A NEW TRIASSIC FLORA FROM LIVINGSTON ISLAND, SOUTH SHETLAND ISLANDS*

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A NEW and interesting fossil flora, which was discovered at Livingston Island (lat. 62°36′S., long. 60°30′W.), South Shetland Islands, has been studied, and it can be assigned a Triassic age. This is the first time that sediments containing Triassic plant fossils have been recorded in western Antarctica.

The flora, which is represented by a small number of species and also relatively few specimens, can be compared directly with the Triassic flora of Argentina and therefore with all of the deposits of this stratigraphic horizon in the Upper Gondwana of India, Africa and Australia.

The species comprising this new flora do not allow precise correlation or comparison, because some of them are new to the palaeontological literature and the remainder are either too poorly preserved or too damaged to enable them to be determined specifically. Furthermore, it is even difficult to recognize the genus to which some of the specimens belong.

The limited amount of fossiliferous material (39 specimens) comprising the new fossil flora is all that was collected by G. J. Hobbs in January and March 1959 from the several localities on Livingston Island (Fig. 1). For this reason it is at present impossible to carry out a more exhaustive analysis of additional material which could confirm the age suggested by the deposits. Nevertheless, the general appearance of the flora indicates a clear connection with the classical deposits of Argentina known to the present time, which are of Upper Gondwana age in the Precordillera of San Juan, La Rioja and Mendoza.

These beds, which were long considered to be Rhaetic in age by comparison with European formations of the same age, indicate the existence of ancient lacustrine basins (either limited in extent or extensive), whose deposits always show definite characteristics. According to Frenguelli (1948), the represent "pockets" situated between rigid crystalline blocks in those areas which are partly covered by Palaeozoic sediments.

Many geologists have investigated the "Rhaetic" outcrops or "Rhaetic strata" of the Argentine Precordillera; Stelzner (1885) began the study of these outcrops without giving any degree of detail; following him were Brackebusch (1891), Bodenbender (1896, 1911), Hausen (1921), Rassmuss (1922), von Huene (1931), Groeber (1940), Cabrera (1943), Borello (1944) and Braccaccini (1946). Frenguelli, between 1943 and 1948, after a careful analysis of the problem, resolved it and showed (Frenguelli, 1948, p. 300) that the sediments referred to as "Rhaetic" form a sequence in which one can distinguish four conformable horizons, which are well differentiated by their palaeontological and petrographical characters, and which are named after the localities where the major basins that are represented occur:

i. *Strata of Ischichuca—Cerro de las Cabras*, which contain the remains of fish related to those of the South African Beaufort Series, and plant remains connected with the Lower Molteno and Beaufort Series, the Narrabeen beds, the Esk Series (Australia) and the Parsora beds (India). According to Frenguelli, this horizon contains a flora whose genera of Permian descendence (*Zuberia*, *Noeggerathiopsis* and *Asterotheca*) are mixed with Triassic genera (*Cladophlebis*, *Dicroidiopsis*, *Neocalamites* and *Johnstonia*), from which he inferred that they cannot be younger than Middle Triassic in age.

ii. *Strata of Rastros—Potrerillos*, which are conformable with (i) above and which have an abundant fossil flora including a species from the Upper Permian and Lower Triassic of Australia and many species common to beds which are attributed to the Lower and Middle Triassic and the Lower Keuper in South Africa (lower part and middle of the Molteno Series) and Australia (Upper Esk, Hawkesbury Beds, Lower Ipswich). Furthermore, fish connected with the Upper Beaufort Series of South Africa and the Lower and Middle Triassic Hawkesbury Beds of Australia have been found here.

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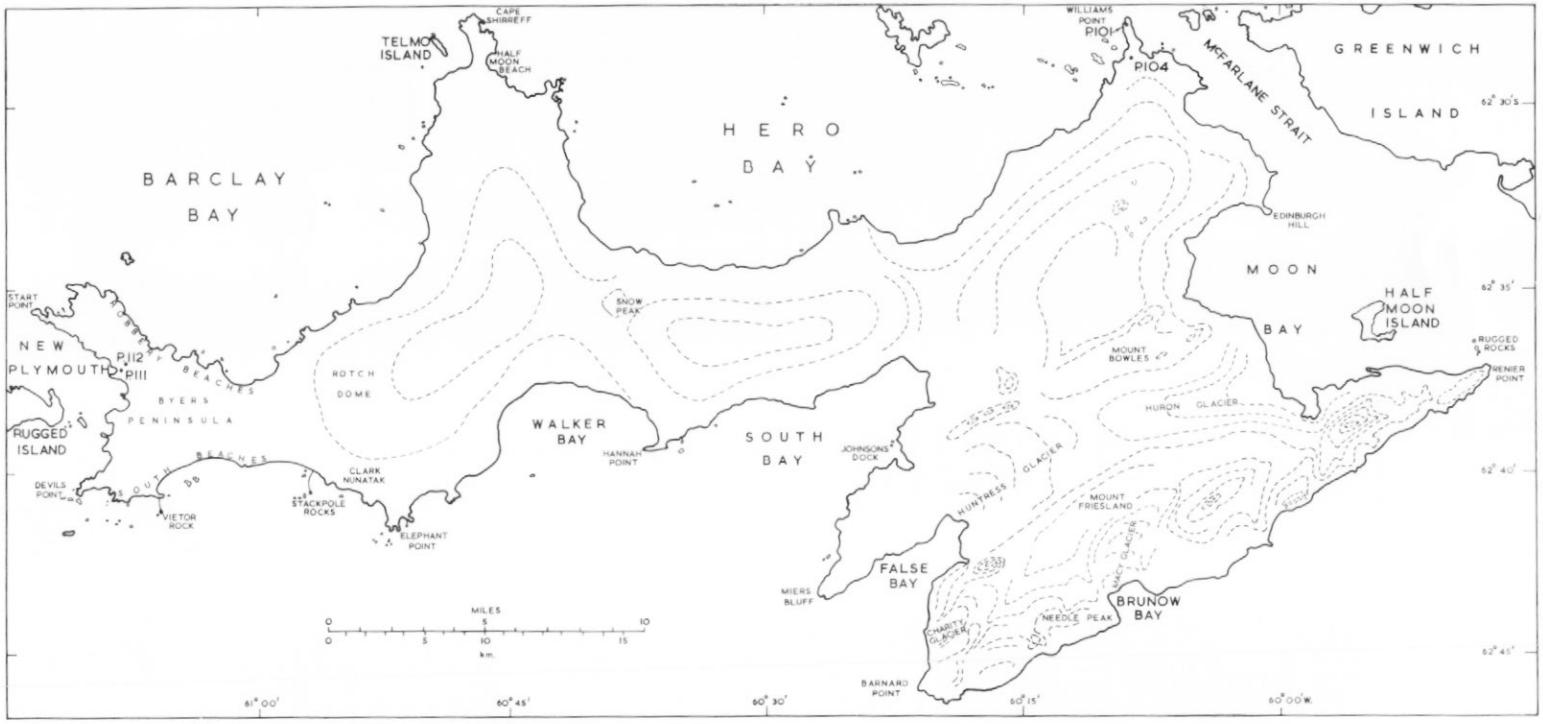


Fig. 1. Sketch map of Livingston Island, South Shetland Islands, showing the localities of the specimens described here.

iii. *Strata of Ischigualasto—Cacheuta*, which have been observed to be transitional above those of Rastros—Potrerillos and also possess abundant remains of fossil plants with a predominance of *Dicroidium odontopteroides* and *D. lancifolium*, characteristic of the Upper Keuper, i.e. the Upper Ipswich (Australia) and the Upper Molteno Series (South Africa). On the other hand, there has been mention of the remains of batrachians and fossil reptiles closely related to genera and species of the Red Beds of the Molteno Series (South Africa) and the Santa Maria beds (Brazil), from which Frenguelli insists that they should correspond to the Noriano.

iv. *Strata of Gualo—Río Blanco*, which overlie (iii) and which are transitional; because of their interstratification they are intimately related to the basic pillow lavas of northern Patagonia, which can be considered as lying between the Rhaetic and the Lower Lias (Hettangiano).

According to Frenguelli (1948), the Triassic of the Argentine Precordillera was deposited in separate basins "escalonadas en serie a lo largo de los viejos bloques positivos, pero entre sí separadas e independientes, cada una revistiendo además, los caracteres de un bolsón tectónicamente activo, lo que permitió la acumulación de potentes pilas sedimentarias en ambientes lacustres de fondo chato y aguas someras" ["arranged in series along the old elevated blocks, but separate and independent of each other, each one having the characteristics of a tectonically active basin which allowed the accumulation of thick deposits in lacustrine environments with flat bottoms and shallow waters"].

The fossils described here accumulated in a lacustrine basin of limited extent but comparable with those which were responsible for the Lower to Middle Triassic deposits of the Argentine Precordillera.

Field Relations

The plant remains described here were collected from detrital material at Williams Point (Fig. 1; P.101, 104) and *in situ* on the Start Point peninsula (Fig. 1; P.111, 112). The "Younger Volcanic Group" (Hobbs, 1968), which comprises stratified volcanic rocks (andesite and basalt lavas, tuffs and agglomerates) interbedded with sediments (conglomerates, conglomeratic sandstones and tuffaceous sandstones) bearing plant remains and carbonized woods, is exposed at both of these localities. Because of the paucity of good exposures, the complete stratigraphic sequence in the "Younger Volcanic Group" has not yet been established.

Pebbles of sedimentary rocks, similar to those of Williams Point and the Start Point area, and also containing plant remains, are abundant in the moraines fringing the central ice cap of Livingston Island, and therefore it is concluded that they have a wide distribution.

While the northern promontory of Williams Point is formed by a westward-dipping, massive, amygdaloidal lava flow at least 75 ft. (22·8 m.) thick, to the south-west fine-bedded conglomerates 5–10 ft. (1·5–3·0 m.) thick occur at the base of a 50 ft. (15·2 m.) thick, massive, unbedded pale conglomerate with well-rounded boulders averaging 1 ft. (0·3 m.) in diameter. Although no plant fossils were observed in these conglomerates, a 6 ft. (1·8 m.) thick coarse greenish conglomeratic sandstone overlying them contains poorly preserved plant stems. The conglomerates are overlain by massive lava flows at least 200 ft. (61 m.) thick and displaying prominent vertical jointing.

In thin section the greenish conglomeratic sandstones contain a considerable amount of volcanic material, indicating that there was volcanic activity during the deposition of the sediments.

As is the case over the whole of Byers Peninsula, the highest part of the Start Point peninsula is formed by basaltic agglomerates and augite-andesites, some of which contain pyroclasts up to 4–5 ft. (1·2–1·5 m.) in length. This volcanic sequence dips gently southward. Greenish grey and buff-coloured tuffaceous sandstone intercalations are common at several horizons in the volcanic succession.

Both at Williams Point and on the Start Point peninsula, frost-shattering of detritus derived from the sedimentary intercalations has split them into platy and angular fragments which cover large areas. At Williams Point the best-preserved fossil plants occur in a fine-grained, buff-coloured tuffaceous matrix forming detrital fragments scattered over the 75 ft. (22·8 m.) high lava platform.

Material Examined

The greater part of the material described here was collected at station P.101 (Fig. 1) on Livingston Island, and it is a homogeneous collection of quite well preserved fossil impressions, on which the conclusions given here are based. The remainder of the specimens are of little value because of their poor preservation; they are mainly specimens of indeterminate plants, which are sometimes covered with a carbonaceous patina.

Some coal specimens were collected at station P.104 (Fig. 1); specimen P.104.6 is a prismatic piece of coal $5 \times 5 \times 2$ cm. in size but it does not possess any plant impression or cellular structure; it is probably the internal part of a carbonized trunk because there is no indication of remains of the bark. As a result of an analysis carried out on a small part of this carbonaceous material, no sporomorphs or pollen grains were found. The general appearance of this carbonaceous mass does not allow the assumption that it could possibly be composed of various plant materials (leaves, branches, fruits, etc.) which accumulated and were carbonized, but that it is simply a piece of wood which has undergone carbonization with total alteration of its structure. The other carbonaceous fragment studied, specimen P.104.5, also has no features to enable it to be determined and it can only be classified as "carbonized vegetable material".

Specimens P.111.1, 2 and 3 (Fig. 1) are also of little palaeontological value, because they are indeterminate impressions in the form of small leaf fragments and compressed stems, which indicate that they had been transported and crushed prior to their final accumulation in the basin. The coarse grain-size of the sandy rock has not allowed preservation of either the morphological or anatomical characters.

Specimens P.112.2, 3 and 6 (Fig. 1), which are similar to the material mentioned above, are plant remains in the form of carbonaceous patinas which do not allow any positive determination. In spite of the carbonaceous surface having an appreciable thickness, it has not preserved any recognizable cellular elements. Oxidation of the organic substance was carried out with the intention of finding epidermal cuticles or the remains of cells but the part submitted to this treatment gave no positive results. This type of sample is relatively frequently found in the Triassic series of Cacheuta and Potrerillos, in some of which it has been possible (when properly oxidized with nitric acid and potassium chlorate) to identify the cellular epidermal structure and therefore to arrive at specific determinations (Orlando, 1954).

Specimen P.101.26 has dark indeterminate remains which remind one of the classical mineral dendritic markings but they have a radial arrangement in plan, are somewhat irregular and in some parts resemble the "form genus" *Chondrites*, which is of little palaeobotanical value. On the reverse side of this specimen there is an indeterminate plant impression corresponding to part of a branch.

Specimen P.101.5 is an indeterminate impression of a stem or rachis of a pteridophyte or pteridosperm on a very coarse-grained sandstone, which has prevented the preservation of the blade of the frond.

Species Determined

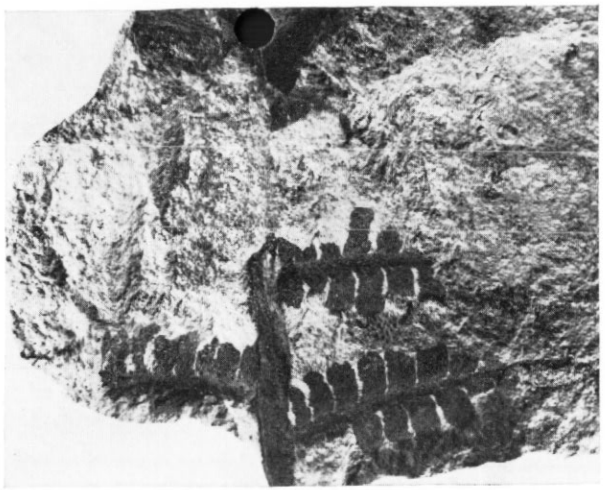
Asterotheca crassa n. sp.

Figs. 2a-d, 3a-d

Based on numerous impressions of fragments of fronds collected at station P.101, this is proposed as a new species which occurs in several forms in specimens P.101.8, 9, 10, 11, 15, 17, 18, 19, 20, 21 and 23. In general appearance, the impressions examined appear to correspond to a woody plant with probably well-developed tripinnate fronds.

The fragments of the fronds studied are all sterile, although on the surfaces of the pinnules of some specimens there is some granulation (P.101.20; Fig. 2d) which resembles fertile organs, but this is only a product of fossilization because the same granulation occurs on the rachis and the surface of the rock on which the impression occurs.

The impressions examined are small fragments of damaged fronds, not only of the distal but also of the proximal parts.



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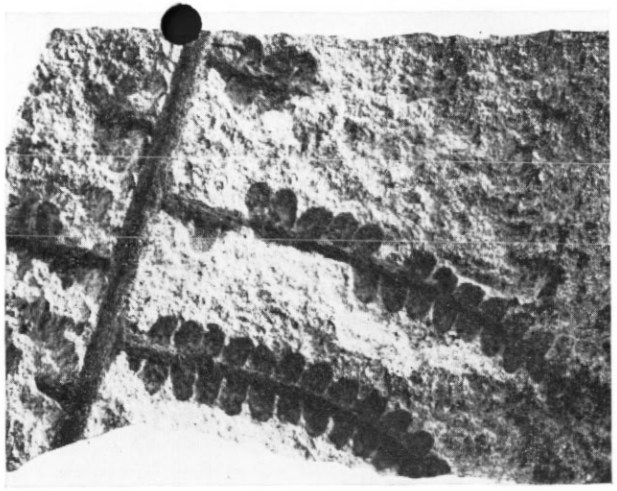

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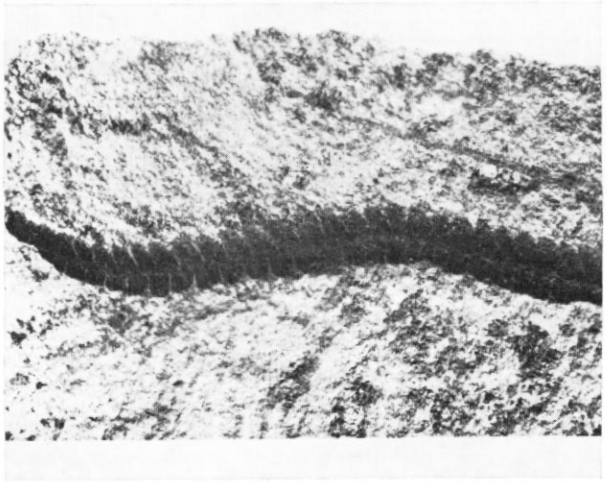

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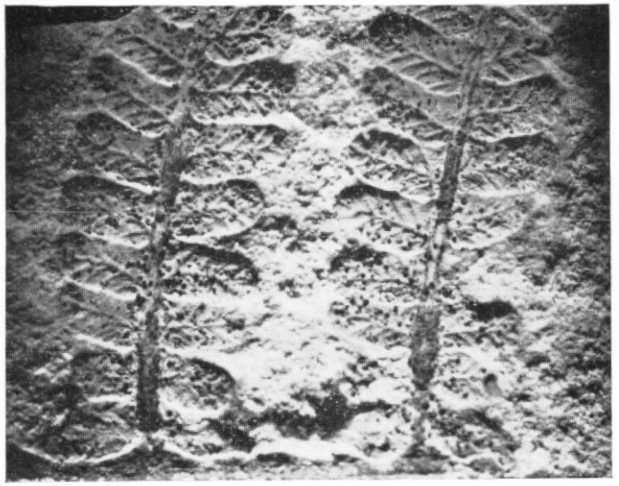


d

Fig. 2. a. *Asterotheca crassa* n. sp. (P.101.15; ×2·45).
c. *Asterotheca crassa* n. sp. (P.101.8; ×2·2).

b. *Asterotheca crassa* n. sp. (P.101.18; ×3·45).
d. *Asterotheca crassa* n. sp. (P.101.20; ×5·5). (Photograph of the Instituto Antártico Argentino, catalogue number VN 399.)

Fig. 3a shows the proximal part of a second-order pinna, in which the characteristics of the rachis and the insertion of the pinna can be well seen; in every case the pinna is linear-lanceolate becoming narrower towards the distal end and whose apex (now damaged) was possibly acute. As in all the fronds of this type, the principal rachis was rigid, thin and becoming more delicate and incurved towards the apex. In isolated impressions of the proximal fragments of the rachis, which presumably belong to this species, a pronounced keel with a sharp border has been noted.

The third-order pinnae are distributed at a definite distance from each other, alternating and never coming into contact on their lateral margins. They are linear with parallel edges on the proximal part but towards the distal extreme the edges converge and the pinna becomes lanceolate. In nearly all cases, the apex of these third-order pinnae is damaged. The maximum width of the pinnae measured reaches 8 mm. Normally, the dimensions of the rachis are proportional to the size of the pinnae and they vary from 1·5 to 0·8 mm. in thickness.

The insertion of the pinna on the rachis is alternating and it occurs at an angle of 80–90°; in the proximal zones of the frond there is a slight decurrency. In the distal extremes the angle of insertion may become more acute.

The pinnules, which are densely distributed, are small, opposite or sub-opposite and attached to the sides of the rachis at an angle of 75° in the older proximal parts of the frond and at 45° in the distal younger parts of the frond. The form of the pinnules is elliptic to round trapezoid or rectangular round according to the position of the frond. In the older parts of the frond the pinnules are separated but they gradually come closer together up to the point of being imbricated in the extreme young parts, where the proximal edge of the distal pinna is superimposed and covers the distal edge of the proximal pinna. The lamina of the pinnules must have been very thick, considering the concavity or the pronounced convexity of the impressions on some of the specimens, as can be seen in Fig. 3c. The pinnules have a distinct median vein which extends as far as the apex of the lamina, but which is decurrent in the older parts of the frond. Secondary veins, which are also very marked, are given off from this central vein at an angle of 45°, and they form deep depressions on the upper surface of the pinnule, thus confirming what has already been mentioned in respect of the thickness of the lamina. The secondary veins do not divide and are normally straight; they are slightly curved and with the convexity towards the apex of the pinnule when they belong to pinnules of the younger parts of the frond. The size of the pinnules is variable, from 2·8 mm. in the best developed to 1 mm. in the smallest.

In agreement with the characteristics indicated above, the species described here can be compared with illustrations of specimens from the Sierra de los Llanos, La Rioja (Kurtz, 1921, pl. IX, figs. 106–111, 120–121), from Cacheuta (Kurtz, 1921, pl. XVI, fig. 202a, b) and from Río Atuel (Kurtz, 1921, pl. XXIII, figs. 338–340, 342, 344, 347, 348, 349; pl. XXIV, figs. 343a, 345, 347, 350, 351), and which have been determined as *Asplenium whitbyense*. It can also be compared with pl. XXIII, fig. 339 (Kurtz, 1921), which has been determined as *Asterotheca fuchsii* (Schimp.) Solms by comparison with the "Rhaetic" species of La Ternera (Chile), which Solms-Laubach (1899, p. 604) determined as *Pecopteris* (*Asterotheca*) *fuchsii* Schimp.

The new form is quite close to the characteristics of the last-named species, but the distribution of the venation does not allow its identification. Another example which is very closely related to the species described here is *Asterotheca truempyi* Frenguelli (1942, p. 421), but this species differs from it and its relatives in the form of the base of the pinnules and the general appearance.

For this reason it is believed that a new species is being dealt with and that this cannot be identified with any of those already known; therefore the new name *Asterotheca crassa* is proposed.

In the Gondwana Triassic the genus *Asterotheca* is well represented in all the known deposits, and in Argentina it is found in the Cerro de las Cabras beds, which are the lower beds of the Triassic series in the Argentine Precordillera.

Thinnfeldia sp.

Fig. 4

A fragmentary and badly preserved impression of a pinnate frond (P.101.22) is included in this genus. A keeled rachis is determined by the presence of a rib or central longitudinal

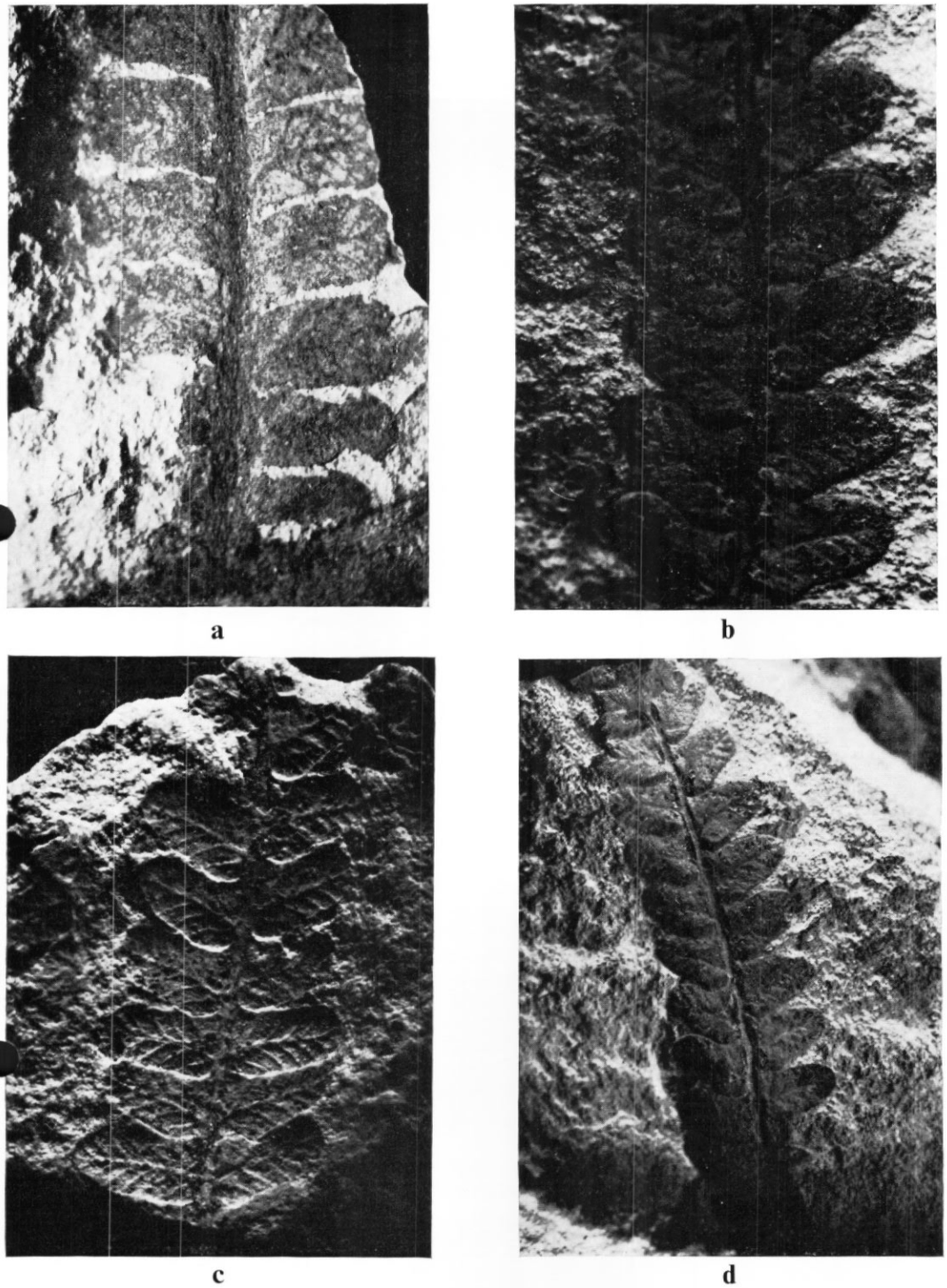


Fig. 3. a. *Asterotheca crassa* n. sp. (P.101.21; ×8·3). (Photograph of the Instituto Antártico Argentino, catalogue number VN 385.)
b. *Asterotheca crassa* n. sp. (P.101.20; ×10·1). (Photograph of the Instituto Antártico Argentino, catalogue number VN 386.)
c. *Asterotheca crassa* n. sp. (P.101.20; ×7·0). (Photograph of the Instituto Antártico Argentino, catalogue number VN 398.)
d. *Asterotheca crassa* n. sp. (P.101.20; ×5·35). (Photograph of the Instituto Antártico Argentino, catalogue number VN 396.)

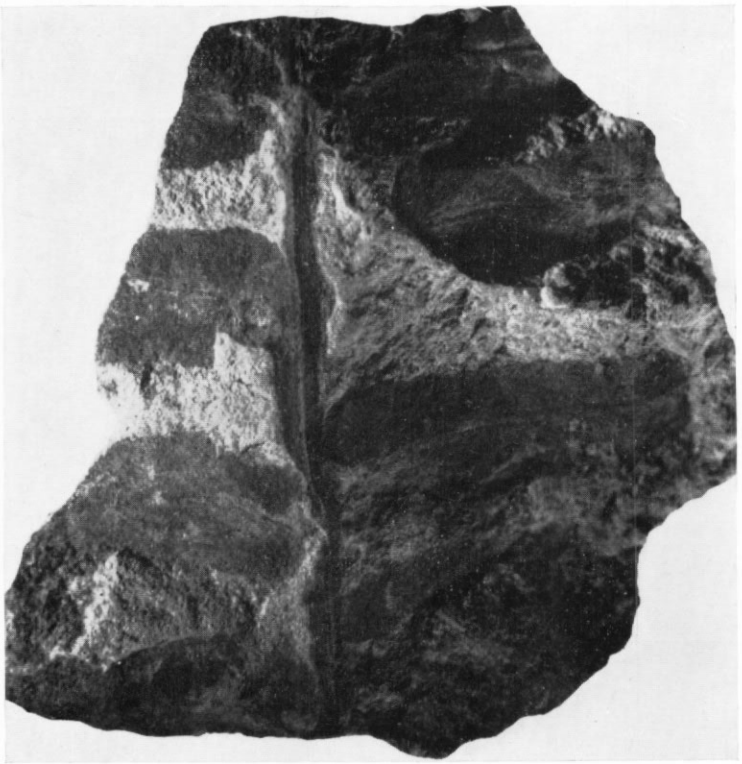


Fig. 4. *Thinnfeldia* sp. (P.101.22; ×2·7).

prominence to which are attached eight variously damaged leaflets. In none of them is the base or the distal extremity clearly seen. In only one of them can one manage to see clearly part of the distal margin, but in the remainder it has been lost either through a fracture in the rock or by poor preservation.

The central venation can be seen without difficulty but the secondary venation is so weak that it is barely perceptible. In both cases it coincides with the aletopteroid venation of *Thinnfeldia*. The pinnae are slightly alternate or sub-opposite.

The insertion of the pinnae on the rachis forms an angle of 80–90° which could be due to the mode of fossilization.

From the general appearance of the frond, it can be considered to be related t *T. praecordillerae* Freng., although the present specimen possesses somewhat more linea pinnae as found by Frenguelli (1944, p. 513) in the strata of Potrerillos in Cacheuta and in the strata of Los Rastros in La Rioja, which correspond, as has been seen, to the Lower or Middle Triassic.

Coniopteris distans n. sp.

Figs. 5, 6a, b

This new species is proposed for a fragment of a fertile frond which is present on specimen P.101.24 (holotype).

Since no impression of a sterile frond could be found with which the fragment described here could be identified, it is provisionally assigned to the genus *Coniopteris*.

The impression is that of a fragment of a frond whose rachis is divided dichotomously three times and damaged at its distal extremity. It possesses three incomplete fertile pinnae, which in turn bear alternate pinnules.

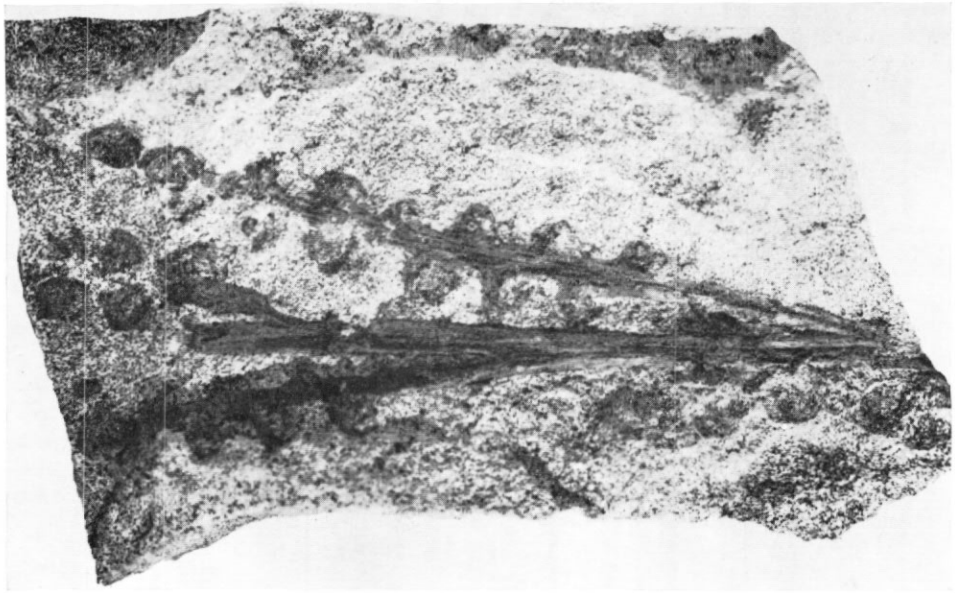
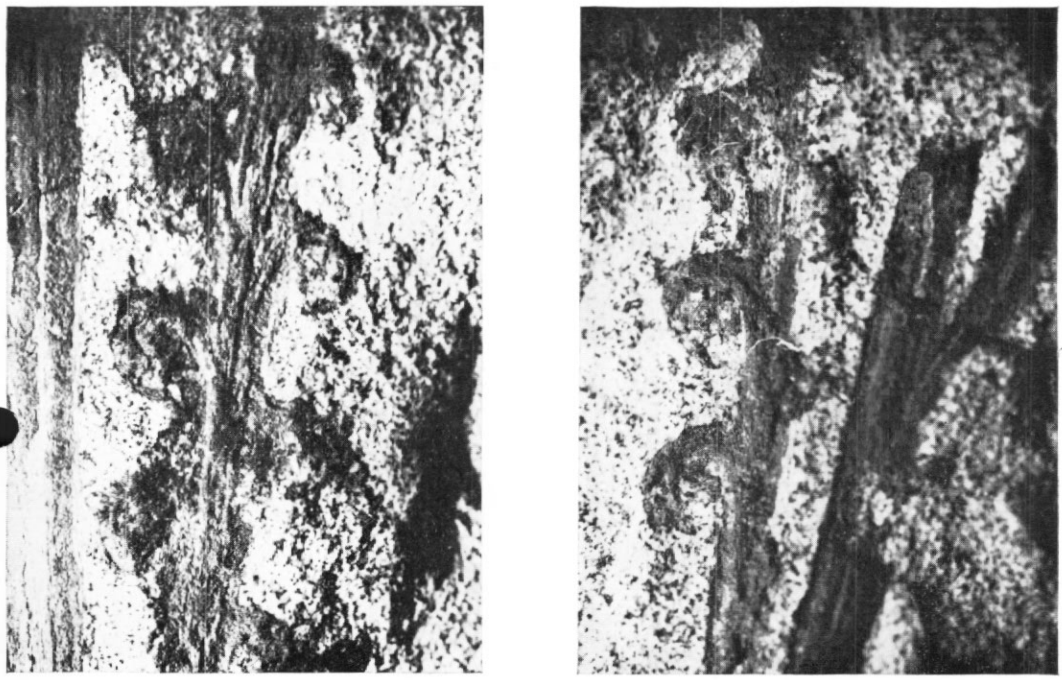


Fig. 5. *Coniopteris distans* n. sp. (holotype) (P.101.24; ×2·1).



a b

Fig. 6. a. *Coniopteris distans* n. sp. (holotype) (P.101.24; × 5·65). (Photograph of the Instituto Antártico Argentino, catalogue number VN 392.)
b. *Coniopteris distans* n. sp. (holotype) (P.101.24; ×5·65). (Photograph of the Instituto Antártico Argentino, catalogue number VN 391.)

The rachis, which is possibly secondary, is flat, 2·8 mm. in maximum width at the proximal end and 2 mm. in width in the right branch of the impression. Its dimensions gradually become less in successive divisions until they reach a minimum of 1·3 mm. in the third ramification. The surface of the rachis is covered with wrinkles or irregular longitudinal grooves especially on the right-hand branch; the left-hand branchings are somewhat smoother. The total length of the fragment is 48 mm. and the longest pinna (the right one) is 46 mm. long and possesses 12 fertile pinnules with smaller blades, eight to the right and four to the left. It has not been possible to examine the apex of the pinna because it is damaged at its distal extremity, so that its total length and the number of fertile pinnules that it possessed will not be precisely known. The blades of the pinnules are surrounded by reniform sori (Figs. 6a and b), 3·8 mm. in total length and 2·5 mm. broad, measured on the best-preserved pinnule. The sori have a smooth and simple border; it has not been possible to see clearly the line of dehiscence in any of the sori examined. In general appearance the indusium was coriaceous in texture.

The pinnules are alternately spaced along the sides of the rachis in such a way that they never come in contact with each other, and the distal margin of the proximal pinnule on the right reaches the same level as the proximal margin on the base of the upper pinnule following on the left-hand side.

Because of the poor fossilization, it is not possible to obtain more distinctive morphological information, but from the general appearance of the impression it cannot be identified with any of the fertile species known (it has not been possible to find sterile fronds) and for this reason a new species has been established for which the name *Coniopteris distans* is proposed.

The new species described here is very similar to the specimen which Frenguelli (1950, p. 10) named *C. harringtoni*; this was found in the Quebrada de Cortaderita, Barreal, San Juan, a plant-bearing horizon synchronous with the strata of Ischichuca and Cerro de las Cabras, which would be correlated with the Middle Triassic or, as Frenguelli (1950, p. 22) has indicated, the top of the Lower Keuper.

Dipteridaceae

Fig. 7a

A small fragment of a lamina of a frond, which is very close to the Dipteridaceae, is preserved on specimen P.101.27; it is part of a blade 12·5 mm. long and 9 mm. broad. In it are clearly seen the dichotomously branched secondary veins which become gradually thinner towards the distal end of the lamina. The tertiary veins are barely perceptible and those of fourth order cannot be seen at all.

From the general appearance of this small and damaged fragment of a blade and from the distribution of the venation, it can be placed near the genera *Dictyophyllum* or *Thaumatopteris*, but it would be risky to assign it to one or other of these since there is so little material from which to form a precise judgement. In any case, the present fossil can be included in the family Dipteridaceae, which is present in the Triassic and Liassic beds of the Gondwana continents.

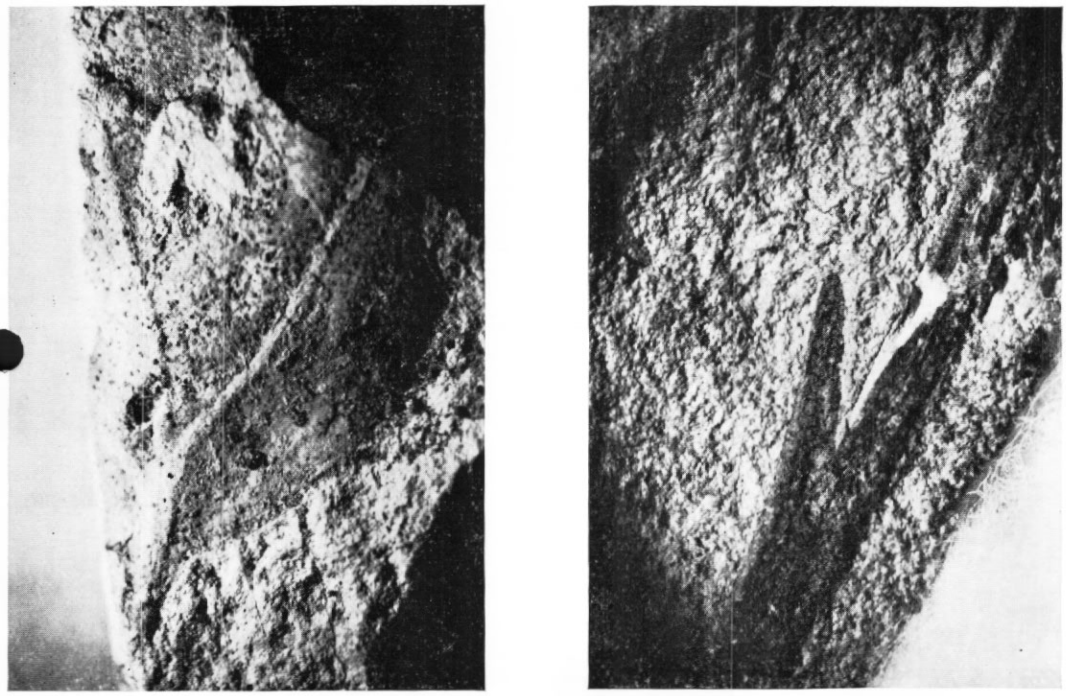
Xilopteris cf. *elongata* Carr.

Fig. 7b

In specimen P.101.8 there is an impression of the distal end of the apex of a frond of *Xilopteris* Frenguelli (1943, p. 318), which is clearly similar to the apex of fig. 31 (right) of *Xilopteris elongata* Carr. (Frenguelli, 1943, p. 324), a reproduction of one of Dun's figures. The overall length of the impression is 29 mm. and it comprises two linear pinnae, very narrow and pointed, and dichotomously divided. The maximum width of the pinnae is 2 mm. and they narrow gradually towards the apex, which is very pointed. The venation, according to Frenguelli (1943, p. 329), is submerged in the parenchyma and is therefore imperceptible.

On the reverse side of the specimen there are also intermediate fragments of the fronds of *Xilopteris* cf. *elongata* in which the monopinnate bifurcation can be clearly seen.

Xilopteris elongata Carr. was widespread in the Lower to Middle Triassic of the "capas de Potrerillos", the Cacheuta beds and the strata of Tronquimalal and Chihuiu at Llantenes, Mendoza, Argentina (Menéndez, 1951); in the Keuper of Queensland, New South Wales, Tasmania, the Cape Province and Natal.



a **b**

Fig. 7. a. Dipteridaceae (P.101.27; ×6·05). (Photograph of the Instituto Antártico Argentino, catalogue number VN 393.)
b. *Xylopteris* cf. *elongata* Carr (P.101.8; ×4·45). (Photograph of the Instituto Antártico Argentino, catalogue number VN 394.)

Rachis of Osmundaceae

Fig. 8

A small piece of a rachis has been fossilized, preserving part of its anatomical characters and enabling identification of the typical leaf structure of the fern, where the woody part of the upper surface has an arcuate form. An analysis of a thin section (P.101.4) indicates that the fundamental unity of the vascular structure is represented by the "divergent" form of the central nucleus of the protoxylem, from which two wings of metaxylem unite with the divergent ones forming the curve of the wood. Of note is the unequal development of the wings of divergent xylem which, re-uniting, tend to enclose the protoxylem in the central zone; all of this is enclosed in the basic parenchyma. This is the typical structure of the Osmundaceae and for this reason the fossil material described here is included in this family.

Conclusions

This flora is undoubtedly very poor in species of any correlative value but overall there is a clear predominance of typical Gondwana elements, i.e. the age of the deposit is without doubt Lower to Middle Triassic, and the material accumulated in a limited lacustrine basin similar to the synchronous basins of the Argentine Precordillera.

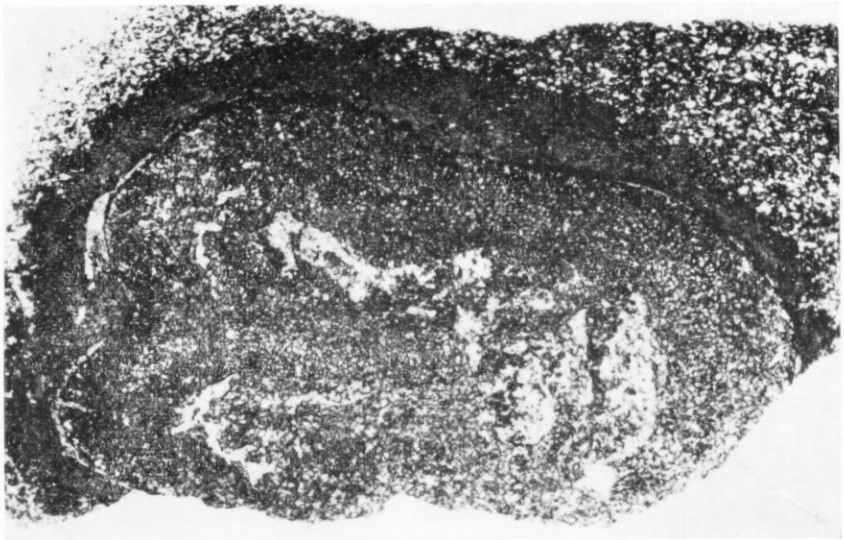


Fig. 8. Tranverse section of a rachis of an Osmundaceae (P.101.4; ×15). (Photograph of the Instituto Antártico Argentino, catalogue number VN 390.)

Photographs of all the specimens comprising this collection of fossil plants have been deposited in the technical archives of the Instituto Antártico Argentino, Buenos Aires, and the specimens themselves have been deposited in the British Museum (Nat. Hist.), London.

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APPENDIX

TRIASSIC FOSSIL PLANT MATERIAL FROM LIVINGSTON ISLAND, SOUTH SHETLAND ISLANDS

Specimen number	*Identification*
P.101.4	Rachis of Osmundaceae (Fig. 8).
P.101.5	Indeterminate impression of a pteridophyte or pteridosperm stem.
P.101.8	*Asterotheca crassa* n. sp. (Fig. 2c) and *Xilopteris* cf. *elongata* Carr. (Fig. 7b).
P.101.9	*Asterotheca crassa* n. sp.
P.101.10	*Asterotheca crassa* n. sp.
P.101.11	*Asterotheca crassa* n. sp.
P.101.15	*Asterotheca crassa* n. sp. (Fig. 2a).
P.101.17	*Asterotheca crassa* n. sp.
P.101.18	*Asterotheca crassa* n. sp. (Fig. 2b).
P.101.19	*Asterotheca crassa* n. sp.
P.101.20	*Asterotheca crassa* n. sp. (holotype) (Figs. 2d, 3b-d).
P.101.21	*Asterotheca crassa* n. sp. (Fig. 3a).
P.101.22	*Thinnfeldia* sp. (Fig. 4).
P.101.23	*Asterotheca crassa* n. sp.
P.101.24	*Coniopteris distans* n. sp. (holotype) (Figs. 5, 6a, b).
P.101.26	Indeterminate plant remains.
P.101.27	Dipteridaceae (Fig. 7a).
P.104.5	"Carbonized vegetable material."
P.104.6	Prismatic piece of coal.
P.111.1	Indeterminate carbonaceous impressions.
P.111.2	Indeterminate carbonaceous impressions.
P.111.3	Indeterminate carbonaceous impressions.
P.112.2	Indeterminate carbonaceous impressions.
P.112.3	Indeterminate carbonaceous impressions.
P.112.6	Indeterminate carbonaceous impressions.