: *Lipocarpha sphaelata* (Vahl.) Kunth, *Pyc-reus pumilus* (Linn.) Nees, *Scirpus kernii* Raymond, *Scleria pergracilis* (Nees) Kunth, etc., *JK 6253*.

Widely distributed in tropical Africa and Asia, and already known from various localities in Northern Nigeria (Alston 1959).

OPHIOGLOSSUM GOMEZIANUM WELW. EX A. BR.

In open savanna woodlands at the foot of granitic hills of the Mandara Mts., in seasonally wet depressions, in patches of short grassland or in communities of annual *Cyperaceae*. July-October.

Borno State, Mandara Mts.: Takaskara Hills, 11 km S of Gwoza, 10°59' N, 13°40' E, alt. 520 m, in a community of tiny annuals with *Cyperus amabilis* Vahl, *C. pulchellus* R. Br., *Drosera indica* Linn., *Eleocharis setifolia* (A. Rich.) J. Raynal, *Fimbristylis hispidula* (Vahl) Kunth, *Lipocarpa sphaclata* (Vahl) Kunth, *Mariscus squarrosus* (Linn.) C. B. Cl., *Microchloa indica* (Linn. f.) P. Beauv., *Ophioglossum costatum* R. Br., *Ophioglossum* *cfr.* *rubellum* Welw. ex A. Br., *Pycneus melas* (Ridl.) C. B. Cl., *P. pumilus* (Linn.) Nees, *Oldenlandia* *spp.*, *Rhamphicarpa fistulosa* (Hochst.) Benth., *Scirpus kernii* Raymond, etc., *AJK* 6185 A, 6205, 7072, 7075, 7077, 7078 A.

Widespread in tropical Africa from Ivory Coast and the Sudan Republic to Angola, Rhodesia and South Africa (Schelpe 1970) and already recorded from Southern Nigeria by Alston (1959).

OPHIOGLOSSUM RETICULATUM LINN.

Found only once at the foot of the Mandara Mts., in a dry bed of a seasonal watercourse, in dense woodland, in shady and humid crevices of granitic rocks. October.

Borno State: Mandara Mts.: Takaskara Hills, 11 km S of Gwoza, 11°59' N, 13°40' E, alt. 550 m, *AJK* 6209.

Widespread in the tropics of the Old and New Worlds; fairly common in tropical Africa and already reported from several localities in Northern Nigeria (Alston 1959).

MARSILEA BERHAUTII TARDIEU

Found only once near Maiduguri in dry thorn savanna, in a seasonal pool c. 0.5 m deep. Rhizomes long 0.5 m and more, floating on the water surface and producing abundant sporocarps. Leaves usually floating and large. Merely in very few individuals the rhizomes were rooting in water-logged masses of decaying plants and produced erect aerial leaves. Evidently *M. berthautii* is a typical floating hydrophyte, only exceptionally able to grow in the emersed state. October.

Borno State: Molai Forest Reserve near Maiduguri, 11°47' N, 13°08' E, alt. 320 m, together with other aquatics: *Eichhornia natans* (P. Beauv.) Solms-Laub., *Najas* *spp.*, *Nymphaea lotus* Linn., *Nymphoides indica* (Linn.) Ktze, etc., *JK* 6282 (rev. E. Launert).

Known only from West Tropical Africa, from Senegal and Gambia to Nigeria (Launert 1968). Recorded from Northern Nigeria by Alston (1959) under the name of *M. polycarpa* Hook.

MARSILEA COROMANDELIANA WILLD.

Found only once in the northernmost part of the Kano State, in dry mud 50 m from the edge of a large, shallow lake. February.

Kano State: Acha Lafia, 12°48' N, 8°24' E, *M. E. Dyer* 0172.

Widely distributed in tropical Africa from Mauritania and Senegal to the Sudan Republic, Burundi, Tanzania, Mozambique, Angola, Namibia and South Africa. Also known from Madagascar, Socotra and India (Launert 1968, Schelpe and Diniz 1979). Not recorded previously from Nigeria.

MARSILEA DISTORTA A. BR.

In thorn savanna around Maiduguri, in dry pools on sandy soil, rather common. Also collected in the Kano State. A terrestrial plant, only once found submersed and with floating leaves (in water up to 5 cm deep). Sporocarps buried 1-2 cm underground, evidently geocarpic. October-December (-February).

Kano State: Acha Lafia, 12°48' N, 8°24' E, *M. E. Dyer* 0174. **Borno State:** Molai Forest Reserv near Maiduguri, 11°47' N, 13°08' E, alt. 320 m, *JK* 6281; Maiduguri, 11°48' N, 13°08' E, alt. 320 m, *JK* 6308; between Maiduguri and Gambole Cattle Ranch, 11°42' N, 13°15' E, alt. 320 m, *JK* 6271 (rev. E. Launert); 8 km NEE of Mafa, 11°58' N, 13°40' E, alt. 300 m, *JK* 6428, 6435; 12 km NEE of Mafa, 11°58' N, 13°42' E, alt. 300 m, *JK* 6419 (rev. E. Launert), 6420.

Scattered in tropical Africa from Mauritania, Senegal and Mali to Tanzania (Launert 1968) and Mozambique (Schelpe and Diniz 1979). Not recorded previously from Nigeria.

MARSILEA MINUTA LINN.

Widely distributed in Northern Nigeria in roadside ditches, pools, seasonal lakes, on stream banks, etc. Around Maiduguri found mostly on heavy clay, and evidently amphibious, beginning its seasonal cycle with a submersed phase of vegetative growth and finishing it with a terrestrial phase of sporocarp production. Sporocarps not buried underground. October-February.

Kano State: Acha Lafia, 12°48' N, 8°24' E, *M. E. Dyer* 0173, 0175; Kano-Kari Rd., 59 km NW of Birnin Kudu, 11°36' N, 8°58' E, alt. 400-500 m, *JK* 6476 (rev. E. Launert). **Bauchi State:** Kano-Kari Rd., 9-km W of Misau, 11°21' N, 10°23' E, alt. 400-500 m, *JK* 6477; Yankari Game Reserve, Wikki, 9°45' N, 10°30' E, alt. 230 m, *AJK* 6669, *M. E. Dyer* 0160. **Borno State:** Gajibo, 8 km NEE of Dikwa, 12°06' N, 13°59' E, alt. 290 m, submersed with other aquatics: *Limnophyton obtusifolium* (Linn.) Miq., *Nymphaea micrantha* Guill. et Perr., *Scirpus articulatus* Linn., etc., *JK* 6378, 6418, 6625 (rev. E. Launert), 6626.

The widest distributed species of the genus, extending in continental Africa from Algeria to Angola and Zambia; also growing in the Comoro Is., Madagascar and tropical Asia, from India to Malaysia. Recorded already from Northern Nigeria by Launert (1968).

MARSILEA NUBICA A. BR.

Fairly common in the Lake Chad Basin near Maiduguri, in tall tree savannas (e.g. with *Anogeissus leiocarpus* (D. C.) Guill et Derr), thorn savannas (with *Acacia spp.*) and treeless flats, in ditches, seasonal pools and flooded depressions, on naked soil or in communities of tiny annuals, on sandy-muddy, muddy or heavy clay soils. This is the most precocious *Marsilea* species which appears soon after the rains. Amphibious, growing initially submersed, later emerging and producing sporocarps. September-December.

Borno State: on Gambaru Rd., 39 km NEE of Maiduguri, 11°54' N, 13°31' E, alt. 300 m, *AJK 6181*; near Mafa, 46 km NEE of Maiduguri, 11°55' N, 13°35' E, alt. 300 m, emerged on dry mud in a community of tiny annuals: *Ammania auriculata* Willd., *Cyperus submicrolepis* K k, *Elytrophorus spicatus* Willd., *Fimbristylis quinquangularis* (Vahl) Kunth, *Pycreus macrostachyos* (Lam.) J. Raynal, *Sphenoclea zeylanica* Gaertn. etc., *AJK 6161, 6162* (rev. E. Launert); 5 km NEE of Mafa, 11°57' N, 13°38' E, alt. 300 m, *JK 6423*; Usha Pulka, 30 km S of Bama, 11°17' N, 13°47' E, alt. 350 m, *AJK 6215, 6216*; Gajibo, 8 km NEE of Pulka, 12°06' N, 13°59' E, alt. 290 m, *JK 6379* (rev. E. Launert).

Widely distributed in tropical Africa from Mauritania and Senegal to Namibia, Mozambique, Tanzania and Madagascar (Launert 1968). Not recorded previously from Nigeria.

MARSILEA SUBTERRANEA LEPR. EX A. BR.

Rarely found in the Lake Chad Basin NE of Maiduguri, in seasonal pools and ditches, on very heavy black clay. Forming pure stands on bare soil. Initially submersed, but later on emerging and producing abundant sporocarps, which are always completely buried underground (Fig. 2). This is the tardiest *Marsilea* species which appears late in the dry season when the last rain pools disappear from the area. January-February.

Borno State: Gajibo, 12 km NE of Dikwa, 12°08' N, 13°59' E, alt. 290 m, *JK 6581* (rev. E. Launert); Ngala near Gambaru, South Chad Irrigation Pilot Project, 12°20' N, 14°10' E, alt. 280 m, *JK 6611* (rev. E. Launert).

Apparently very rare; known only from very few collections from Senegal and Tanzania and not recorded earlier from Nigeria (Launert 1968).

AZOLLA AFRICANA DESV.

(= *AZOLLA PINNATA* R. BR. VAR. *AFRICANA* (DESV.) BAK.)

Found only once, on the Bauchi Plateau, floating in masses in shallow pools of standing water on a river bank, in full sunlight. March.

Bauchi State: Yankari Game Reserve, River Gaji, NE of Wikki, 9°48' N, 10°34' E, alt. 240 m, *AJK 6586*.

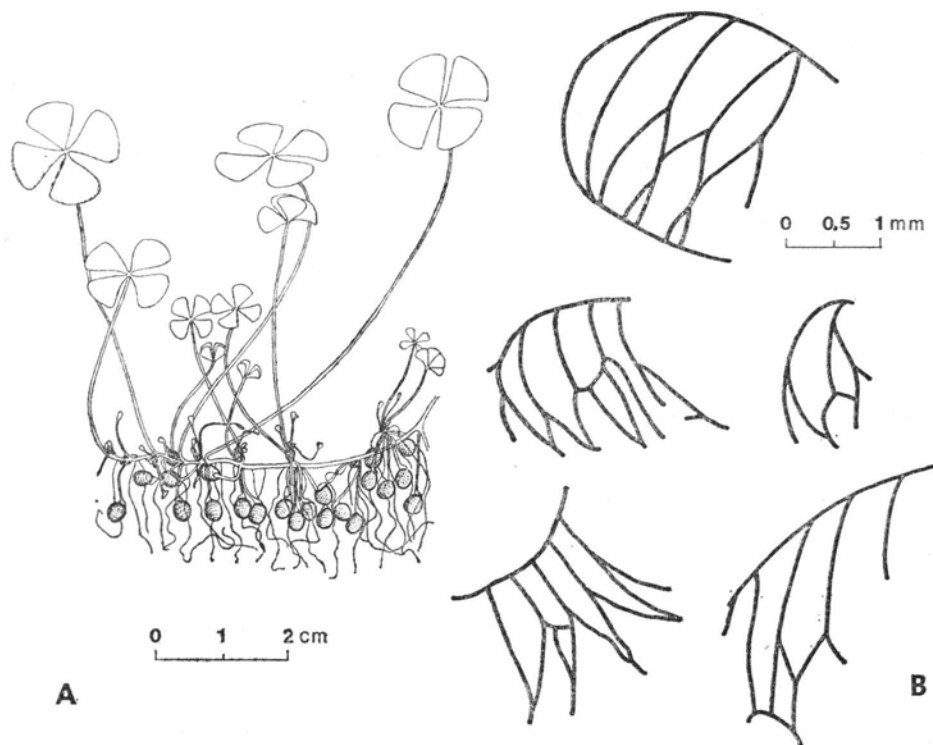


Fig. 2. *Marsilea subterranea* Lepr. ex A. Br.: A — habit. B — interior wall of sporocarp showing anastomosing venation. J. Kornaš, Pl. Afr. no. 6581, KRA

Widespread in tropical Africa and already recorded from Southern Nigeria (Alston 1959).

CERATOPTERIS RICHARDII BROGN.

Found only once on the Bauchi Plateau, floating in masses in pools of standing water on a river bank, in shade of an evergreen riverine forest. November, March.

Bauchi State: Yankari Game Reserve, along the river below Wikki Warm Spring, 9°45' N, 10°30' E, alt. 230 m, *AJK 6670*.

West Tropical Africa, from Senegal, Gambia and Sierra Leone to Liberia; isolated populations in the Sudan Republic and Madagascar; South America from Brazil to Guiana and Venezuela; isolated populations in Guatemala and the southern U.S.A. in Louisiana and Florida (Lloyd 1974). Not yet recorded from Nigeria.

ADIANTUM CAPILLUS-VENERIS LINN.

Under waterfalls in spray zones, apparently very local and limited to the hilly areas. November, April.

Kaduna State: Kafanchan Waterfall, c. 9°35' N, c. 8°18' E, *M. A. Dyer 0261*. **Borno State, Biu Plateau:** Jafi Kwaya Waterfall at Gubi near Kwaya Tera, 33 km SWW of Biu, 10°34' N, 11°52' E, alt. 360 m, on calcareous tufa over basalt, together with *Selaginella tenerrima* A. Br. ex Kuhn, *JK 6311*.

Almost cosmopolitan and widespread in Africa, but not yet recorded from Nigeria.

ADIANTUM INCISUM FORSK. S. STR.

In shaded crevices of sandstone rocks. January (most individuals already dormant).

Borno State, Biu Plateau: Lake Tila at Kwaya Bura near Biu, on the northern rim of the crater, 10°33' N, 12°08' E, alt. 750 m, *JK 6573*.

The specimens collected match the description of the "tetraploid race" in Manton et al. (1970), which is an African taxon, ranging from Ghana and the Sudan Republic to Namibia and South Africa. *A. incisum* has already been recorded from Northern Nigeria by Alston (1959).

ADIANTUM PHILIPPENSE LINN.

The most widely distributed fern in all hilly areas of Northern Nigeria. In the Mandara Mts. found usually only in deep and shady crevices, under overhangs or under boulders, in the most protected and humid microhabitats, on black and humus-rich soil, forming pure stands and freely reproducing vegetatively by the proliferous tips of rhachises. Young fronds appear about one month after the first rain (in May), they stay green and produce sporangia during the rainy season, till September, and turn yellow in October. The seasonal pattern seems to be much less rigid in the higher-rainfall areas.

Kaduna State: Dumbi Hill near Zaria, c. 10°55' N, c. 7°35' E, alt. 600-700 m, *JK n.c.*; Zaria, Kufena Rock, 11°05' N, 7°40' E, *M. E. Dyer 0028*. **Bauchi State:** Yankari Game Reserve, Wikki, 9°45' N, 10°30' E, alt. 250 m, *JK n.c.* **Borno State, Biu Plateau:** Jafi Kwaya Waterfall at Gubi near Kwaya Tera, 33 km SWW of Biu, 10°34' N, 11°52' E, alt. 360 m, *JK 6312*; Buratai Forest Reserve, Zagu Hill, 39 km S of Buni, 10°57' N, 12°05' E, alt. 600-700 m, *JK n.c.*; Lake Tila at Kwaya Bura near Biu, 10°33' N, 12°08' E, alt. 710 m, *JK n.c.* **Borno State, Mandara Mts.:** Guduf near Gwoza, 11°04' N, 13°43' E, alt. 480 m, together with *Cheilanthes farinosa* (Forsk.) Kaulf., *Nephrolepis undulata* (Afzel ex Sw.) J. Sm. and *Selaginella tenerrima* A. Br. ex Kuhn, *JK n.c.*; Gavva (Basle) Mission, 15 km S of Pulka, 11°07' N, 13°46' E, alt. 600 m, *JK n.c.*; Bokko Sato near Ngoshe, 9 km S of Pulka, 11°09' N, 13°47' E, alt. 490-590 m, *JK n.c.*; Kirawa, 16 km of Pulka, 11°11' N, 13°54' E, alt. 520 m, *JK n.c.* **Gongola State, Mandara Mts.:** Gulak, 10°49' N, 13°28' E, alt. 500 m, *JK n.c.*; on Zuwa River near Wuro Dawa, 10°51' N, 13°29' E, alt. 500 m, *JK n.c.*; Uba, 10°28' N, 13°14' E, alt. 490 m, *JK 6025*; Para Hussara near Uba, 10°30' N, 13°14' E, alt. 520 m, *JK 6242*. **Cameroon, Margui-Wandala Reg., Mandara Mts.:** Rhoumsiki, 10°31' N, 13°35' E, alt. c. 1000 m, *JK n.c.*; Rhoumzou, 25 km S of Mokolo, 10°42' N, 13°36' E, alt. 1050 m, *JK n.c.* **Cameroon, Diamaré Reg.:** Pic de Mindif, c. 10°26' N, c. 14°25' E, alt. c. 450 m, *JK n.c.* **Cameroon, Logone-Chari Reg.:** Waza, 11°22' N, 14°38' E, alt. c. 450 m, *JK n.c.*

Pantropical; widespread in Africa and already recorded from several places in Northern Nigeria (Alston 1959) and Northern Cameroon (Tardieu-Blot 1964).

ADIANTUM SCHWEINFURTHII KUHN

Collected in the Mandara Mts. only in Cameroon, but very likely to be found also on the Nigerian side. Under overhanging boulders near a source, on bare soil, in shade. April (dormant specimens only).

Cameroon, Margui-Wandala Reg., Mandara Mts.: Rhoumzou, 25 km S of Mokolo, 10°42' N, 13°36' E, alt. 1020 m, *AJK 6752*.

Widespread in the moister parts of tropical Africa from Guinea and Mali to the Sudan Republic, Sokotra and Angola, and already recorded from Northern Nigeria (Alston 1959) and Southern Cameroon (Tardieu-Blot 1964).

CHEILANTHES FARINOSA (FORSK.) KAULF. S. L.

Very rare in the Mandara Mts., and occurring in highly reduced dwarf specimens only. On bare soil in deep shade of overhanging boulders. March-June (dormant specimens).

Borno State, Mandara Mts.: Guduf near Gwoza, 11°04' N, 13°44' E, alt. 480 m, together with *Adiantum philippense* Linn., *Nephrolepis undulata* (Afzel ex Sw.) J. Sm., and *Selaginella tenerrima* A. Br. ex Kuhn, *AJK 6805*; Gavva (Basle) Mission, 15 km S of Pulka, 11°07' N, 13°46' E, alt. 740 m, *AJK 7007*.

A highly polymorphic complex, very much in need of critical revision. Widely distributed in tropical Africa and Asia. Already recorded from Northern Nigeria by Alston (1959).

PELLAEA DONIANA J. SM. EX HOOK.

Uncommon on granitic hills of the Mandara Mts. In large colonies under huge overhanging boulders, in half-shade, on black humus soil. Fronds persistent, poikilohydrous, dormant through the dry season (from October to March) and "reviving" short after the first rain (in April). Young fronds and prothalli with very young sporophytes also found in April.

Borno State, Mandara Mts.: Gavva (Basle) Mission, 15 km S of Pulka, 11°07' N, 13°46' E, alt. 780 m, *AJK 7008*; Guduf near Gwoza, 11°04' N, 13°44' E, alt. 480 m, *AJK 6799*. Gongola State, Mandara Mts.: on Zuwa River near Waro Dawa, 10°51' N, 13°30' E, alt. 500 m, *JK 6251*; Para Hussara near Uba, 10°30' N, 13°14' E, alt. 520 m, *JK 6243*.

Widespread in tropical Africa from Guinea and Sierra Leone to the Sudan Republic, Mozambique and Angola, and already recorded from Northern Nigeria by Alston (1959). This is apparently the least drought resistant *Pellaea* in Zambia, where it usually grows in the shade of evergreen riverside forests, while other *Pellaea*

species occupy rock crevices in open sunny places (Kornaś 1979). It seems that in the Mandara Mts. *P. doniana* just takes advantage of its higher shade tolerance, "submerging" into the relatively humid cave-like habitats under overhanging boulders, and thus avoiding the excessive drought.

ASPIDOTIS SCHIMPERI (KUNZE) PIC. SER.

Very rare on granitic hills of the Mandara Mts. Under overhanging rocks, in half-shaded crevices. July-October.

Borno State, Mandara Mts.: Takaskara Hills, 11 km S of Gwoza, 10°59' N, 13°40' E, alt. 520-540 m, *JK 7073*. **Cameroon, Margui-Wandala Reg., Mandara Mts.:** Rhoumsiki, 10°31' N, 13°35' E, alt. c. 1000 m, *JK n.c.*; Rhoumzou, 25 km S of Mokolo, 10°42' N, 13°36' E, alt. c. 1050 m, *JK n.c.*

Widespread in tropical Africa from Nigeria to Ethiopia, Mozambique and Rhodesia, and already recorded from several places in Northern Nigeria by Alston (1959). Not indicated by Tardieu-Blot (1964) for Cameroon.

ACTINOPTERIS RADIATA (SW.) LINK

This is a very common and most drought-resistant lithophytic fern of Northern Nigeria, occurring in the hilly regions of the Bauchi and Biu Plateaux and the Mandara Mts. In crevices of dry granitic rocks. Found fully sun-exposed only in the higher-rainfall areas; in the Mandara Mts. always in the half-shade under overhangs, between boulders, etc., on bare soil. Fronds persistent and poikilohydrous; the plants become active after each rain, starting with the first one (in April), and enter their definitive dormancy period at the beginning of the dry season (September-October). Young fronds of the current year seen since June.

Kano State: Kila, 32 km E of Birnin Kudu, 11°20' N, 9°46' E; alt. c. 500-600 m, *JK n.c.* **Borno State, Biu Plateau:** gorge below Jafi Kwaya Waterfall at Gubi near Kwaya Tera, 33 km SWW of Biu, 10°34' N, 11°52' E, alt. 390 m, *JK 6317*; Buratai Forest Reserve, Zagu Hill, 39 km S of Buni, 10°57' N, 12°05' E, alt. 600-700 m, *JK n.c.* **Borno State, Mandara Mts.:** Takaskara Hills, 11 km S of Gwoza, 10°59' N, 13°40' E, alt. 600 m, *AJK 6934* (rev. R. E. G. Pichi Sermolli); Guduf near Gwoza, 11°04' N, 13°43' E, alt. 500 m, together with *Actiniopteris semiflabellata* Pic. Ser., *AJK 6803*; Gavva (Basle) Mission, 15 km S of Pulka, 11°07' N, 13°46' E, alt. 500 m, *AJK 7012* (rev. R. E. G. Pichi Sermolli); Pulka, on Kirawa Rd., 11°13' N, 13°47' E, alt. 450 m, *JK n.c.*; Bokko Sato near Ngoshe, 9 km S of Pulka, 11°09' N, 13°47' E, alt. 520 m, *JK 6306*; Kirawa, 16 km of Pulka, 11°11' S, 13°54' E, alt. 520 m, *JK n.c.* **Gongola State, Mandara Mts.:** on Zuwa River near Wuro Dawa, 10°51' N, 13°29'-13°30' E, alt. 480-500 m, *AJK 6249, 6879*. **Cameroon, Diamaré Reg.:** Pic de Mindif, c. 10°26' N, c. 14°15' E, alt. c. 450 m, *AJK 6738*.

The widest distributed species of the genus, occurring in Africa from the Cabo Verde Is., Togo, Northern Nigeria, N. Sudan and N. E. Egypt to Namibia, Botswana and South Africa. Also known from Madagascar, the Mascarene Is. and Southern Asia from Arabia to India and Ceylon. Already recorded from Northern Nigeria

by Alston (1959) and from Northern Cameroon by Tardieu-Blot (1964): however, records earlier than Pichi Sermolli's revision (1962) remain doubtful because of the possible confusion with the following species (cfr. Kornaš et al., 1982).

ACTINIOPTERIS SEMIFLABELLATA PIC. SER.

Collected only once in the Mandara Mts., and apparently very rare. Found under boulders on a rocky slope of granitic hill, in half-shade, together with *A. radiata* (Sw.) Link. April.

Borno State, Mandara Mts.: Guduf near Gwoza, 11°04' N, 13°43' E, alt. 500 m, *AJK 6803 A*

A species of northeastern and eastern tropical Africa, occurring from Tanzania and E. Zaire to S. Sudan and N. E. Egypt, and extending westwards to N. Cameroon and N. E. Nigeria. Also found in Arabia, Yemen, Madagascar and the Mascarene Is. Older data on the occurrence of *Actiniopteris australis* (Linn. f.) Link in Nigeria and Cameroon (Alston 1959, Tardieu-Blot 1964) most probably refer to *A. semiflabellata*.

NEPHROLEPIS UNDULATA (AFZ. EX SW.) J. SM.

Very rare in the Mandara Mts. Growing on granitic hills, in the full shade under overhanging boulders, on bare soils. Specimens markedly reduced in size and vitality. July.

Borno State, Mandara Mts.: Guduf near Gwoza, 11°04' N, 19°43' E, alt. 510 m, together with *Adiantum philippense* Linn., *Cheilanthes farinosa* (Forsk.) Kaulf. s.l. and *Selaginella tenerrima* A. Br. ex Kuhn, *JK n.c.*; Gavva (Basle) Mission, 15 km S of Pulka, 11°07' N, 13°46' E, alt. 740 m, together with *Adiantum philippense* Linn., *AJK 7006*. **Cameroon, Margui-Wandala Reg., Mandara Mts.:** Rhoumzou, 25 km S of Mokolo, 10°42' N, 13°36' E, alt. c. 1050 m, *JK n.c.*

Widespread in tropical Africa, Madagascar and the Mascarene Is., and already recorded from various places in Northern Nigeria by Alston (1959).

CHRISTELLA DENTATA (FORSK.) HOLTZ.

(= *CYCLOSORUS DENTATUS* (FORSK.) CHING, *THELYPTERIS DENTATA* (FORSK.) ST. JOHN)

Very rare in the Mandara Mts., found only in one locality in the upper part of a granitic hill, in the bed of a permanent rivulet, in the shade under overhanging boulders or dense evergreen shrubs, on humid gravel soil. Much reduced specimens, with very few sori. March, June.

Borno State, Mandara Mts.: Gavva (Basle) Mission, 15 km S of Pulka, 11°07' N, 13°46' E, alt. 700 m, *AJK 6697, 7004*.

Distributed throughout the tropics of the Old World, adventive in South America (Holtum 1974). Widespread in tropical Africa, and already recorded from Northern Nigeria by Alston (1959).

CYCLOSORUS STRIATUS (SCHUM.) CHING
(=*THELYPTERIS STRIATA* (SCHUM.) SCHELPE)

Collected only on the Bauchi Plateau, but most probably rather widely distributed in swampy places of Northern Nigeria. On a river bank in evergreen river-side forest, dominant in wet depressions. March.

Bauchi State: Yankari Game Reserve, Wikki, along the river below Wikki Warm Spring, 9°45' N, 10°30' E, alt. 230 m, *AJK 6668*, *M.E. Dyer 0151*.

Widespread in tropical Africa (Holttum 1974), and already reported from various places in Northern Nigeria by Alston (1959).

DISCUSSION

Two different pteridophyte floras occur in Northern Nigeria, more or less excluding one another:

1. the highly specialized hydrophytic flora of ferns and fern allies flourishing in the seasonal pools of the Lake Chad Basin;
2. the xerophytic flora of rock habitats, limited to the hilly areas of the Mandara Mts. and the Biu and Bauchi Plateaux.

The hydrophytic ferns seem to be very characteristic of the northern part of the Sudanian Domain and the Sahelian Domain of tropical Africa. They appear in the Lake Chad Basin of Northern Nigeria to the end of the rainy season and at the beginning of the dry season, when the seasonal pools and lakes shrink and uncover their muddy bottoms. The perennating organs of these plants are either buried underground (corms of *Isoetes schweinfurthii*, sporocarps of *Marsilea distorta* and *M. subterranea*) or closely adhere to the substratum (rhizomes of *Marsilea* spp., sporocarps of *M. minuta*). A marked ecological specialization among the *Marsilea* species is evident; some of them seem to be strictly aquatic (*M. berhautii*) or terrestrial (*M. distorta*), and the others regularly amphibious, starting their seasonal cycle submersed and finishing it with an emersed phase of sporocarp production (*M. minuta*, *M. nubica*, *M. subterranea*). There is a clear phenological sequence in the appearance of the species, the most precocious being *M. nubica*, followed by *M. distorta* and *M. minuta*, and the most tardy *M. subterranea*. This is the reason why the *Marsilea* species show a marked zonation when growing side by side: the more precocious one on the periphery and the tardier one in the centre of the pool (as seen e.g. in the case of *M. nubica* and *M. minuta* at Gajibo near Dikwa). However, there is also a kind of specialization with regard to the substratum: some species seem to prefer light, sandy soils (*M. distorta*), while some others occur preferably (*M. minuta*) or exclusively (*M. subterranea*) on very heavy soils. Along with the typically geocarpic species which bury their sporocarps under the ground due to the positively geotropic growth of pedicels (*M. distorta*, *M. subterranea*), there are other in which the sporocarps always remain exposed on the

soil surface (*M. minuta*). All these facts indicate that the genus *Marsilea* has undergone intense adaptive radiation in the dry parts of the savanna zone of tropical Africa — a process which certainly is worth studying in more details.

The lithophytic ferns found in Northern Nigeria represent the most drought-resistant types and mostly belong to one of three different life-forms (Kornaś 1977): poikilohydrous hemicryptophytes with persistent xeromorphic fronds (*Actiniopteris radiata*, *A. semiflabellata*, *Adiantum incisum*, *Cheilanthes farinosa*, *Pellaea doniana*), geophytes (*Ophioglossum* spp., *Nephrolepis undulata*), or therophytes (*Selaginella tenerrima* — Kornaś and Jankun 1983). The proportion of mesomorphic summer-green hemicryptophytes which become leafless in the dry season is negligible (*Adiantum philippense*, *A. schweinfurthii*, *Aspidotis schimperii*). Thus the flora of rock ferns of Northern Nigeria is evidently more xerophytic than a similar flora occurring in Zambia (Kornaś 1979), and has to be regarded as a highly impoverished outlier of its kind, growing just at the verge of existence. The climatic character of this boundary is clearly indicated by the fact, that the lithophytic ferns in the northern Mandara Mts. evidently avoid open places and seek their shelters in more favourable microhabitats of deep crevices under overhangs and boulders. The same observation also was made in Northern Cameroon, where lithophytic ferns “se refugient dans les anfractuosités rocheuses des ruptures de pente et n'apparaissent qu'en saison des pluies” (Tardieu-Blot et al. 1949).

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REFERENCES

- Alston A. H. G., 1959. The ferns and fern allies of West Tropical Africa. Suppl. to the 2nd ed. of the Flora of West Tropical Africa, Crown Agents for Oversea Governments and Administrations, London.
- Brenan J. P. M., 1979. Some aspects of the phytogeography of tropical Africa. Ann. Missouri Bot. Gard. 65: 437-478.
- Hepper F. N., 1978. Africa. In: Systematic Botany, Plant Utilization and Biosphere Conservation. Hedberg I. (ed.), Almqvist and Wiksell, Stockholm, pp. 41-46.
- Hepper F. N., 1979. Second edition of the map showing the extent of floristic exploration in Africa south of the Sahara, published by A. E. T. F. A. T. In: Taxonomic Aspects of African Eco-

- onomic Botany. Proceedings of the IX Plenary Meeting of A. E. T. F. A. T. Kunkel G. (ed.), A. E. T. F. A. T., Las Palmas de Gran Canaria, pp. 157-162.
- Holmgren P. K., Keuken W., Schofield E. K., 1981. Index Herbariorum. Part I. The Herbaria of the world. 7th ed., W. Junk Publ., Utrecht/Antwerpen — The Hague/Boston, Bohn, Scheltema and Holkema. pp. VIII, 452.
- Holtum R. E., 1974. *Thelypteridaceae* of Africa and adjacent islands. J. S. African Bot. 40: 123-168.
- Hutchinson L. L. D., Dalziel J. M., 1954-1972. Flora of West Tropical Africa. Crown Agents for Oversea Governments and Administrations, London. Vol. I: pp. VIII, 828. Vol. II: pp. XI, 544. Vol. III: pp. VI, 574.
- Kornaś J., 1977. Life-forms and seasonal patterns in the pteridophytes in Zambia. Acta Soc. Bot. Pol. 46: 669-690.
- Kornaś J., 1979. Distribution and ecology of the Pteridophytes in Zambia. PWN, Warszawa.
- Kornaś J., Dzwonko Z., Harmata K., Pacyna A., 1982. Biometrics and numerical taxonomy of the genus *Actiniopteris* (*Adiantaceae*, *Filicopsida*) in Zambia. Bull. Jard. Bot. Natl. Belg. 52: 265-309.
- Kornaś J., Jankun A., 1983. Annual habit and apomixis as drought adaptations in *Selaginella tenerrima* A. Braun ex Kuhn. Bothalia 14: 3-4.
- Launert E., 1968. A monographic survey of the genus *Marsilea* Linnaeus. I. The species of Africa and Madagascar. Senckenberg. Biol. 49: 273-315.
- Léonard J., 1965. Carte du degré d'exploration floristique de l'Afrique au sud du Sahara. Map of the extent of floristic exploration in Africa south of the Sahara. Webbia 19: 907-914.
- Lloyd R. M., 1974. Systematics of the genus *Ceratopteris* Brogn. (*Parkeriaceae*). II. Taxonomy. Brittonia 26: 139-160.
- Manton I., Sinha B. M. B., Vida G., 1970. Cytotaxonomic studies in the *Adiantum caudatum* complex of Africa and Asia. II. Autoploidy and alloploidy in African representatives of *A. incisum*. J. Linn. Soc. Bot. 63: 1-21.
- Pfeiffer N. E., 1922. Monograph of the *Isoëtaceae*. Ann. Missouri Bot. Gard. 9: 79-227.
- Pichi-Sermolli R. E. G., 1962. On the fern genus "*Actiniopteris*" Link. Webbia 17: 1-32.
- Reed C. F., 1953. Index *Isoëtiales*. Bol. Soc. Brot. 27: 5-72.
- Schelpé E. A. C. L. E., 1970. *Pteridophyta*. Flora Zambesiaca. Crown Agents for Oversea Governments and Administrations, London.
- Schelpé E. A. C. L. E., Diniz M. A., 1979. Flora de Moçambique. *Pteridophyta*. Junta de Investigações Científicas do Ultramar, Centro de Botânica, Lisboa.
- Tardieu-Blot M.-L., 1964. Pteridophytes. In: Flore du Cameroun. Aubreville A. (ed.). Museum National d'Histoire Naturelle, Paris, no. 3: 1-372.
- Tardieu-Blot M.-L., Niklès H., Jacques-Felix H., 1949. Contribution à la flore et à l'écologie des fougères du Cameroun. Études Cameroun 2: 81-112.

Paprotniki zebrane w północnej Nigerii i północnym Kamerunie

Streszczenie

Zebrano 25 gatunków paprotników w północnej Nigerii (głównie w niecce Jeziora Czad i w górach Mandara) oraz w przyległych częściach Kamerunu. 11 spośród nich nie było podawanych z tego terenu: *Isoëtes schweinfurthii* A. Br. in Bak., *Selaginella tenerrima* A. Br. ex Kuhn, *Ophioglossum gomezianum* Welw. ex A. Br., *Marsilea coromandeliana* Willd., *M. distorta* A. Br., *M. nubica* A. Br., *M. subterranea* Lepr. ex A. Br., *Azolla africana* Desv., *Ceratopteris richardii* Brogn., *Adiantum capillus-veneris* Linn. i *Actiniopteris semiflabellata* Pic. Ser.