SECTION V — SUMMARY OF THE FOSSIL FLORA OF THE CAPE SYSTEM — ITS SIZE, COMPOSITION, ENVIRONMENT, AGE AND IMPORTANCE IN AFRICA

A. SIZE OF THE FLORA

No Devonian flora in the world is comparable in size or variety with those which successively mark each later geological period.

Ten genera and sixteen species of early vascular plants have been described and in addition, a number of stems cannot be accurately classified because their preservation is too poor. Some of them are undoubtedly related to lycopods (Pl. XVI) but at least five others (Pl. XIX) are of genera not otherwise represented in the collection.

There are two genera and four species of problematical fossils believed to be algae.

This total is small when compared with any of the famous Devonian floras of the world like those of New York, Gaspe, Ireland, Spitzbergen, Bohemia, Germany and the Donetz Basin but it has one real advantage. The plants occur in the continuous stratigraphic succession of a geological system distributed over a comparatively wide area. This makes the chronological sequence of the plants far easier to determine than where only isolated small basins of Devonian rocks are preserved.

As interest grows and exploration is extended I have no doubt that a number of other Devonian plant fossils will be discovered in some of the richer of the Cape sites named, as well as in the new areas, but it will now be much easier to fit them into the chronological stratigraphical table provided.

B. ENVIRONMENT

In several places plant fragments have been found associated with marine invertebrates in the Lower Bokkeveld. The fossil plants of the Upper Bokkeveld and Witteberg Series are far more numerous and have always been regarded as of fresh water or land origin. These too are sometimes found associated with small invertebrate, eurypterid and fish remains and Swart (1950, p. 474) who made a detailed lithological study of the Cape System in the western area has stated that at Wuppertal the conditions of deposition of the lower Witteberg must have been identical with those of the Bokkeveld sandstones. He has suggested that shallow marine conditions persisted into Lower Witteberg times and that no evidence exists for regarding the beds as a lacustrine deposit. It is possible that there was a gradual closing of the passage between the Cape Basin and the ocean and that, in consequence, the water became less saline. The survival of *Spirophyton* through the whole deposition of the main Witteberg quartzite is significant in this connection for whether or not its vegetable origin is accepted it is normally found in a marine environment. Caster (1952) stated that it was characteristic of near shore marine sands in other areas from Lower Devonian to Pennsylvanian times. (Incidentally evidence for the later age of *Spirophyton* is unknown to me unless it was based on Du Toit's assessment of the age of the Witteberg.)

It is possible that a brackish shallow shoal and sand bank environment prevailed in the area throughout the period.

C. SUGGESTIONS ABOUT THE ENVIRONMENT OF PSILOPSIDA

Several of the plants described must have lived partly in water. There is, for example, little direct evidence of a land environment for *Palaeostigma* other than the thick cuticle. I have suggested that the small oval elevations were of the nature of bulbils—detachable vegetative buds capable of growing into a new plant. Such an arrangement can be envisaged as intermediate between a Thallophyte stage—where vegetative propagation from severed fragments of algae was probably the most common form, and the forms of reproduction found in permanent land plants of later periods. The small outgrowths on *Rhynia gwynne vaughni* and the axillary buds in the axils of some Devonian branched stems might equally serve the same purpose. There has, however, been a growing body of opinion among certain palaeobotanists which culminated in the views of Pant (1962) mentioned on pp. 26-27 that the actual plant on which such buds grew, represented the gametophyte stage which could be without vascular tissue and could be aquatic while the sporophyte stage was terrestrial or mainly so. If this should prove to be true of other psilophytes, beside *Rhynie gwynne vaughni*, as may well be the case, the close proximity of psilophyte floras to swamps and lakes would be explained. The vast numbers of outgrowths on a plant like *Palaeostigma* suggest that the method was not always efficient as a means of propagation and was gradually discarded. Many of the Upper Witteberg plants were fragments of higher and more diverse plant orders and appear to have been of drift origin.

D. THE COMPOSITION OF THE FLORA

The study has revealed a far greater variety of plants than had been known previously. Such variety is now known to be characteristic of all recently studied Devonian floras (see Banks 1965). All the plants, without exception, belong to what has sometimes been called the Psilophyte stage in the history of plant life in which true psilophytes are present and only the primitive, simple or archaic forms of other vascular plant divisions.

There is one notable and perhaps significant absentee from the Cape plant assemblage. There are no early ferns or pteridosperms. I do not know of any other Devonian flora of this size which has no representative of this group. One possible explanation might be found in the predominantly arenaceous nature of the sediments, for Frenguelli (1952c) stated that in Argentina he detected a marked preference of lycopods for sandy, and of ferns for clay environments among the Upper Devonian and Lower Carboniferous fossiliferous horizons. There would seem, however, to be enough shaley bands especially in the Upper Witteberg to invalidate this distinction. Differences of altitude can scarcely be considered for all the fossil plant fragments found at this level appeared to have been of drift origin. For the time being it is necessary to assume that the flora consisted predominantly of lycopods and psilophytes.

It is, however, interesting to record that the 'fern' complex remained insignificant throughout the rest of the Palaeozoic in Southern Africa compared with its great fulfilment in most other areas.

E. AGE OF THE FLORA

1. Age based on fossil plants

The primitive nature of the plants described is most apparent and leads inevitably to a discussion of its age. In Table III the Cape plants are compared with the species most nearly related in the southern as well as in the northern hemisphere. It will be seen that although a small number of the plant-genera are known to range beyond the Devonian, all of them are more characteristic of this period. In the case of the exceptions the appearance of a definitely Carboniferous genus such as *Rhacopteris* invariably proclaims the younger age. No such plant has been found up to now in Cape sediments and consequently, judged on floral evidence alone, not only the Bokkeveld but the whole of the Witteberg Series must be regarded as of Devonian Age. It must be assumed that at the time when *Rhacopteris* and associated Carboniferous plant fossils made their appearance in Argentina and in Australia, the lowest of the great thickness of glacial deposits in the Cape had already begun to accumulate. In both Argentina and parts of Australia in the Tupe and the Kuttung Series respectively, tillites are found interspersed with sediments containing *Rhacopteris* and lycopods which are more highly developed than those from the Cape. Along the southern margin of the Karroo the thickness of the tillite is immense and must represent a very great span of time.

It is possible that sediments containing the missing Lower and Middle Carboniferous flora may yet be found in a few areas further north protected from erosion by overlying Karroo rocks. In the meantime the only positive

TABLE 3

SHOWING THE TIME RANGE OF THE MOST NEARLY RELATED OR SIMILAR SPECIES FROM BOTH HEMISPHERES

Cape Plant Fossils	Localities	Horizon	Nearest Known Southern Hemisphere Species	Localities	Age	Nearest Known Northern Hemisphere Species	Localities	Age	Conclusions
Protolepidodendron eximium Frenguelli	Vondeling Willowmore District	Upper Witteberg (360′ below the base of the tillite)	*Protolepidodendron eximium* (Frenguelli 1954) see *Drepanophycus eximius* (Frenguelli) Menendez (1965)	Charnela Juan San Argentina	Upper part of Mid. Devon	*Protolepidodendron scharyanum* (Kräusel and Weyland 1932) *Eleutherophyllum drepanophyciforme* (Remy & Remy 1960)	Germany ,,	Mid. Devon Lowest Namurien	
Protolepidodendron theroni sp. nov.	Vondeling Willowmore District ,,	Main Witteberg 1,900′ below the tillite 2nd Bokkeveld Sdst.	*Protolepidodendron lineare* (Walkom 1928)	Yalwal N.S.W. Australia	Upper Devon	*Protolepidodendron pulchra* (Hoeg 1942)	Spitzbergen	Upper Mid. Devon.	
Archaeosigillaria caespitosum Schwarz nov. comb.	1. Ceres District 2. Willowmore Dist. 3. Steytlerville Dist.	Witteberg Main Witteberg 2,000′ below Tillite Low. Witteberg	*Cyclostigma confertum* (Frenguelli 1954) *Archaeosigillaria conferta* (*Frenguelli*) Menendez (1965a)	San Juan Argentina	Mid. Devon	*Archaeosigillaria vanuxemi* (Grierson & Banks 1963)	New York State	Upper Devon. but vast majority of specimens Mid. Dev.	
Leptophloeum australe (McCoy) Walton	Grahamstown District Touws River	Low. Middle Witteberg Witteberg	*Leptophloeum australe* Carruthers (Feistmantel 1890) (White, etc.)	Queensland N.S.W. Victoria W. Aust. Bolivia	Uppermost Mid. Devon. to Upper Devon. but mainly latter	*Leptophloeum rhombicum* (Dawson 1861)	U.S.A., China, etc.	Upper Devon.	
Platyphyllum albanense sp. nov.	Grahamstown District Howisons Poort	Low. Witteberg	?			*Platyphyllum brownianum* (Hoeg 1942)	Maine U.S.A.	Up. Devon.	
Calamophyton capensis sp. nov.	Bathurst District Farm Sweet Fountain	Bokkeveld Series	*Hyenia argentina* (Frenguelli 1954)	San Juan Argentina	Lower Devon.	*Calamophyton bicephalum* (Leclercq & Andrews 1960)	Belgium	Mid. Devon.	
Haplostigma irregulare (Schwarz) Seward	Port Alfred Bathurst District Steytlerville District and Uitenhage District	Bokkeveld 2nd Bokkeveld Shale (Lower Bokkeveld also ? in Witteberg quartzite	*Haplostigma furguei* (Frenguelli 1952) *Haplostigma irregularis* (Kräusel 1960) *Haplostigma irregulare* (Plumstead 1962) ? *Cyclostigma australe* (Feistmantel 1890)	San Juan Argentina Parana Antarctica N.S.W. Australia	Low. Dev. Low. Dev. Low. Mid. Dev. Devonian —Low Carbon	*Cyclostigma kiltorkense* (see Johnson 1913)	Ireland	Upper Devon.	
Drepanophycus schwarzi sp. nov.	Port Alfred	Bokkeveld	?			*Drepanophycus* cf. *spinosus* (Banks 1960)	New York	Lower Givetian (Mid. Devon.)	
Drepanophycus kowiense sp. nov.	Port Alfred	Bokkeveld	?			*Drepanophycus gaspianus* (Kräusel & Weyland 1948)	Gaspe Canada and New York	Lower Devonian	
Palaeostigma sewardi Kräusel and Dolianiti	Port Alfred Bathurst District Steytlerville District	Bokkeveld	*Palaeostigma sewardi* (Kräusel and Dolianiti 1957)	Brazil	Low. Devon.	cf. *Rhynia gwynne vaughni* (Kidston & Lang 1917 & 1924)	Scotland	Mid. Devonian	
Dutoitia pulchra Hoeg	Knysna District	Bokkeveld				*Psilophyton* (Dawson 1862)	Canada	Low. Mid. Devonian	
Dutoitia alfreda sp. nov.	Port Alfred	Bokkeveld	*Hostimella* etc (Lang & Cookson 1930 and Cookson 1935)	Victoria Australia	Up. Sil. to Lowest Devonian	*Rhynia* (Lang 1931-32) *Cooksonia* (Obhrel 1962)	Scotland Bohemia	Up. Sil.	
Dutoitia maraisia sp. nov.	Grahamstown District Howisons Poort	Low. Witteberg							
Psilophytalean stems	De Doorns	3rd Bokkeveld Sandstone	Baragwanathia Flora (Lang and Cookson 1930 & Cookson 1935)	Victoria Australia	Up. Sil.—Low. Devon.	Rhynie Flora etc. (Lang 1931-32)	Scotland	Mid. Devonian	
Stems A and B—Branched stems with axillary tubercles	A. Steytlerville District B. Alicedale Poort	Up. Bokkeveld Low. Witteberg	Walhalla, Victoria—(Lang & Cookson, 1930 and 1935) also 'Psilophyte stem'—White	Victoria and N.E. Queensland	Up. Silur "Prob. Low. Devonian"	Hostimella etc. (see Hoeg 1942, p. 173)	Spitzbergen	Low.-Mid. Devonian	
Controversial ? algal fossils *Tontalia zollneri* Frenguelli	De Doorns	Upper Shale of Table Mountain Sediments	*Tontalia zollneri* Frenguelli	Sierra de Tontal Argentina	Pre-Devonian also Furnas Sandstone	cf. *Buthotrephis gracilis* (Hall 1843) *Buthotrephis nidarosiensis* (Hoeg 1940)	New York State Trondheim Norway	Ordovician -Silurian Ordovician	Pre-Devonian
Controversial ? algal fossils *Spirophyton* Vanuxem	All areas	Upper Bokkeveld and Lower—Mid. Witteberg	*Spirophyton* ? (not illustrated)	Australia	Ordov.—Silurian	*Spirophyton cauda galli* (Dawson 1881)	Madison County U.S.A.	? Up. Sil. Low. Devon. Mid. Devonian	Best known from Mid. Devonian of New York

CONCLUSIONS ABOUT AGE:

From both hemispheres the fossil plants most nearly related to those of the Cape System fall within the boundary of the Devonian System. The evidence from the Upper Witteberg Series depends largely on *Protolepidodendron eximium* and its close relationship to Argentinian specimens found there in association with *Archaeosigillaria* and *Calamophyton* and regarded as of uppermost Middle Devonian age. This is undoubtedly true for the Argentinian specimens but the species may have a long range. The onset of glaciation along what is now the Cape Fold Belt, if the tillite lies conformably on the Upper Witteberg Beds as believed, cannot have been far from the base of the Carboniferous and may have been a little before or soon after.

available evidence must be accepted. In particular the presence of *Protolepidodendron eximium* approximately 360′ below the base of the tillite in the Willowmore District is significant since its only other known occurrence is in San Juan where Frenguelli found it in Upper Middle Devonian sediments. It may, of course, merely indicate that the species has a longer range. The presence of *Leptophloeum australe* is claimed throughout the main Witteberg quartzite although I do not know of any exact measurement of its highest occurrence. The species does not extend beyond the Upper Devonian. The comparative age table provides other examples in support of an Upper Devonian age to include the Upper Witteberg sediments.

2. Comparative Age Table (See Table 3)

3. Age based on fossil fish

Against this evidence the age of fish associated with plants in the lenses of shale below the tillite must be considered. Theron (1960, p. 406) footnote quotes the age evidence based on fish in these nodules as determined by the more recent work of Dr. B. G. Gardiner of the University of London on fishes: " . . . a series of nodules from the Lower Dwyka Shales (i.e. now Upper Witteberg Shales) of the Willowmore District has been collected by Dr. Crompton. These nodules occurring well below the tillite contain a much larger fauna than do the nodules from the Upper Dwyka Shales, there being several genera of deep bodied Platysomids, Cycloptychius, Mesopoma, as well as some completely new genera. As far as I can judge it is a typical Lower Carboniferous Palaeoniscoid fauna, and as such I think it is reasonable to link these Lower Dwyka Shales with the Karroo System rather than, as was the custom in the past, to link them with the Witteberg System of Devonian age."

More recently Marais (1963) described and illustrated another rich occurrence of Palaeoniscoid fossil fish from a large calcareous siltstone lens in the upper part of the Upper Witteberg Series in the Janseville District, south of Lake Mentz. He concluded that the stage of development of three species of fish indicated a late Middle or early Upper Devonian age.

Later Jubb (1965) described one of the forms from this site as a new genus and species *Mentzichthys walshi* and considered it to be of Lower Carboniferous age since of known Palaeoniscids the genus appeared to be most closely related to the Lower Carboniferous genus *Cycloptychius*. He considered that the mass extermination and perfect preservation of the fish had probably been caused by freezing and asphyxiation as a result of the early stages of the approaching Ice Age. The age of this deposit based on fish is not conclusive but favours a slightly younger age than that indicated by the plants alone.

F. EVOLUTIONARY SIGNIFICANCE

The place of the plant fossils of the Cape System in the history of plant life in Southern Africa is an important one.

It represents the complete transition in the plant world from the stage when the whole life cycle of each plant had to be enacted in an aquatic environment so that only forms of Thallophyta were known. This ended with the T.M.S. The Bokkeveld sediments preserved evidence of the semi-aquatic stage suggested by plants like *Palaeostigma* and the psilophytes generally which could never have lived very far from water.

In the Upper Bokkeveld a Pterophyte Stage was introduced with early and primitive members of Lycopsida especially, Sphenopsida and possibly early gymnosperms, if *Platyphyllum* can be placed in this category.

It is only near the top of the Witteberg Series that signs of more advanced and varied plant life appeared in the form of small pieces of drifted stems.

During the immensely long period of glaciation which followed, the plant life of southern Africa must either have been preserved in some small sheltered areas or survived in adjacent lands. In either case the adaptations to the unfavourable frigid conditions must have resulted in the development of the rich and strange southern coal flora which made its appearance in some parts of the country before the termination of the final glaciation and the restoration of temperate conditions.

G. THE RELATIONSHIP BETWEEN THE FOSSIL PLANTS OF THE CAPE SYSTEM AND OTHER DEVONIAN FLORAS

Of the classified plants described in this monograph there are no less than seven which on the evidence available appear to be specifically identical with fossil plants described from various parts of eastern South America. With Australia, *Leptophloeum australe* is identical and a number of others closely related. The affinities with Devonian plants of the northern hemisphere are far more general, i.e. there are generic but no specific identities. The conclusion is inevitable that an affinity between plants of the southern hemisphere was apparent as early as the Devonian Period and that this was far closer than the relationship between Africa and the N. American or Eurasian areas where the comparison amounts to a common stage of development rather than to identical plants.

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PLATE I—*Dutoitia alfreda* sp. nov.

Bokkeveld Series—Port Alfred.

Fig. 1 Type specimen.
Spec. 4418 (× 1) Albany Mus.

Fig. 2 Part of the type specimen enlarged to show:
(*a*) a large obovate erect terminal sporangium.
(*b*) transverse section of a sporangium with small round spores?
(× 3)

Fig. 3 Part of a single plant to show branching. Spec. 4173 (× 2) Albany Museum.

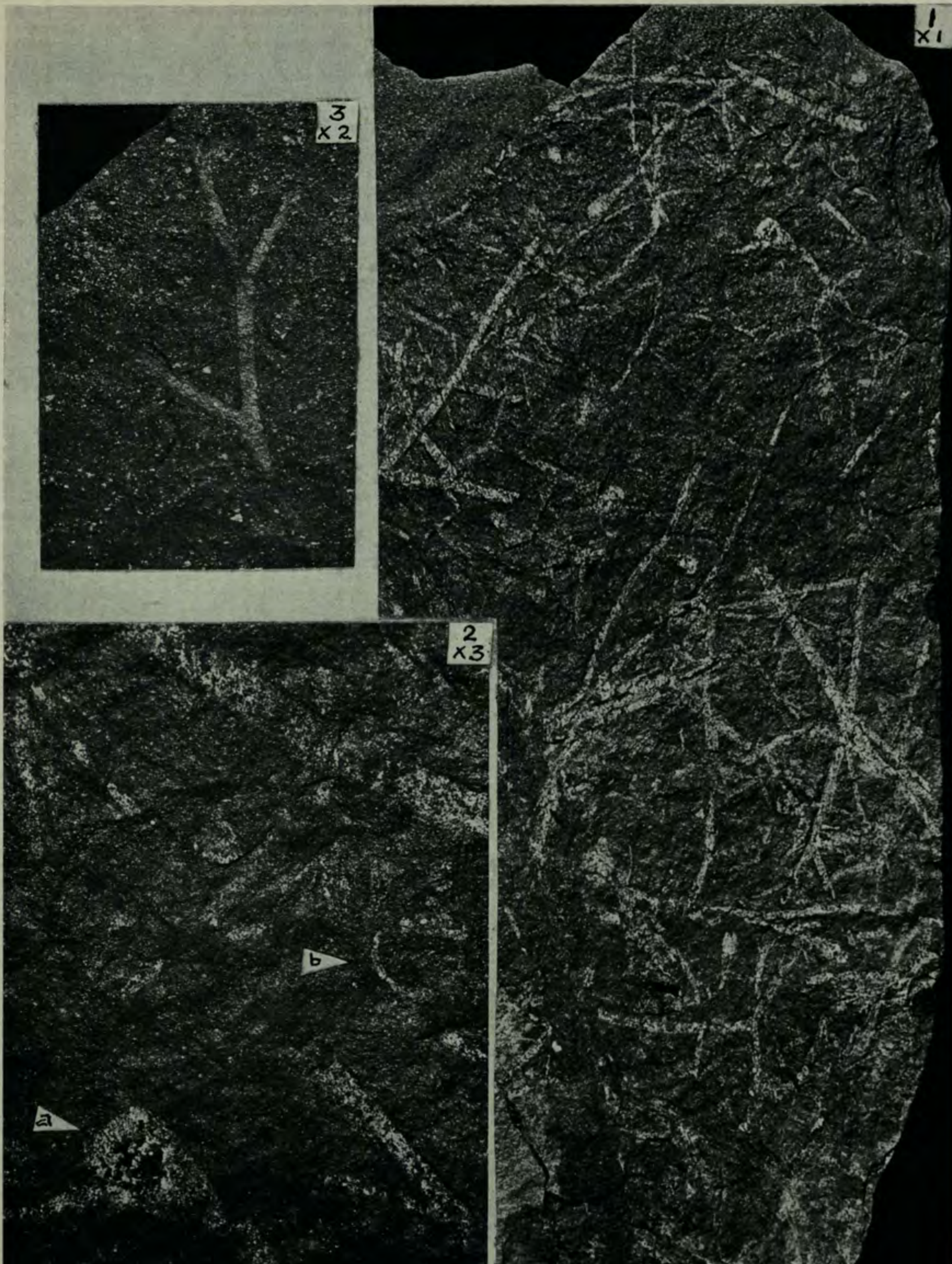

PLATE I—*Dutoitia alfreda* sp. nov.

PLATE II—*Dutoitia maraisia* sp. nov.

Howison's Poort Grahamstown—near base of Witteberg Series.

Fig. 1 Type spec. (× 1)

Fig. 2 Type specimen enlarged to show

(*a*) thin axes branching at a wide angle

(*b*) several broad axes

(*c*) a stem with projections

(*d*) pendulous terminal sporangium

(× 2)

Fig. 3 Another specimen showing fragments of branched stems as well as

(*a*) a pendulous terminal sporangium

(*b*) a stem with projecting spines

(× 1)

These specimens are in the B.P.I. (Pal) Collection, University of the Witwatersrand.

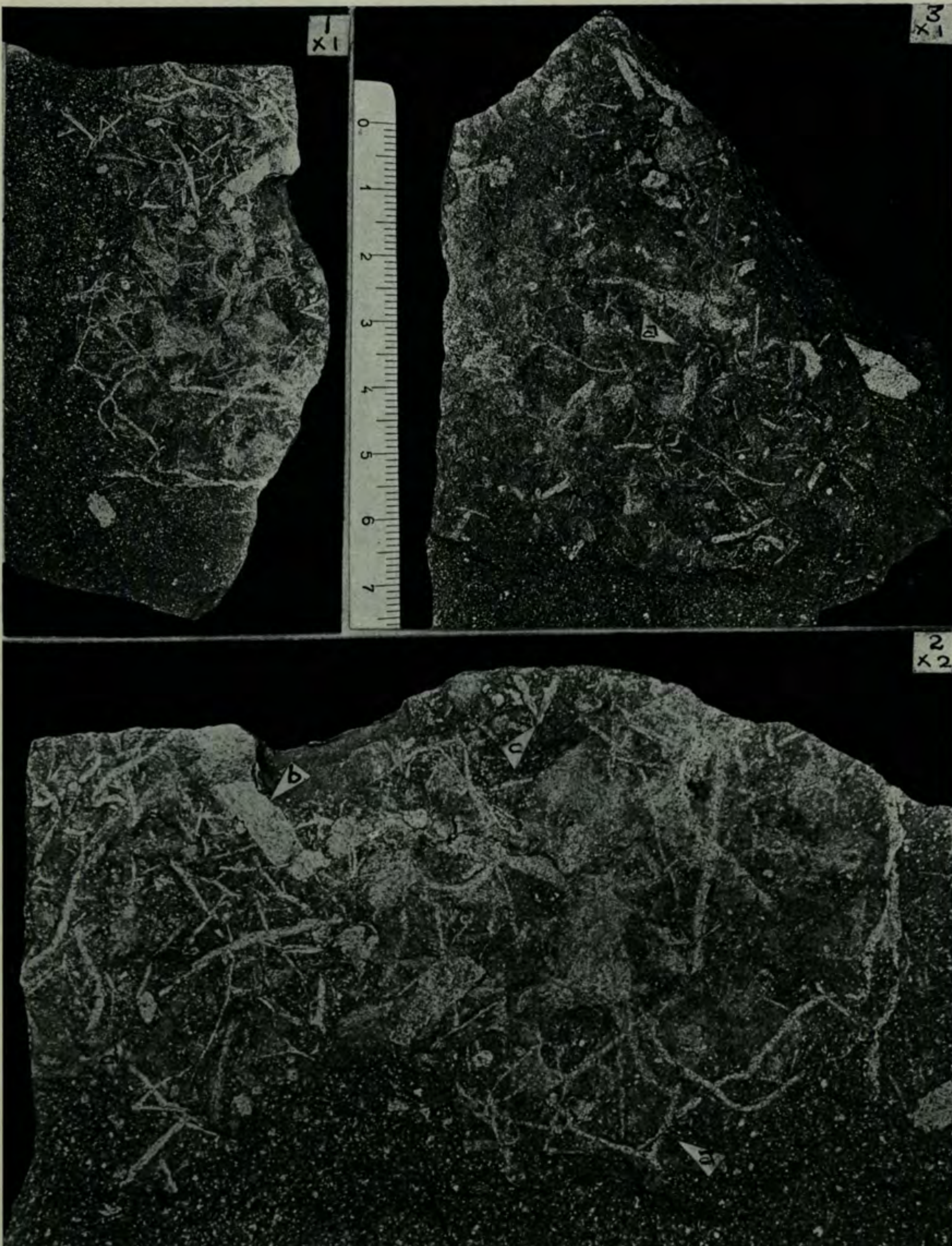

PLATE II—*Dutoitia maraisia* sp. nov.

PLATE III—Psilophytalean Axes ?

Figures 1—8 from the 3rd Bokkeveld Sandstone, De Doorns.

Figures 9 and 10 from the Farm Uitkomst, Bokkeveld, Hex River.

Fig. 1 Two stems longitudinally corrugated—note the irregular spacing of the small round scars.
Spec. T.D. 77B (× 3)

Fig. 2 Stems showing irregular elevations tapering downwards, corrugated stems and (*c*) a small branched axis.
Spec. T.D. 77B (× 3)

Fig. 3 Stem with small elevations and a partly developed groove which may imply a vascular strand. The clean edges of the left hand side at the top may indicate a dichotomous branching.
Spec. T.D. 80 (× 3)

Fig. 4 A finely stranded stem exhibiting inner and outer surfaces.
Spec. T.D. 80 (× 3)

Fig. 5 Two stems showing the irregular distribution of elevations and depressions.
Spec. T.D. 79 (× 3)

Fig. 6 Showing the irregular shape and size of some elevations.
Spec. T.D. 79 (× 3)

Fig. 7 A stem fragment with regular elongated elevations. (This must be viewed from the left.)
Spec. T.D. 83 (× 3)

Fig. 8 The specimen in Fig. 7 enlarged to show fine cell? structure.
Spec. T.D. 83 (× 6)

Fig. 9 A small punctate stem.
Spec. 57f, S.A. Mus. (× 3)

Fig. 10 The concave counterpart of the spec. in Fig. 9.
(× 1)

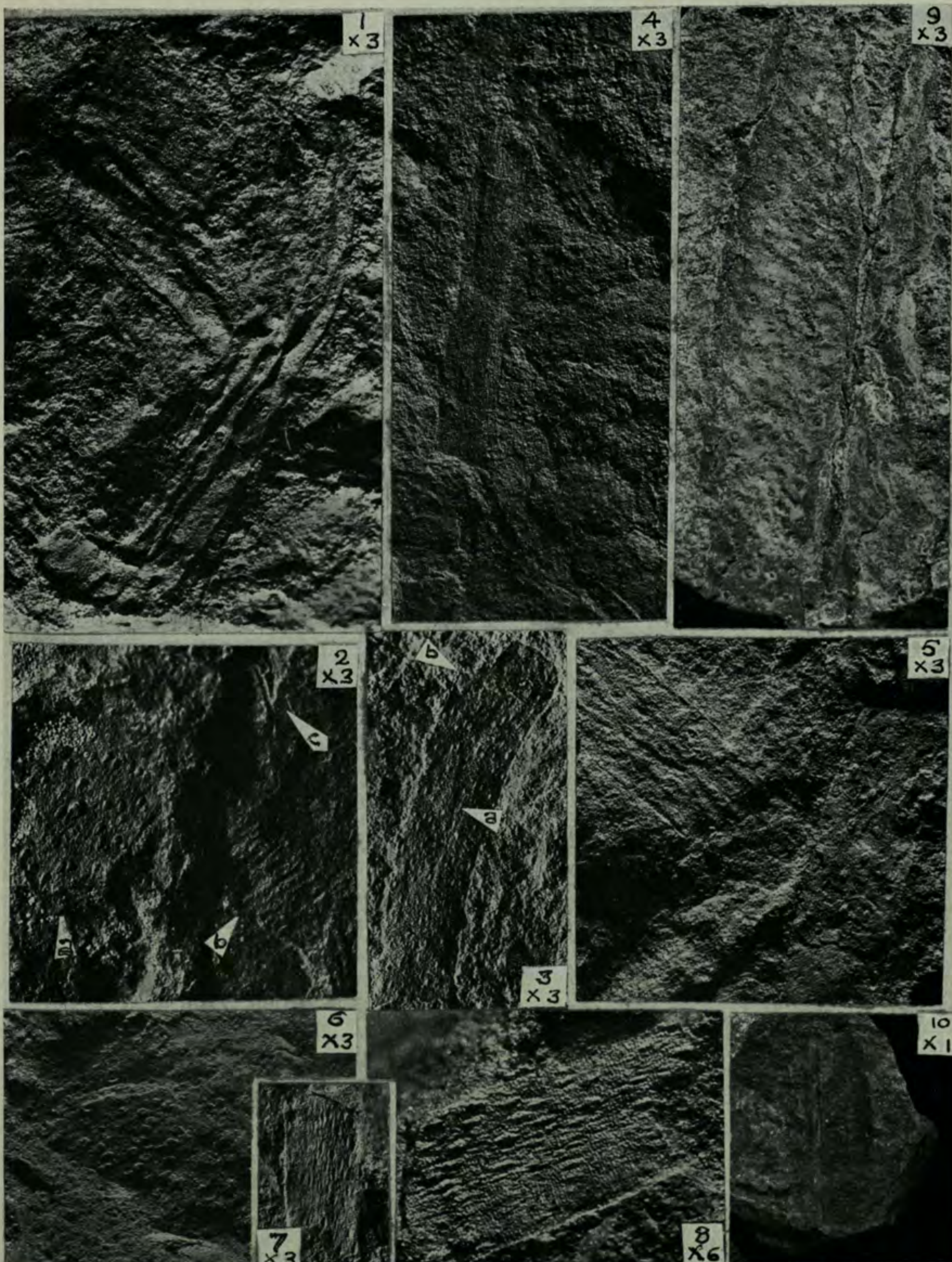

PLATE III—Psilophytalean Axes?

PLATE IV—*Palaeostigma sewardi* Krausel and Dolianiti.

Fig. 1 A single specimen exhibiting the transversely elongated depressions and elevations characteristic of the genus.

Schietkraal, Steytlerville Dist. Upper Bokkeveld Series.

Spec. 10741 (× 1) S.A. Mus. Counterpart of Type Specimen.

Fig. 2 Specimen in Fig. 1 enlarged

(× 2)

Fig. 3 New specimens

Farm Sweet Fountain (Estments) near Bathurst—Bokkeveld Series.

Whole surface of graphitic phyllite covered with tangled stems.

Spec. 4344 (× 1) Albany Mus.

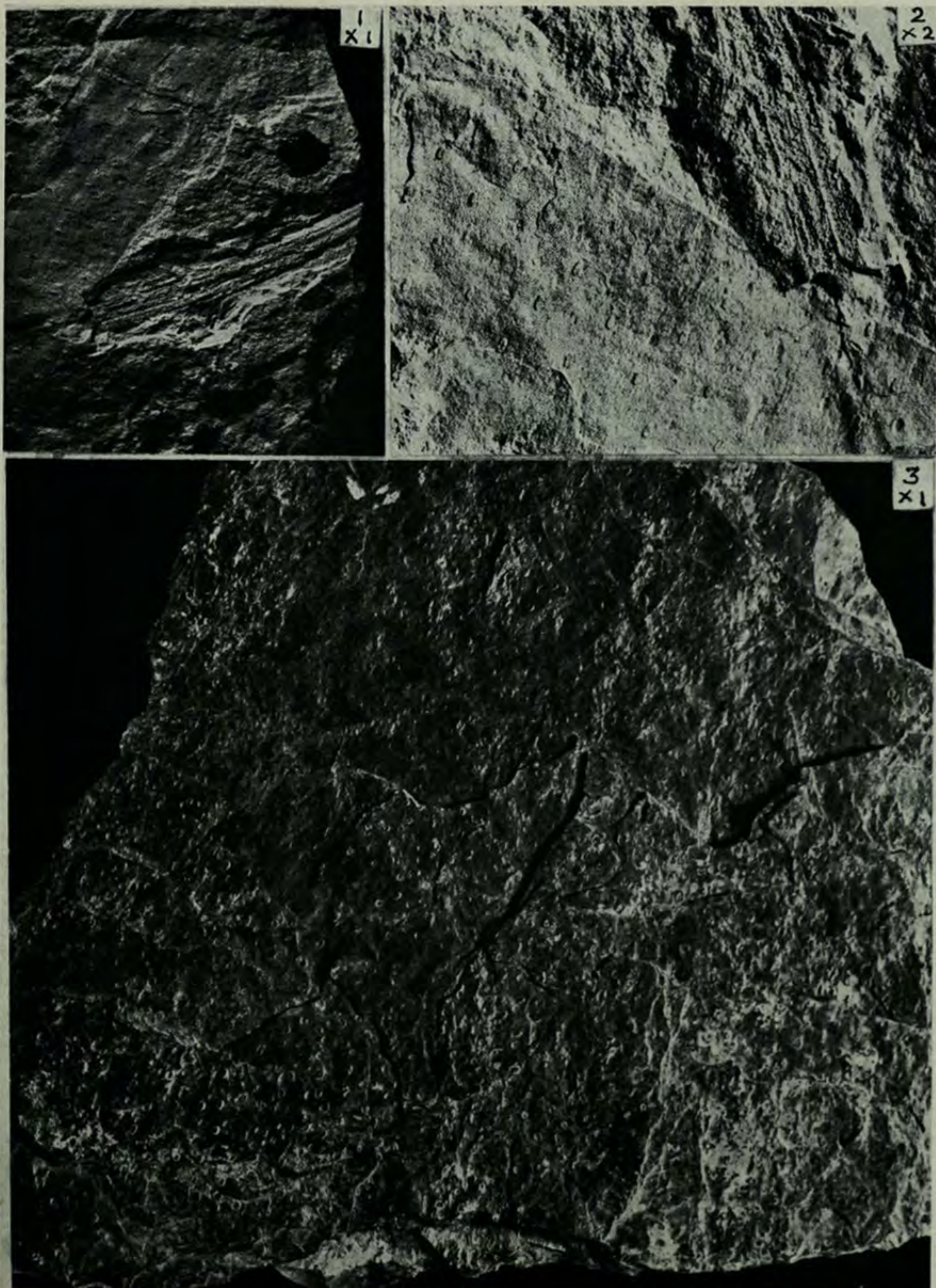

PLATE IV—*Palaeostigma sewardi* Krausel and Dolianiti

PLATE V—*Palaeostigma sewardi* Krausel and Dolianiti.

Farm Sweet Fountain—near Bathurst, Bokkeveld Series.

Fig. 1 A single stem
(× 3)

Fig. 2 The same specimen magnified to show the structure of the epidermis
(× 10)

Fig. 3 Same specimen showing stages of the separation of the "elevations". It is suggested here that the raised projections are vegetative buds which separate from the stems when mature, leaving smooth saucer-like depressions. Note the radiating structure of one of the bulbils which has been damaged.

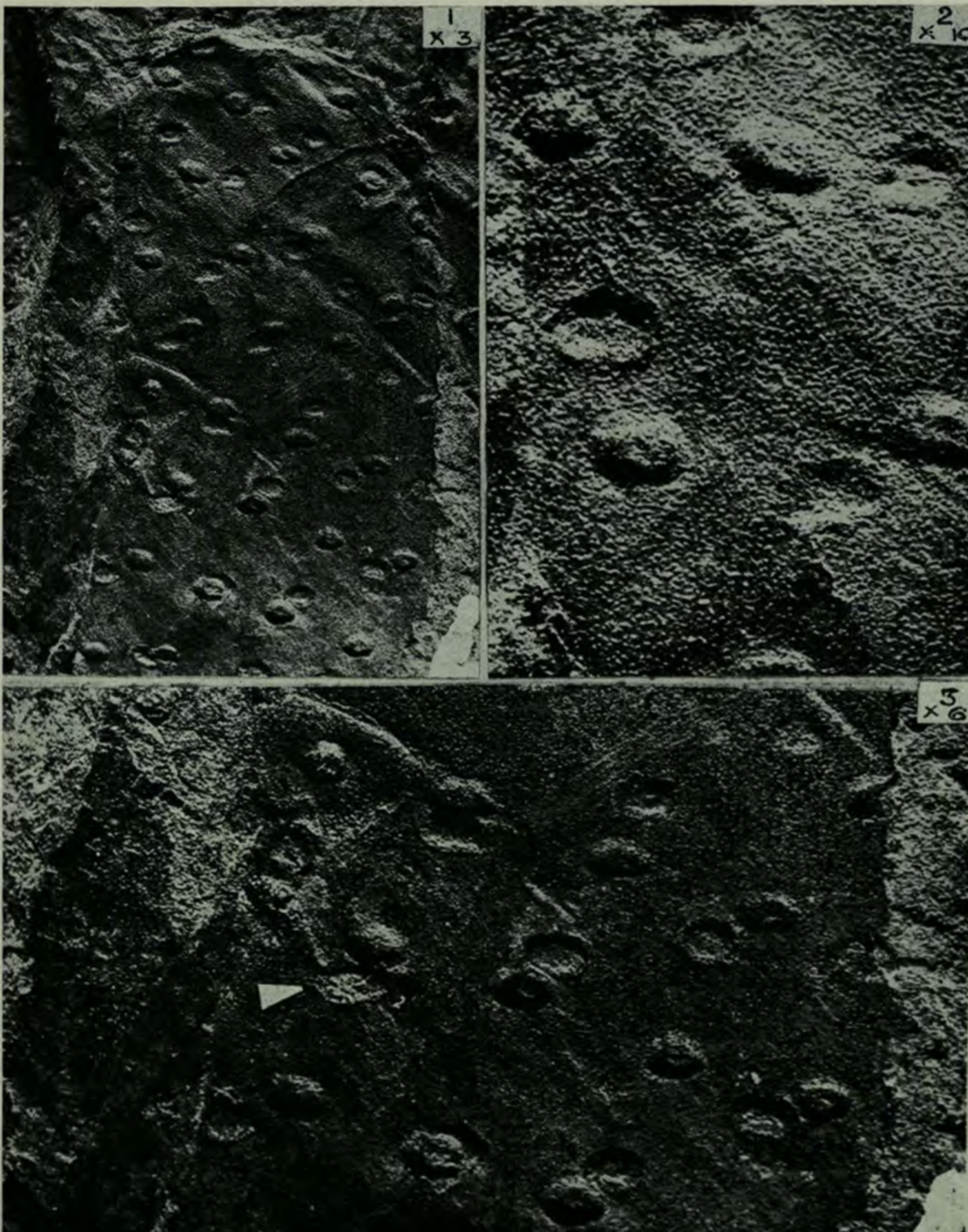

PLATE V—*Palaeostigma sewardi* Krausel and Dolianiti

PLATE VI—*Palaeostigma sewardi* Krausel and Dolianiti.

Farm Sweet Fountain (Estments)—near Bathurst, Bokkeveld Series.

Specimens to illustrate the suggested occurrence of elevated and depressed scars on the same surface rather than belonging to upper and lower cuticular surfaces as suggested by Seward (1932).

Fig. 1 Showing remnants of 'bulbils' in three saucer-like depressions. (× 6)

Figs. 2, 3, 4 Showing the haphazard arrangement of scars with bulbils sometimes above and sometimes below or else still occupying the depressions. The size of the dimple on the top of each bulbil is regarded as an indication of its maturity. Those which are ring shaped being ready for separation. (× 3)

Fig. 5 Stem with elevations exhibiting a slit instead of the normal crater-like apex of mature bulbils.

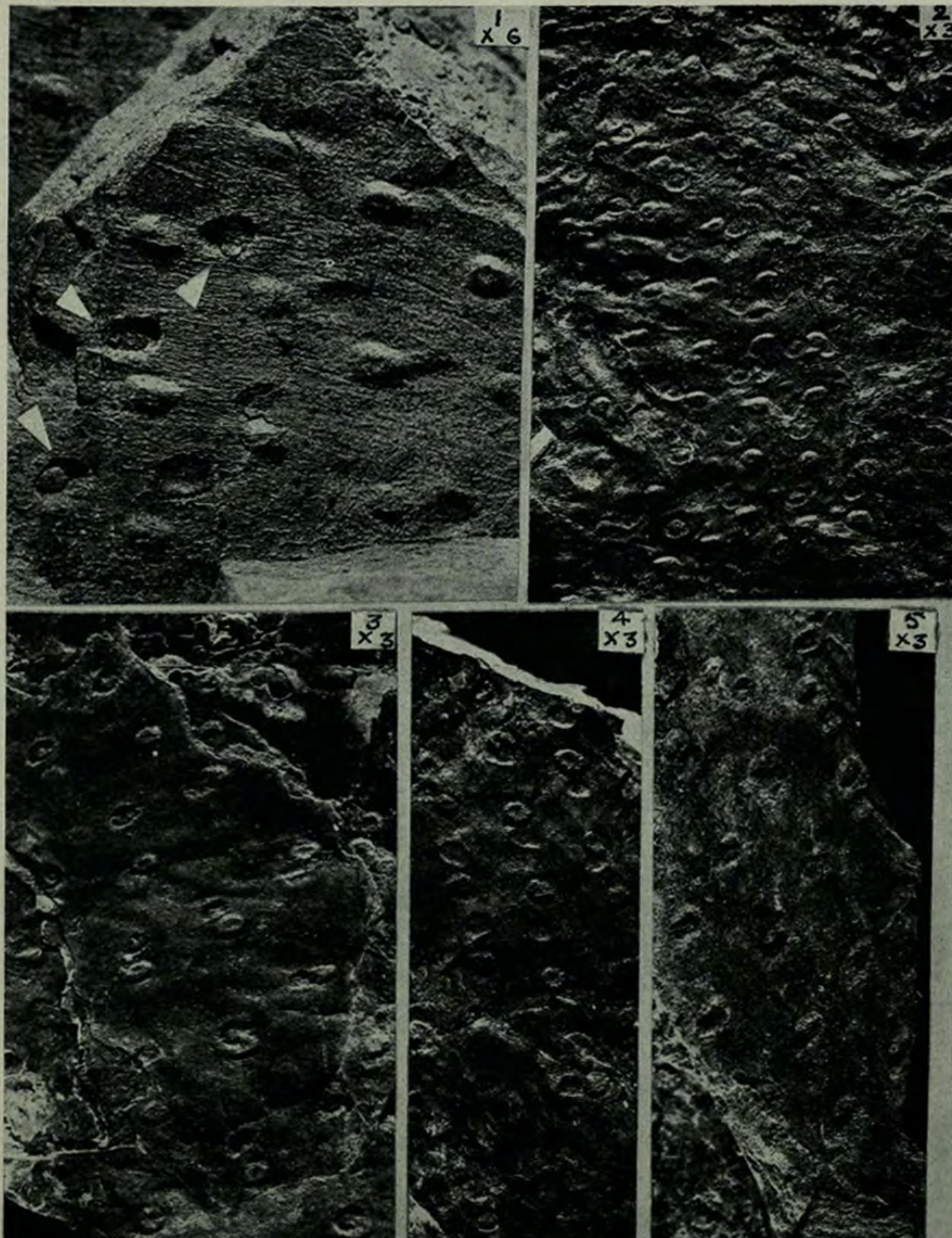

PLATE VI—*Palaeostigma sewardi* Krausel and Dolianiti

PLATE VII—*Palaeostigma sewardi* Krausel and Dolianiti.

Loc: Sweet Fountain near Bathurst.

Fig. 1 A smooth stem on which bulbils are beginning to form. (× 3)

Fig. 2 To show the preservation of a small patch of brownish cuticle (arrow). (× 3)

Fig. 3 An isolated detached bulbil on the right-hand side? (arrow)

Fig. 4 Note the remnants of tissue in the hollow saucer-like depressions near the top of the photograph and the radiating structure visible in some of both saucers and elevations due to damaged and partly sectioned bulbils.

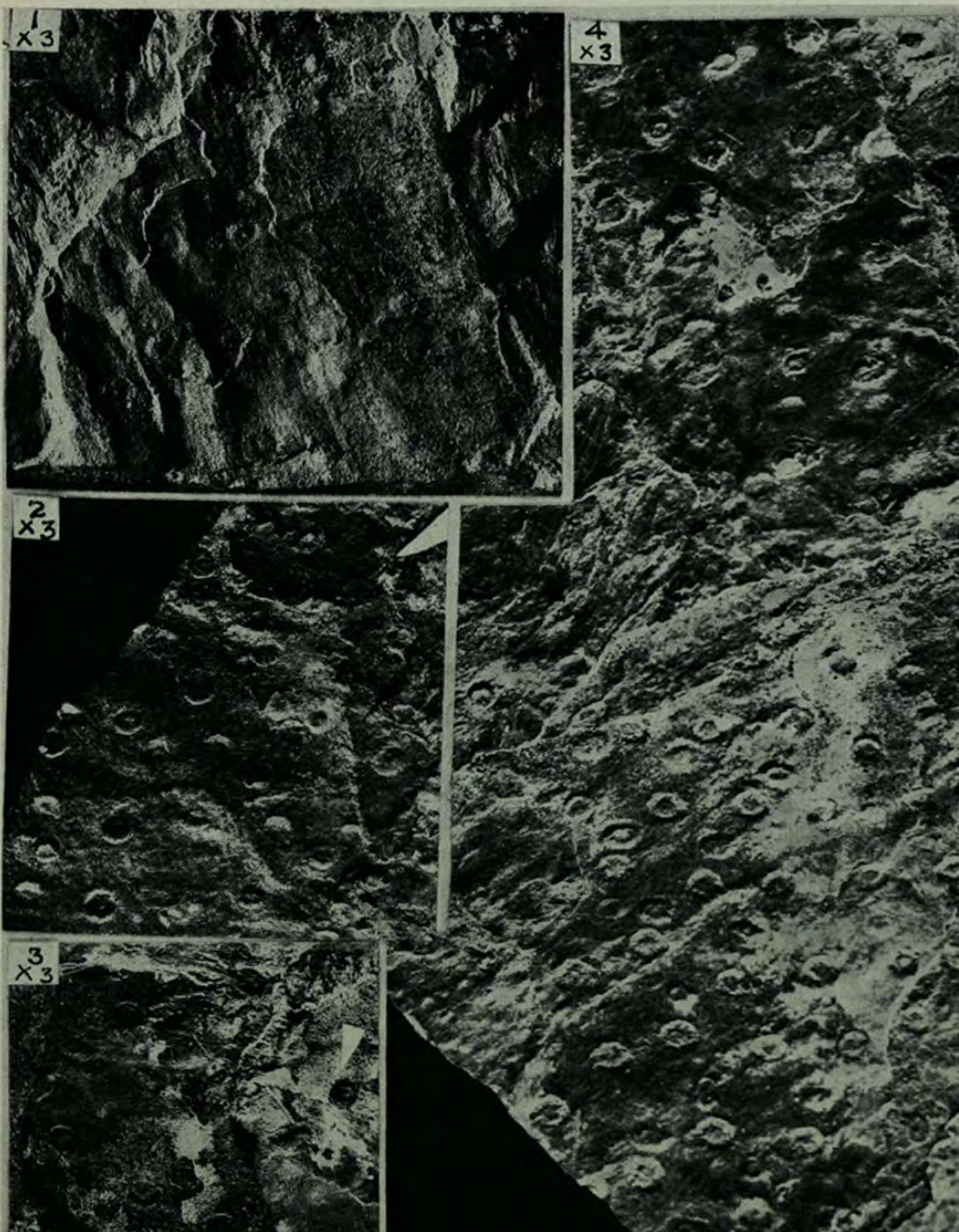

PLATE VII—*Palaeostigma sewardi* Krausel and Dolianiti

PLATE VIII—*Drepanophycus* Göppert.

Fig. 1 *Drepanophycus schwarzi* sp. nov.
Port Alfred—Bokkeveld shales
(The lower stem is *Haplostigma irrequlare*)
Type spec. 2903. (× 1) S.A. Mus.

Fig. 2 Specimen in Fig. 1 enlarged to show the bifurcating branch on the right hand side, the thick falcate spines and two different stem levels.
Type spec. 2903 (× 2) S.A. Mus.

Fig. 3 *D. schwarzi*? poor preservation.
Port Alfred—graphitic phyllite of Bokkeveld Series.
Spec. 4165 A (× 1) Albany Mus.

Fig. 4 *D. schwarzi*? a branched specimen.
Port Alfred. Bokkeveld phyllite.
Spec. 4165 B (× 1) Albany Mus.

Fig. 5 *D. kowiense* sp. nov.
Port Alfred. Bokkeveld phyllite.
Note the alignment of scars, the short thick spines on alternate rows of the left hand margin and the decorticated surface on the left.
Spec. 4173 C (× 2) Albany Mus.

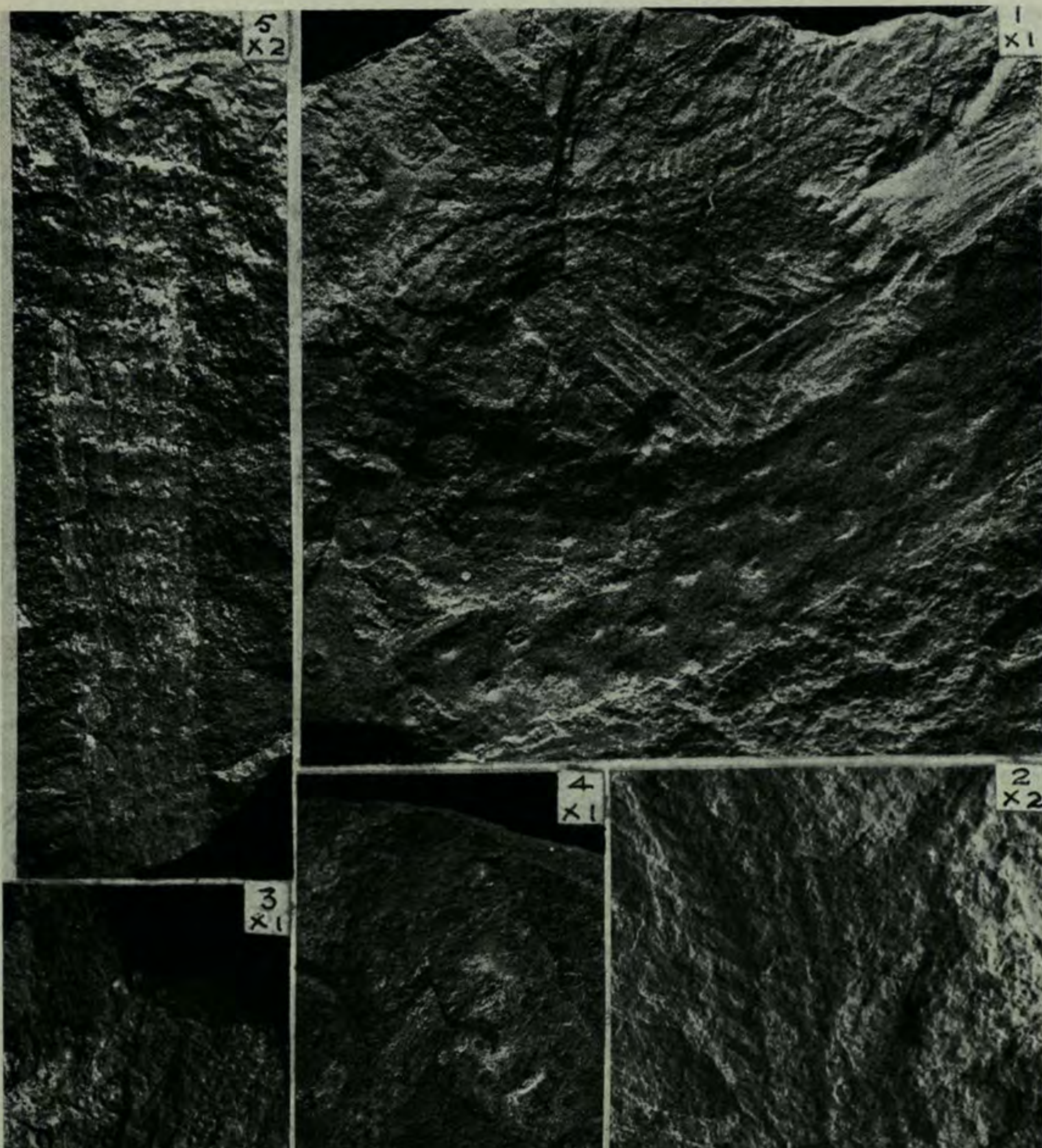

PLATE VIII—*Drepanophycus schwarzi* sp. nov. and *D. Kowiense* sp. nov.

PLATE IX—*Protolepidodendron eximium* Frenguelli.

Fig. 1 Specimen of *P. eximium* showing a curved and bifurcating stem in the upper half of the photograph.
Farm Soetendalsvlei, Willowmore District.
Upper Witteberg Shales.
Spec. J.T. 3 (× 1)

Fig. 2 Ramifying stems of *P. eximium*.
Farm Soetendalsvlei, Willowmore District.
Upper Witteberg Shales.
Spec. J.T. 22 (× 1)

Fig. 3 Showing the bifurcating tip of one of the spines.
Spec. J.T. 22 (× 4)

Fig. 4 Enlargement of the stem to show the long tapering spines along each margin and a small spherical object, a possible sporangium, near the tip of one of them.
Spec. J.T. 22 (× 3)

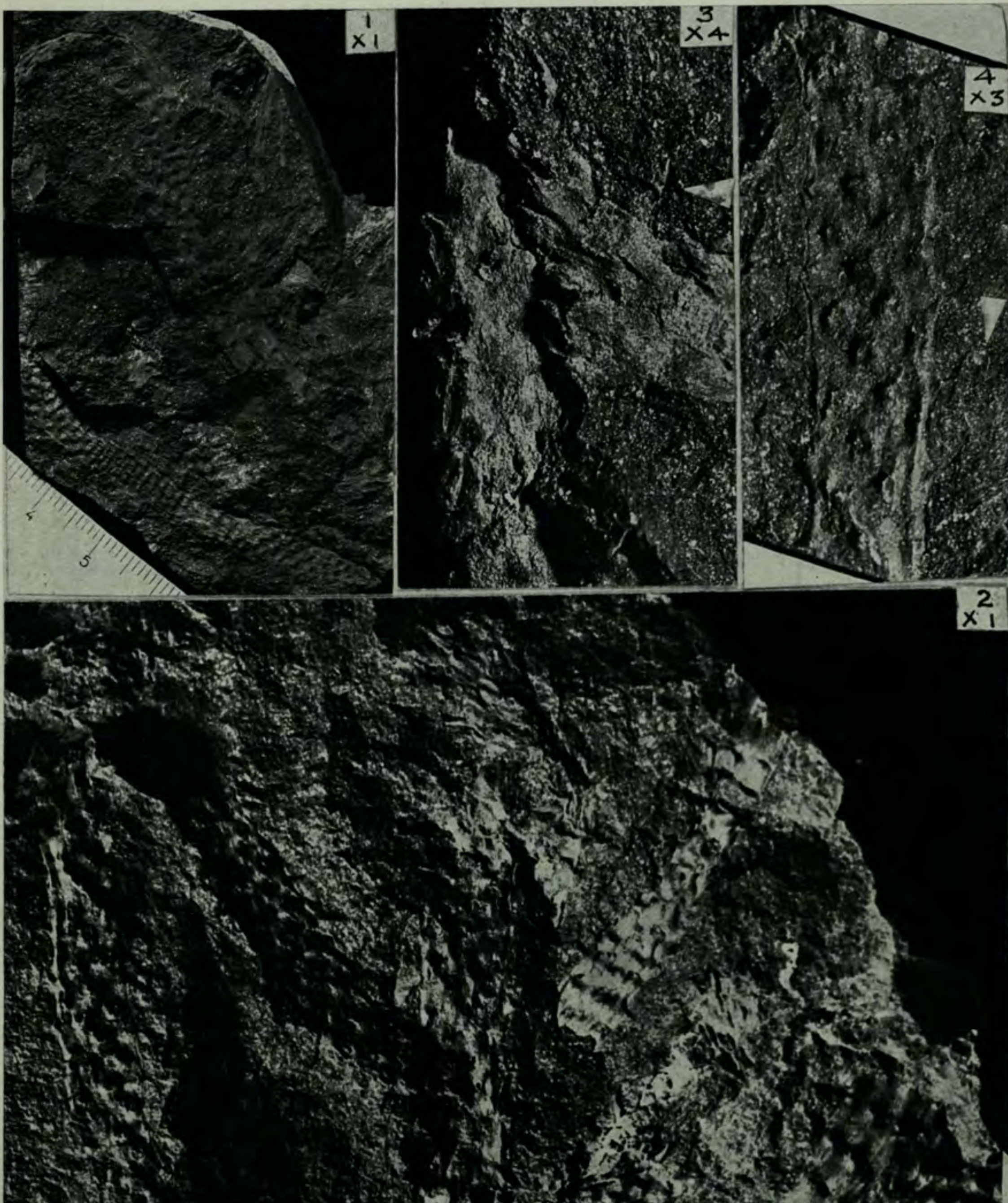

PLATE IX—*Protolepidodendron eximium* Frenguelli

PLATE X—*Protolepidodendron theroni* sp. nov.

Fig. 1 A limonite replacement of a stem. Note the bifurcating mould at the base.
Near Vondeling—Main Witteberg Series.
Type spec. J.T. 31 (× 1)

Fig. 2 Enlargement of type specimen with different lighting to emphasize the leaf cushions.
Type Specimen J.T. 31 (× 2)

Fig. 3 Transverse section of the stem shows the projecting leaf cushions but no structure.
Spec. J.T. 31 (× 3)

Fig. 4 Enlargement to show the angle of branching of the stem mould at the base and a bifurcating spine just above the quartz vein. (× 2)

Fig. 5 The bifurcating mould and part replacement of a stem with diamond shaped scars.
Vondeling Dist.—Second Bokkeveld Sandstone.
Spec. J.T. 24 (× 1)

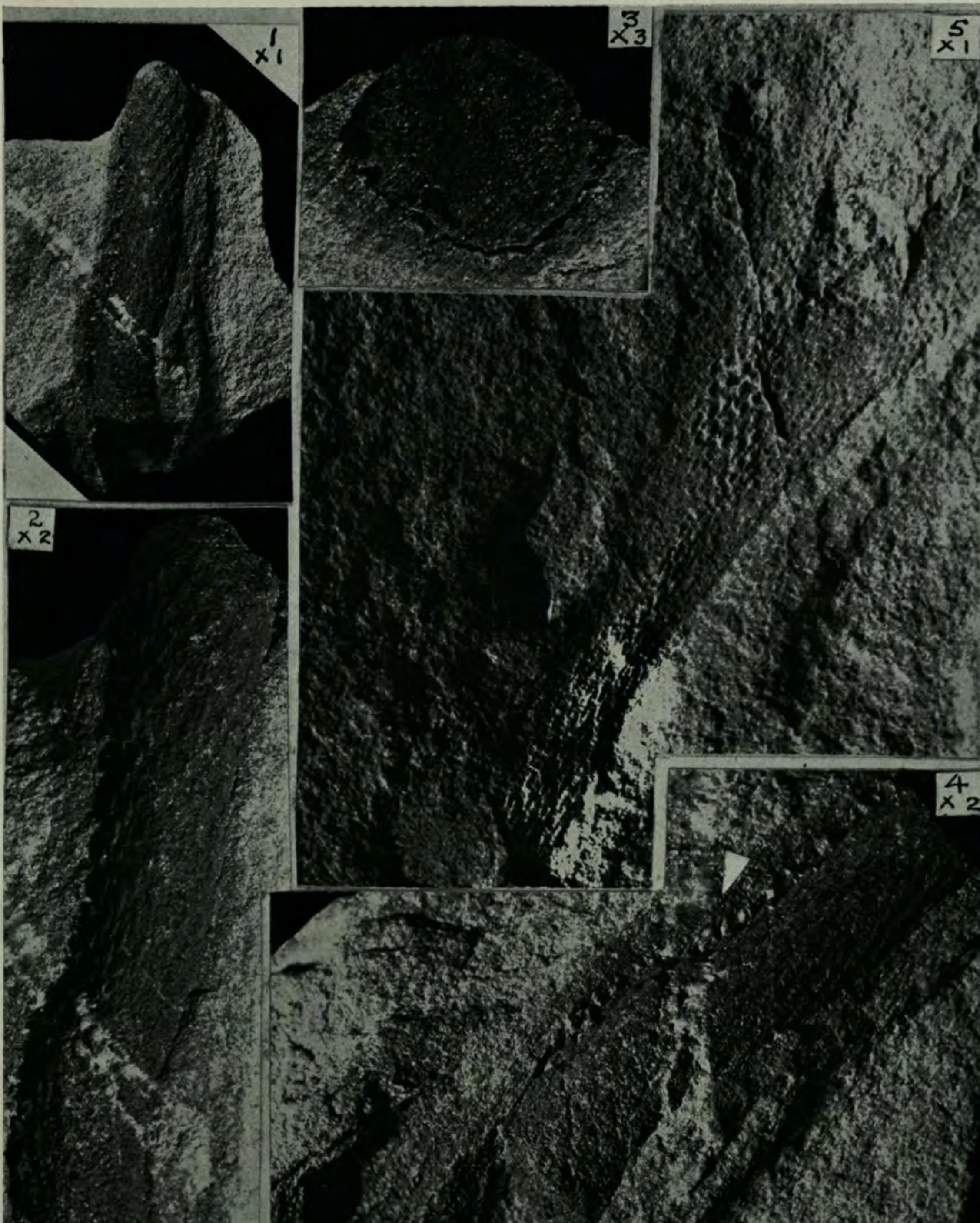

PLATE X—*Protolepidodendron theroni* sp. nov.

PLATE XI—*Archaeosigillaria caespitosum* Schwarz nov. com.

Fig. 1 Type specimen of *Archaeosigillaria caespitosum* Schwarz nov. com.
Ceres—Lower Witteberg Series.
Note the scars on the inner side at the top of the stem showing it to be the right hand branch of a stem.
Type Spec. 142. (× 1) Albany Mus.

Fig. 2 Different view of type specimen in Fig. 1 to show round scars on the left and hexagonal ones on the right.

Fig. 3 A limonite replacement of a branched stem of *Archaeosigillaria caespitosum.*
Vondeling—Main Witteberg Series.
Spec. J.T. 30 (× 1) Geol. Mus. Stellenbosch University.

Fig. 4 Enlargement of fig. 3 with reversed lighting to show details of scars.

Figs. 5 and 6 A clay cast of a small stem of *?A. caespitosum* with counterpart.
Specs. 4172 b & c (× 1) Albany Mus.

Fig. 7 Mould of *?Archaeosigillaria caespitosum.*
Spec. 4140 (× 2) Albany Mus.

Fig. 8 Small rhombic scars of a partly carbonised compression of *?A. caespitosum.*
Nourse Poort near Steytlerville—Lower Witteberg Shales.
Spec. 10739 S.A. Mus. (× 1).

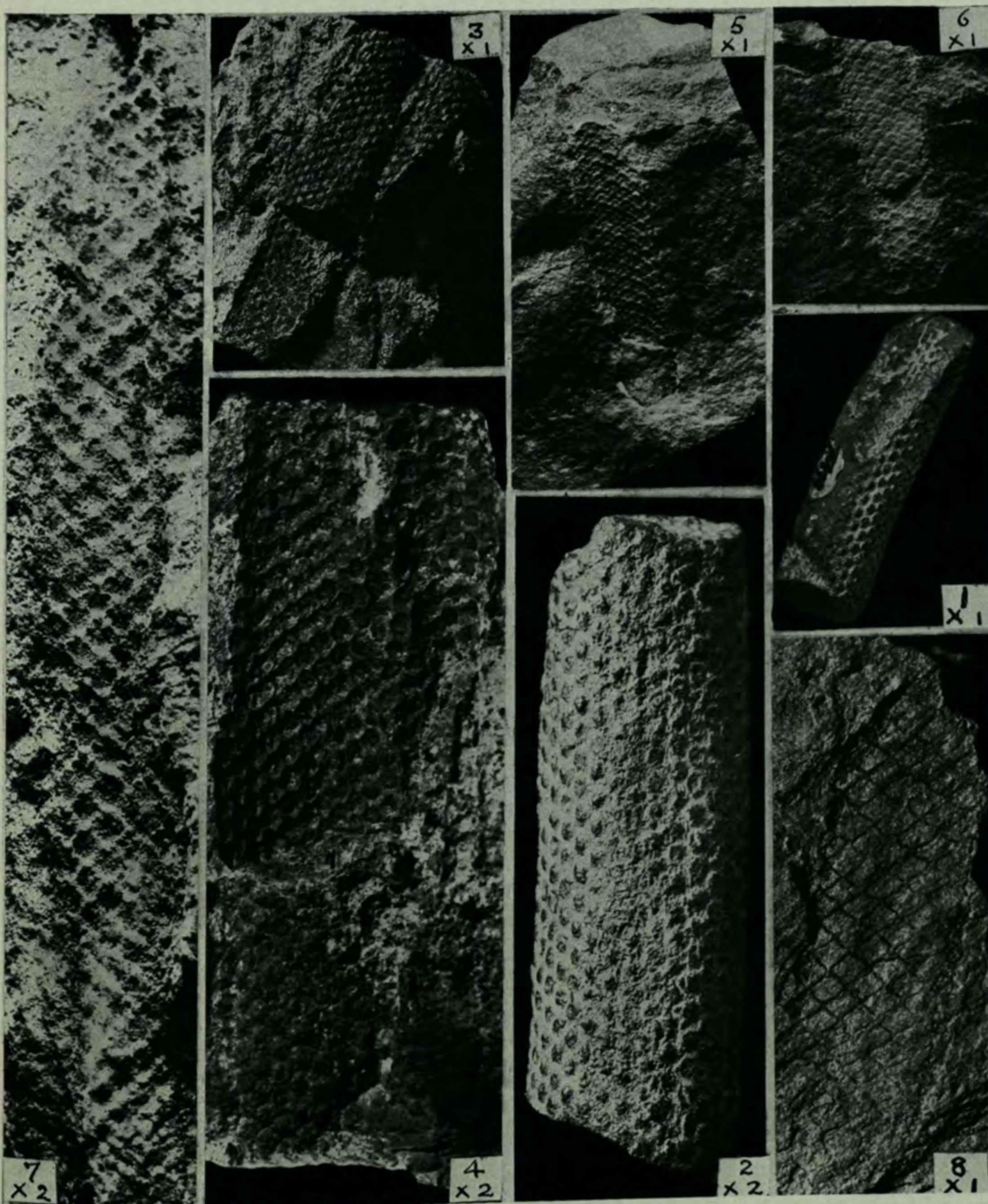

PLATE XI—*Archaeosigillaria caespitosum* Schwarz nov. com.

PLATE XII—*Leptophloeum australe* (McCoy) Walton.

Fig. 1 *L. australe* (formerly the type of *Lepidodendron albanense* Schwarz)
Witteberg Series S. of Grahamstown
Spec. 150 Albany Museum (× 1)

Fig. 2 *L. Australe*. A mould in dense quartzite showing a round vascular scar in the upper angle of several of the rhombic scars.
Witteberg Series—Howisons Poort, S. of Grahamstown.
Spec. 4088 A.M. (× 1)

Fig. 3 *L. australe*. A partly compressed cast of stem with vascular strands replaced by limonite.
Witteberg Series, Touws River.
Spec. 11403 South African Museum (× 1)

Fig. 4 *L. australe*. Specimen in Fig. 3 photographed at right angles to the elongation showing the double margin between the scars (lower right hand side) which is so characteristic of the species.
Spec. 11403 S.A.M. (× 1)

Figs. 5 & 6 *L. australe*. Upper and lower surfaces of specimen in Fig. 3 showing some of the vascular strands replaced by limonite and the amount of compression suffered by the stem cast.
Spec. 11403 S.A. M. (× 1)

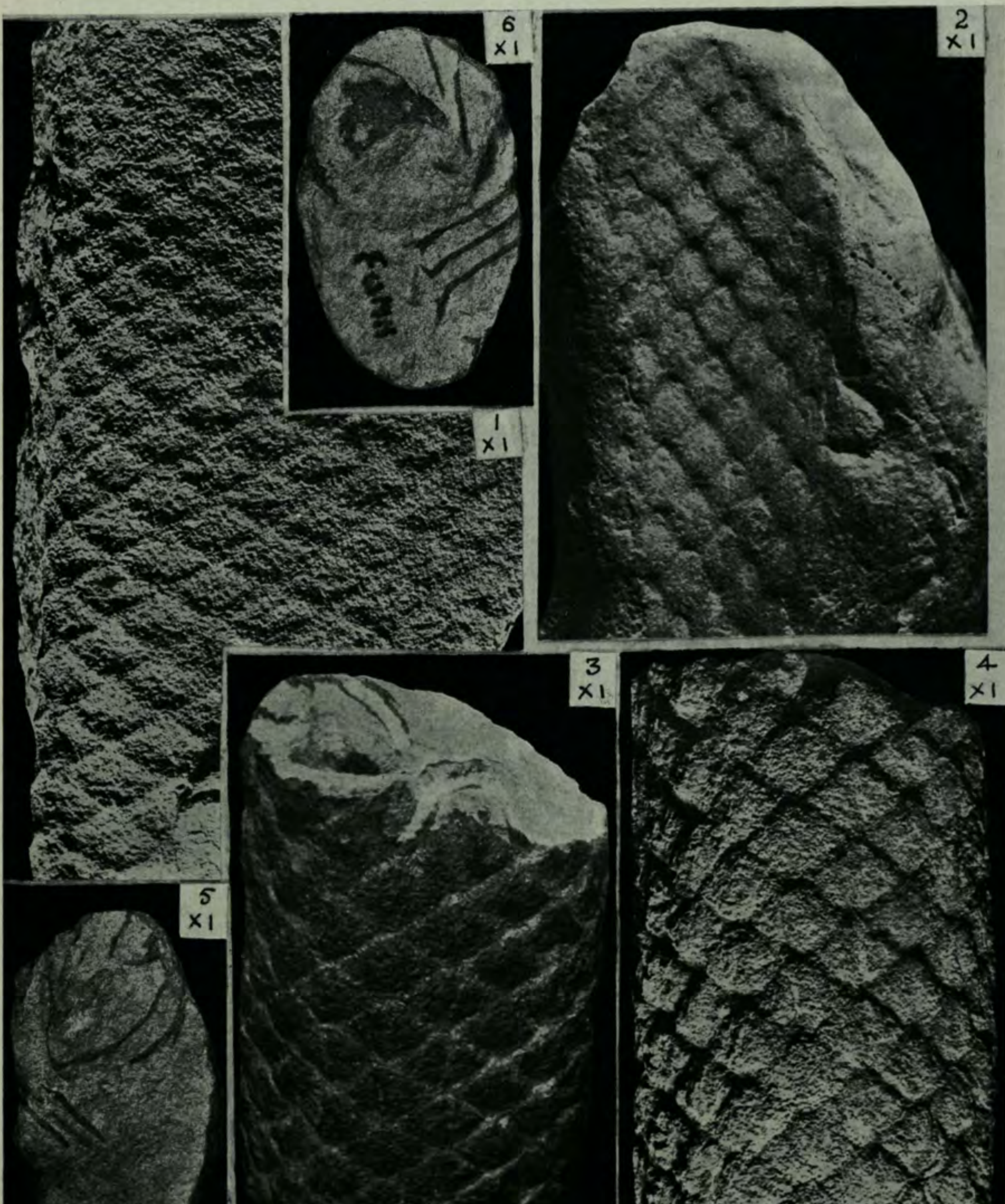

PLATE XII—*Leptophloeum australe* (McCoy) Walton

PLATE XIII—*Haplostigma irregulare* (Schwarz) Seward

Fig. 1 Type specimen *H. irregulare* originally the type of *Bothrodendron irregulare* (Schwarz 1906).
Farm Sweet Fountain (Estments) graphitic Bokkeveld Shales.
Type Spec. 165 (×I) Albany Mus.

Fig. 2 *H. irregulare*—Paratype
Originally erroneously described as *Bothrodendron leslii* (Seward 1903).
Bokkeveld shales.
Matroosberg, Western Cape.
Spec. B. S.A. Mus. (× 1)

Fig. 3 *H. irregulare*. An enlargement of the lower stem in Fig. 1 to show bifurcation.
Type spec. 165. Albany Mus. (× 2)

Fig. 4 *H. irregulare*—Paratype.
Originally described as a lepidodendroid stem (Seward 1903).
Bokkeveld Shales, Port Alfred.
Spec. V236. Nat. Hist. Mus. Lond. (× 1)
Photo by Dr. W. Chaloner

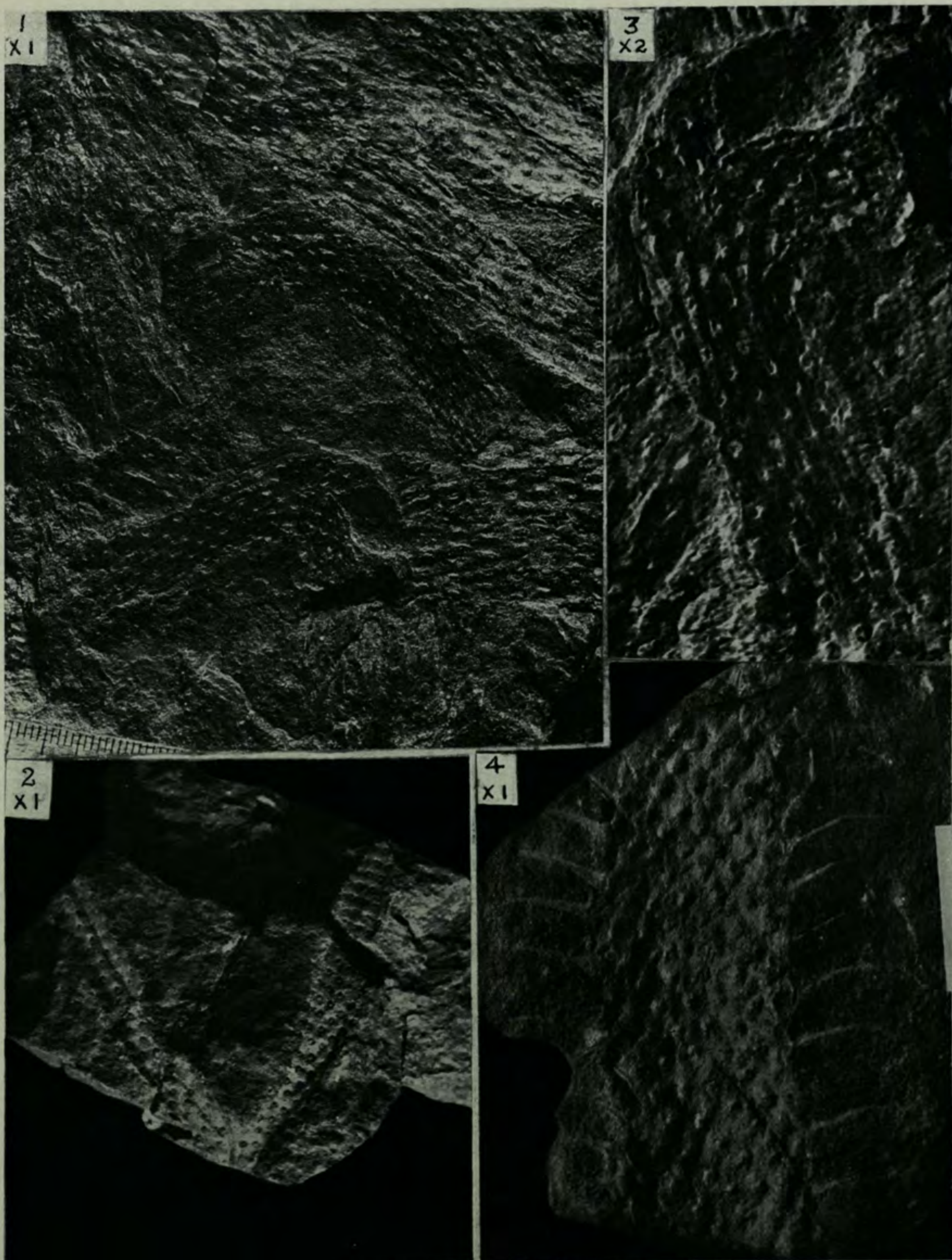

PLATE XIII—*Haplostigma irregulare* (Schwarz) Seward

PLATE XIV—*Haplostigma* Seward.

Fig. 1 *H. irregulare*
Originally described as *Bothrodendron irregulare* (Seward 1909). Notice the thickening beneath the scars on the left hand stem.
Bokkeveld Shales, Port Alfred.
Spec. 2903, S.A. Mus (× 1)

Fig. 2 *H. irregulare* showing long spine-like outgrowths like those on Pl. XIII, Fig. 4, but in this partly decorticated specimen strands of possible vascular tissue project from the middle of the stem and along the outgrowths.
Bokkeveld Shales, Port Alfred.
Spec. 2909, S.A. Mus. (× 1)

Fig. 3 *Haplostigma irregulare* — stem with upper and lower surfaces exposed and with the long outgrowths truncated (by dryness?) to resemble short thick falcate spines.
Bokkeveld Shales, Port Alfred.
Spec. 2905, S.A. Mus. (× 1)

Fig. 4 *Haplostigma irregulare*. Two stems of different sizes and different degrees of decortication but possibly of the same species. Note the small outgrowths on the left hand side of the smaller stem. Bokkeveld Shales, Port Alfred.
Spec. 2909A_2 S.A. Mus. (× 1)

Fig. 5 *H. irregulare*. A large stem with two surfaces exposed.
Bokkeveld Shales, Port Alfred.
Spec. 2905, S.A. Mus. (× 1)

Fig. 6 *H. irregulare*. The only specimen known from the Cape System in which dark cuticular tissue is still preserved. Unfortunately the source of this specimens was not recorded.
Spec. 3750 Albany Mus. (× 1)

Fig. 7 *H. irregulare*. Two stems showing different aspects. The smaller one may form a link with the smaller stem in Fig. 4.
near Steytlerville.
Spec. 10742. S.A. Mus. (× 1)

Fig. 8 ? *H. irregulare*. A stem with very small flat scars and pronounced transverse ribbing which is included, doubtfully in this genus. See text.
Near Steytlerville.
Spec. 10746 S.A. Mus. (× 1)

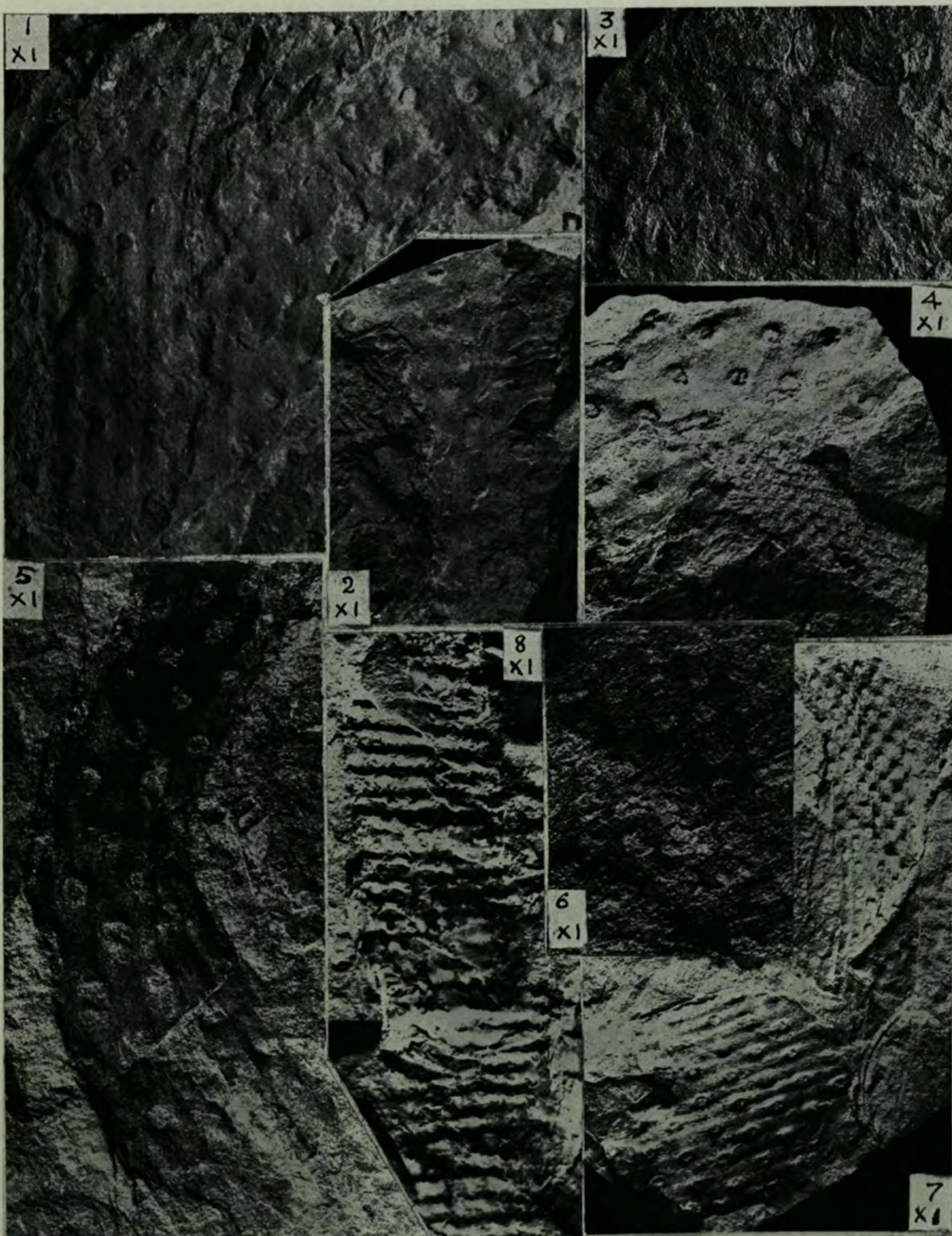

PLATE XIV—*Haplostigma irregulare* (Schwarz) Seward

PLATE XV—*Haplostigma* Seward.

Specimens preserved in quartzite.

Fig. 1 This is the commonest type of hollow mould in quartzite in which the round cavities extend outwards and upwards. Part of the quartzite mould, with hollow impress of the vascular strand, is preserved at the base.
Witteberg Quartzite. Elandsvlei. De Doorns Dist. Spec. TX 18 (× 1)

Fig. 2 A mould similar to that in Fig. 1 in which casts of the stiff outgrowths fill some of the hollows.
Quartzites Witteberg? Groot Rivier Heights, Steytlerville Dist.
Spec. 161. A. Mus. (× 2)

Fig. 3 A small cast of a doubtful *Haplostigma* stem with oval projections and a chequer board pattern which is unusual. (Formerly *Lepidodendron kowiense* Schwarz).
Probably Witteberg. Cold Bokkeveld, Ceres Dist.
Spec. 143. A. Mus. (× 1)

Figs. 4, 5 and 6.
Specimens with impressions of different stages of decortication of ?*Haplostigma*
4. An unlabelled specimen S.A. Mus. from Witteberg Series, Ladismith, Cape.
5. Spec. 1075 (× 1)
6. Spec. 11650 (× 1) S.A. Mus.

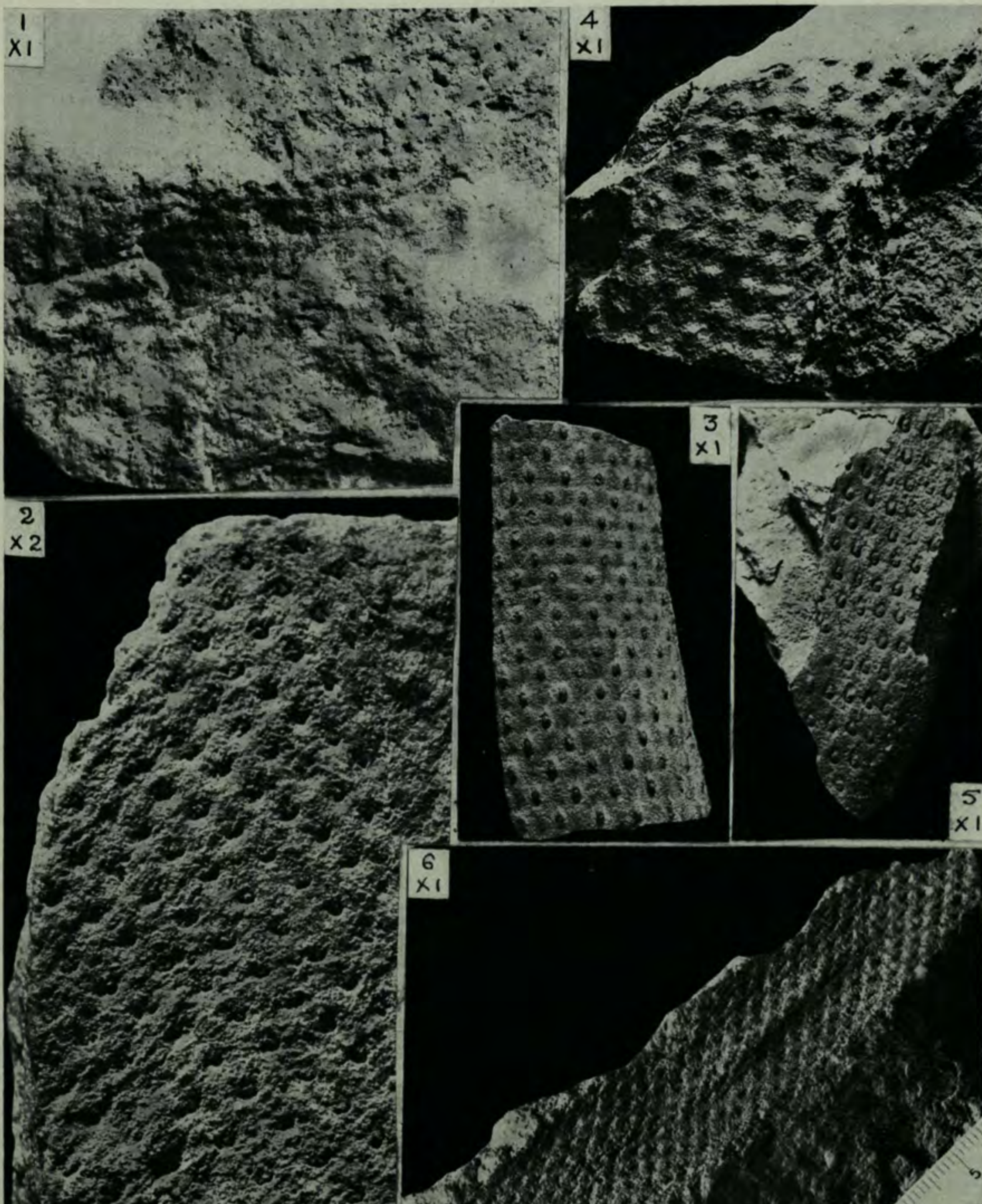

PLATE XV—*Haplostigma* Seward

PLATE XVI—Indeterminable lycopod stems preserved in quartzite—to illustrate different forms of preservation.

Fig. 1 The largest cast of a lycopod stem known from the Cape System — the pattern of leaf scars is indecisive. The scale in this photograph is a twelve inch ruler.
Spec. in Stellenbosch Univ. Geol. Mus.
Photo. J. Theron. Stellenbosch.

Fig. 2 A compressed cast and both sides of the mould of an indeterminable lycopod stem.
Second Bokkeveld Sandstone, Vondeling.
Spec. J.T. 26 (× 1)

Fig. 3 A hollow mould of a bifurcating stem with indications of short spiny outgrowths.
Second Bokkeveld Sandstone, Vondeling.
Spec. J.T. 25 (× 1)

Fig. 4 Mould of a narrow stem with clear oval scars sometimes dimpled — cf. Plate XV, Fig. 5.
Affinity unknown.
Witteberg Quartzite, Ladismith Dist. Cape
Spec. Presented by Dr. A. J. Bruwer — Witwatersrand University. (× 1)

Fig. 5 Specimen in Fig. 4 (× 2) to show details of scars.

PLATE XVI—Indeterminable lycopod stems preserved in quartzite

PLATE XVII—*Calamophyton capensis* sp. nov.

Fig. 1 Type spec. *Calamophyton capensis* sp. nov.
Farm Sweet Fountain, Bathurst District.
Upper Bokkeveld shales.
N.B. Two parallel whorled stems with nodal? positions of left hand stem marked 'a' and 'b'.
Small portion of *Palaeostigma* stem visible at 'c'.
Spec. 1809 Albany Mus. (× 1)

Fig. 2 Portion of a broad finely striated stem cast — lower part of the type specimen.
Type spec. 1809, Albany Mus. (× 1)

PLATE XVII—*Calamophyton capensis* sp. nov.

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PLATE XVIII—*Calamophyton capensis* sp. nov.

Fig. 1 The lower part of the left hand stem shown on Pl. XVII, Fig. 1 enlarged.
Farm Sweet Fountain, Bathurst District.
Upper Bokkeveld Shales.
N.B. The apparent whorl of branches, and the transverse jointing of a film of talc. This gives the impression of short joints but beneath the film the stems are smooth or finely ribbed.
Type spec. 1809 Albany Mus. (× 2)

Fig. 2 A portion of rock split from the type spec. showing a number of small branches.
Spec. 1809 A (× 1)

Fig. 3 Specimen showing branching enlarged.
Spec. 1809 A (× 2)

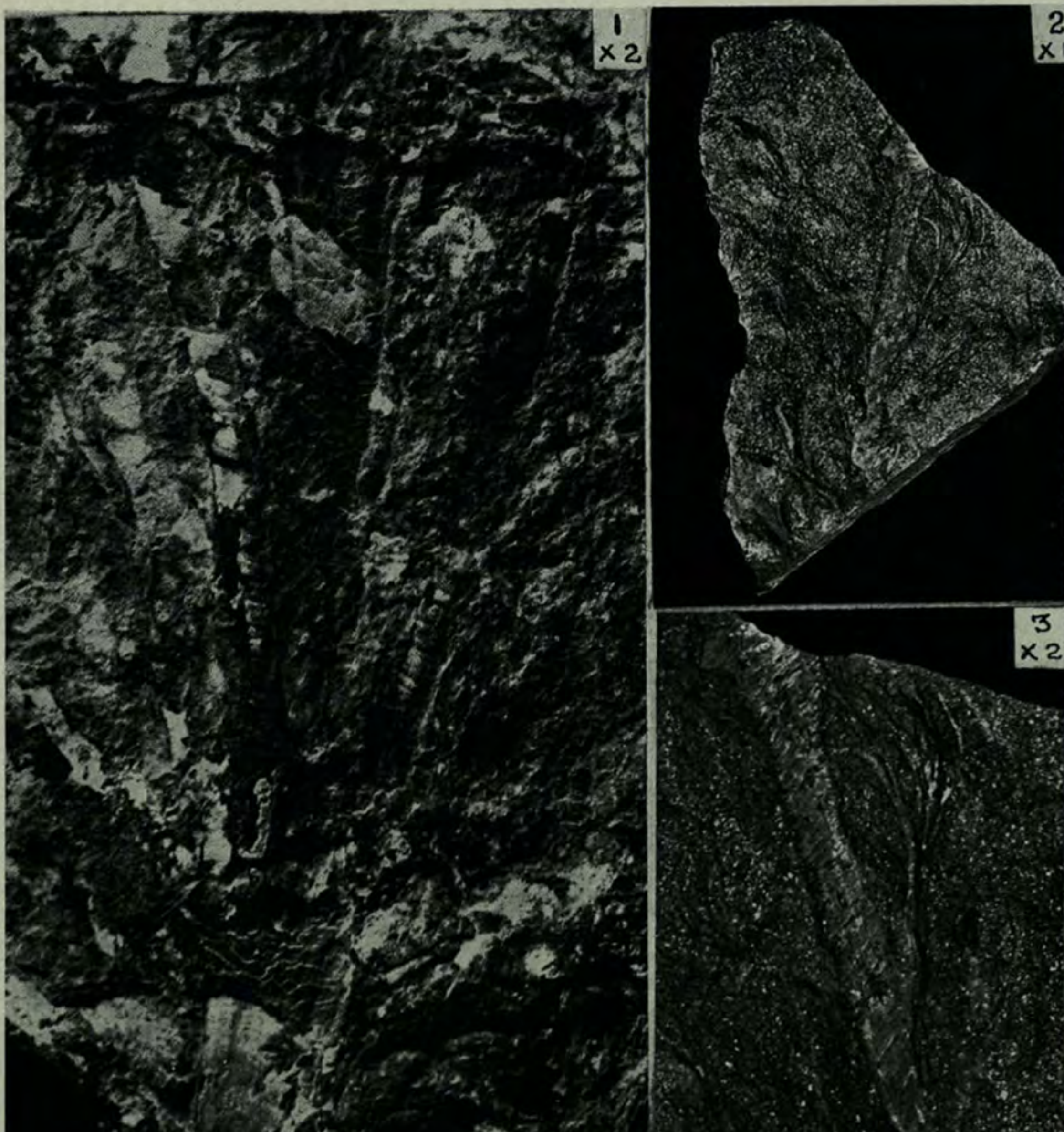

PLATE XVIII—*Calamophyton capensis* sp. nov.

PLATE XIX—*Platyphyllum albanense* and indeterminable stems.

Fig. 1 *Platyphyllum albanense* sp. nov.
The bifurcating venation of parts of two overlapping leaves represent the only known specimens of a large leafed plant from the Cape System.
Howisons Poort near Grahamstown — near base of Witteberg Series.
Type spec. 4487 (× 2) Albany Mus.

Fig. 2 Stem B. A branched and longitudinally grooved stem with thickened axils.
Alicedale Poort — Lower Witteberg Series.
Spec. 3708 (× 1) Albany Mus.

Fig. 3 Stem C. Broad smooth? woody stems.
Willowmore Dist. Upper Witteberg Shales.
Spec. J.T. 13 (× 1)

Fig. 4 Stem D. A large dichotomously branched stem, probably decorticated, with faint longitudinal striae.
Laingsburg Dist.—base of Upper Witteberg Shales.
Spec. 1155 (× 1) S.A. Mus.

Fig. 5 Stem E. Finely striated and jointed stems possibly part of the same system of branching.
Willowmore Dist. Upper Witteberg Shales.
Spec. J.T. 19 (× 1)

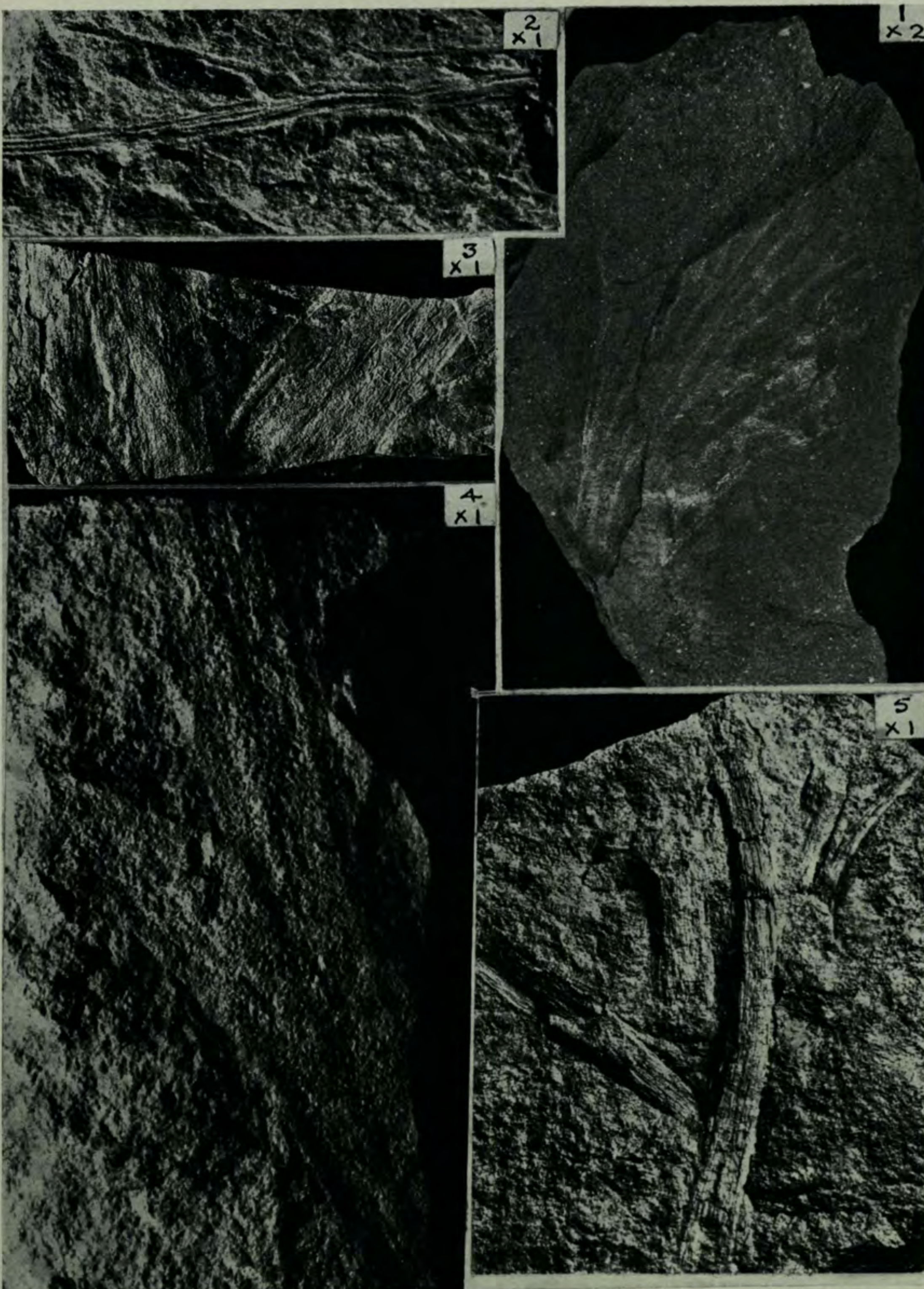

PLATE XIX—*Platyphyllum albanense* sp. nov. and indeterminable stems

PLATE XX—Controversial algal fossils from the Table Mountain Series cf. *Tontalia zollneri* Frenguelli.

Fig. 1 Weathered and bleached carbonaceous shale covered with branched cylindrical algal thalli?, raised slightly above the surface. Upper shale of T.M.S. — De Doorns. Spec. T.D. 28a (× 1)

Fig. 2 The same specimen as Fig. 1 showing the approximate parallel growth and fluctuating width of some of the thalli. Note the dichotomous and lateral branching and the joint central mark indicative of the cylindrical nature of each branch. Spec. T.D. 28a (× 2)

Fig. 3 Another weathered specimen exhibiting the same features. Upper shale T.M.S. Upper surface Spec. T.D. 28b (× 1)

Fig. 4 The unweathered lower surface of the spec. in Fig. 3 oriented in the same position and photographed under water to produce a contrast in colour. Note the thalli? on the two surfaces do not coincide in any particular although the specimen is less than 1 cm in thickness. Lower surface Spec. T.D. 28b (× 1)

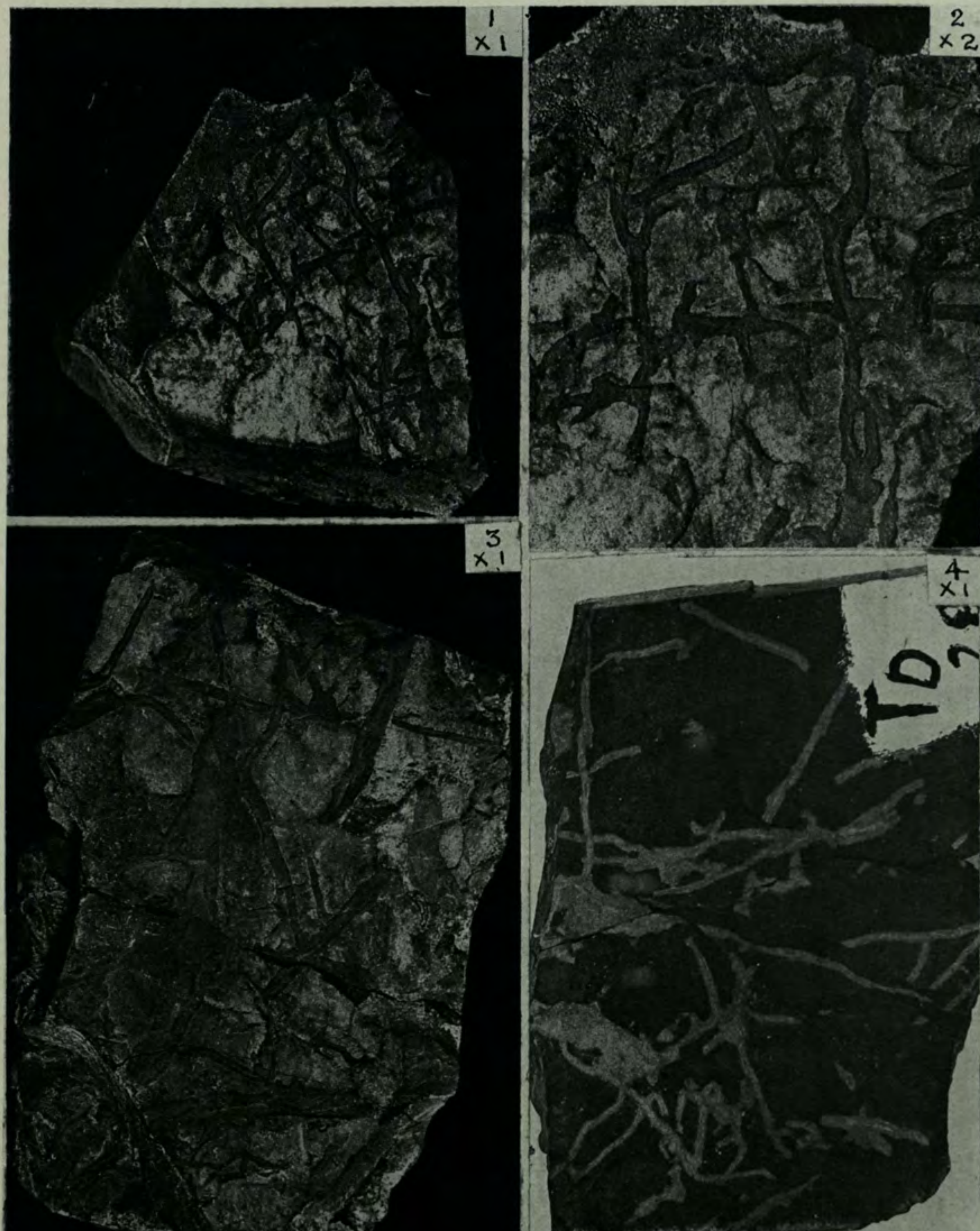

PLATE XX—Controversial algal fossils cf. *Tontalia zollneri* Frenguelli

PLATE XXI—*Spirophyton* with invertebrate tracks superimposed.

Fig. 1 Two portions of rather formless *Spirophyton* possibly from an exposed littoral zone, crossed by trails of worms or other invertebrates which bear no relationship to them. Near Vondeling, Willowmore District, Lower Witteberg Sdst.
Spec. J.T. 39 (× 1)

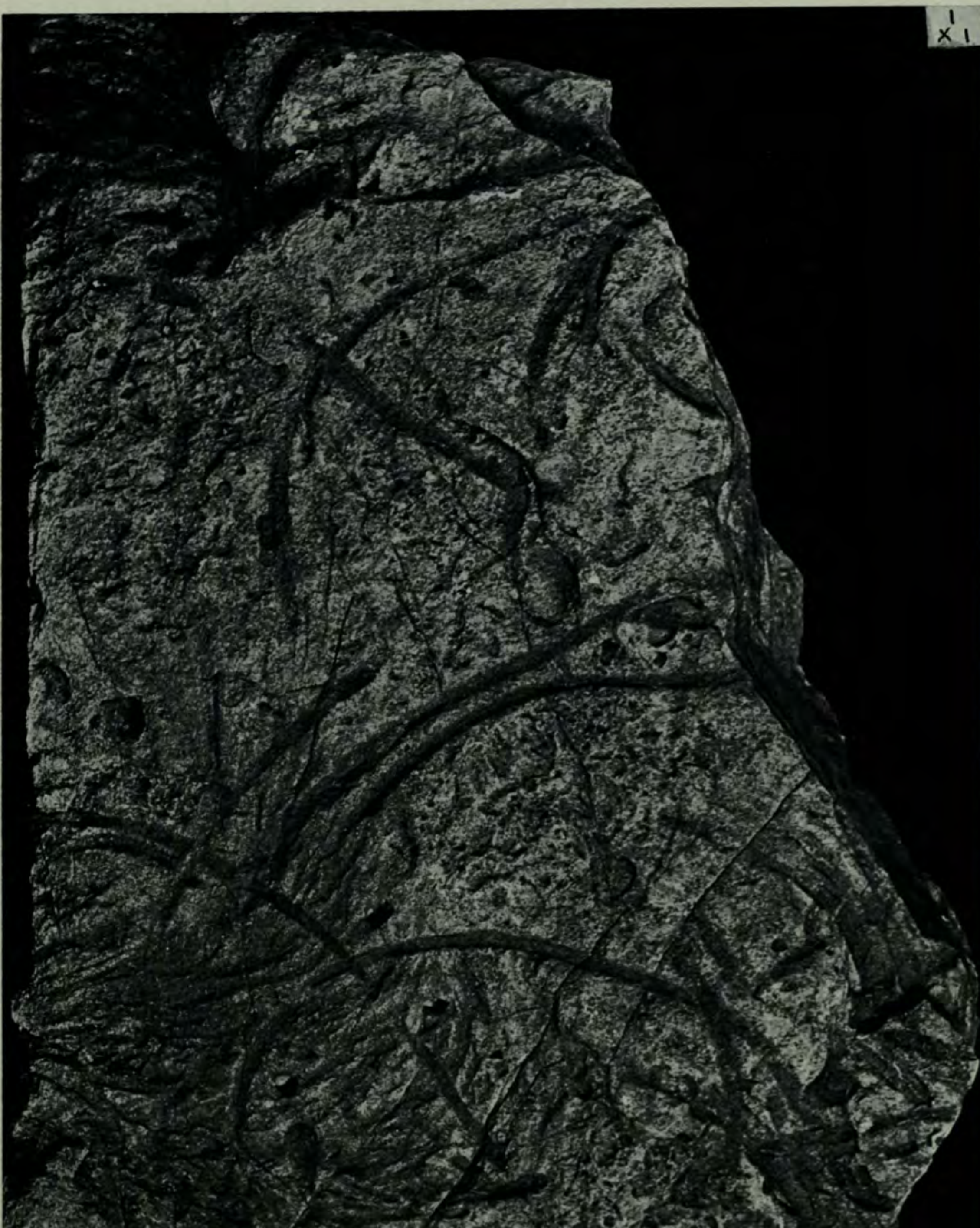

Plate XXI—*Spirophyton* with invertebrate tracks superimposed

PLATE XXII—*Spirophyton* Type "A"—the common type.

Fig. 1 Highly micaceous quartzite with several *Spirophyton* overlapping one another. Note the round compact closed spiral form, the central column and the tight spiral twisting of individual strands which is well illustrated on the right-hand side. Loc. Upper Bokkeveld — 100 ft. below lowest Witteberg quartzite near Touwsberg. University of the Witwatersrand Spec. in B.P.I. Pal. Col. (x 1) Presented by R. B. King.

Fig. 2 Highly micaceous red sandy shale with numbers of small *Spirophyton* overlapping one another on the bedding plane. Loc. Upper Bokkeveld near Touwsberg. University of the Witwatersrand Spec. in B.P.I. Pal. Coll. (× 1) Presented by R. B. King.

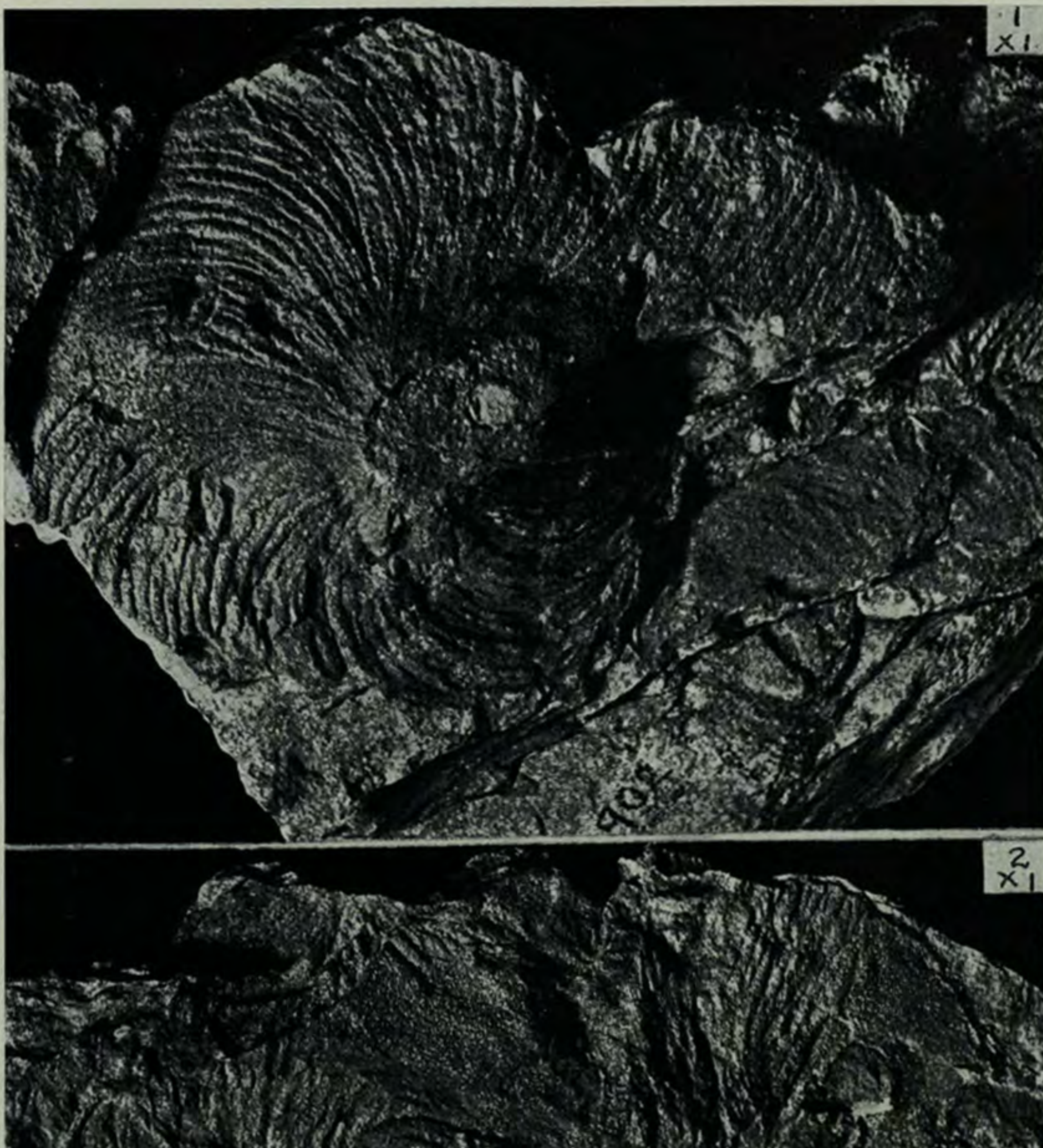

PLATE XXII—*Spirophyton* Type "A"—the common type

PLATE XXIII—*Spirophyton* Type "B"—Note the dark carbon? colouring.

Fig. 1 A large specimen of *Spirophyton* "B" 18 cm in diameter, exposed on a bedding plane. Fragments of others are visible also. Note the grouping of 10-12 individual twisted strands" into petal like units. The general open spiral form is apparent but is less pronounced than in Type "A"
Photo taken in the field by J. Theron.

Fig. 2 Part of *Spirophyton* "B" on a bedding plane. The spiral twisting of individual strands is visible on the right hand side . Locality unknown.
B.P.I. Pal. Coll. (× 1)

Fig. 3 Fragments of *Spirophyton* "B", invertebrate remains and trails preserved in a disturbed littoral zone. Loc. Lower Witteberg Sdst. Vondeling.
Spec. J.T. 35 (× ½)

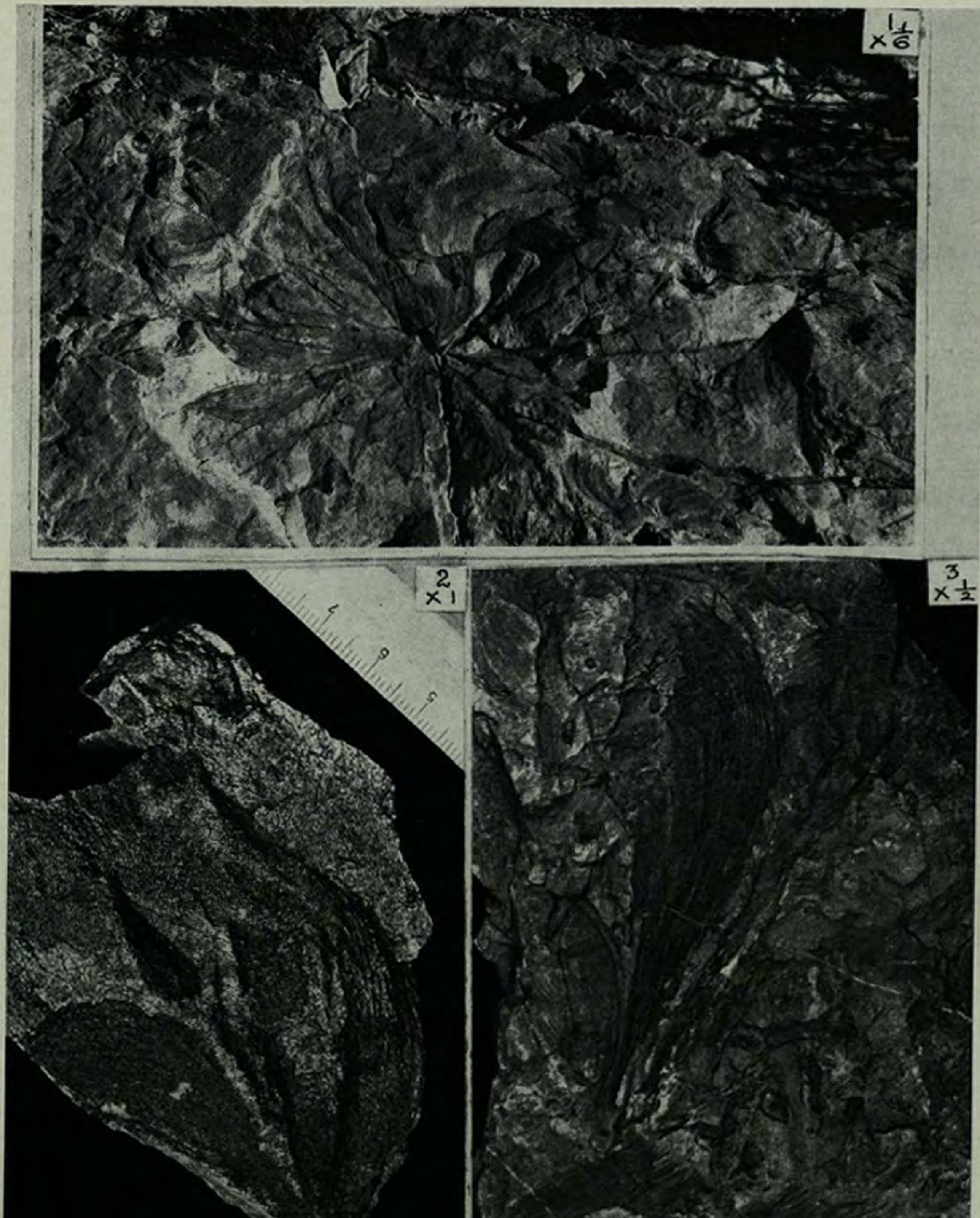

PLATE XXIII—*Spirophyton* Type "B"—Note the dark carbon colouring

PLATE XXIV—*Spirophyton* Type "C".

Fig. 1 Small branched type — several groups of these are visible on different bedding planes. Loc. Uncertain but believed to be Touwsberg.
University of the Witwatersrand B.P.I. Pal. Coll. (× 1) Presented by R. B. King.

Fig. 2 Part of Fig. 1 enlarged. The spiral twisting of individual strands is not visible in the photograph but can be seen with the naked eye.
(× 2)

Figs. 3 and 4 Two specimens believed to represent portions of vertical sections of Type "A" Both now lie on bedding planes. Note the silica cast in the upper part of the central column in Fig. 4.
(× 1).

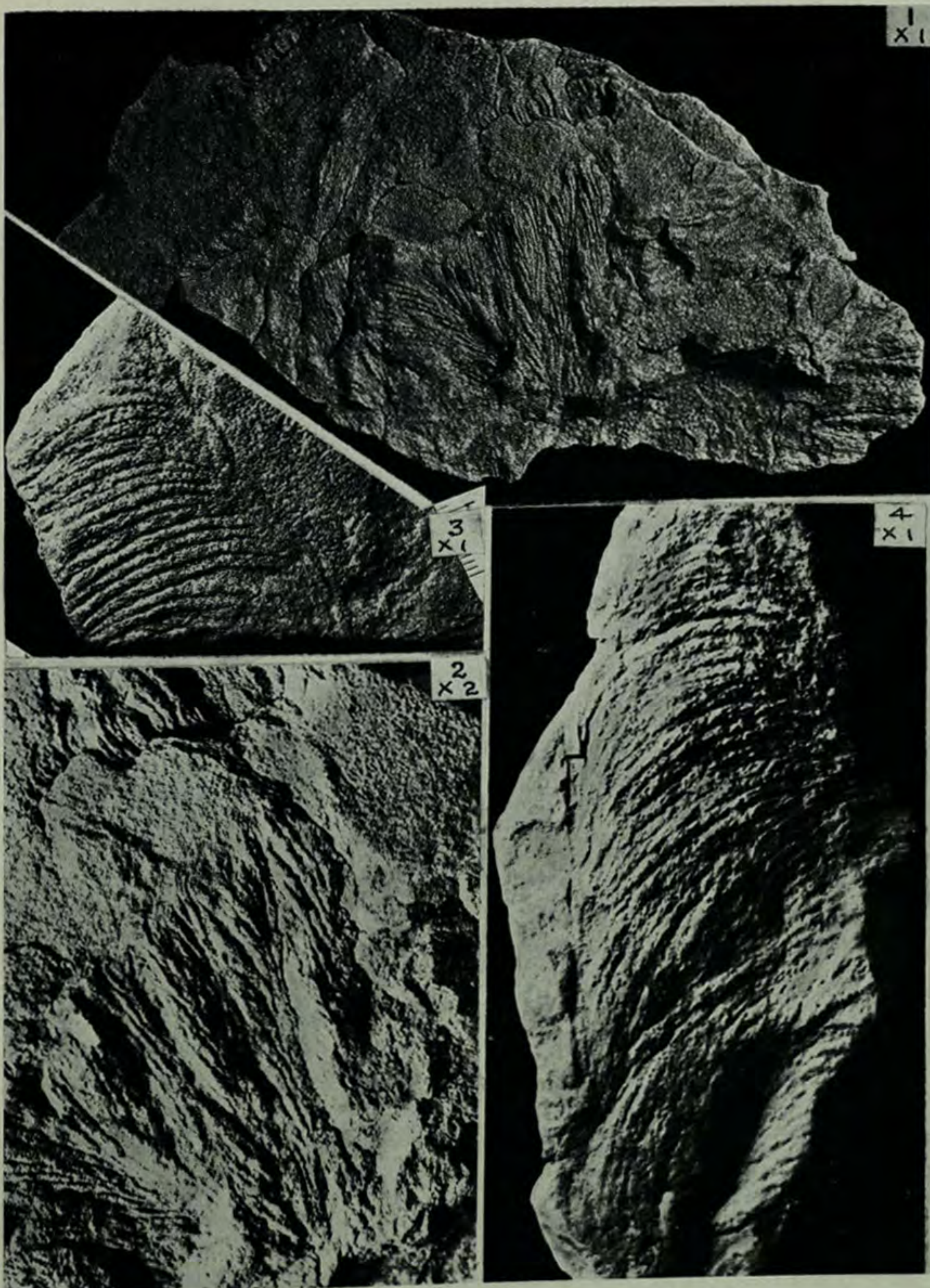

PLATE XXIV—*Spirophyton* Type "C" and Type "A"

PLATE XXV—*Spirophyton* Type "D".

Figs. 1.
and 2 are believed to represent different degrees of dried and collapsed algal colonies. In Fig. 2 the spiralling of individual strands is barely visible. Forms like this probably suggested an inorganic origin due to eddying currents (Seward 1903).

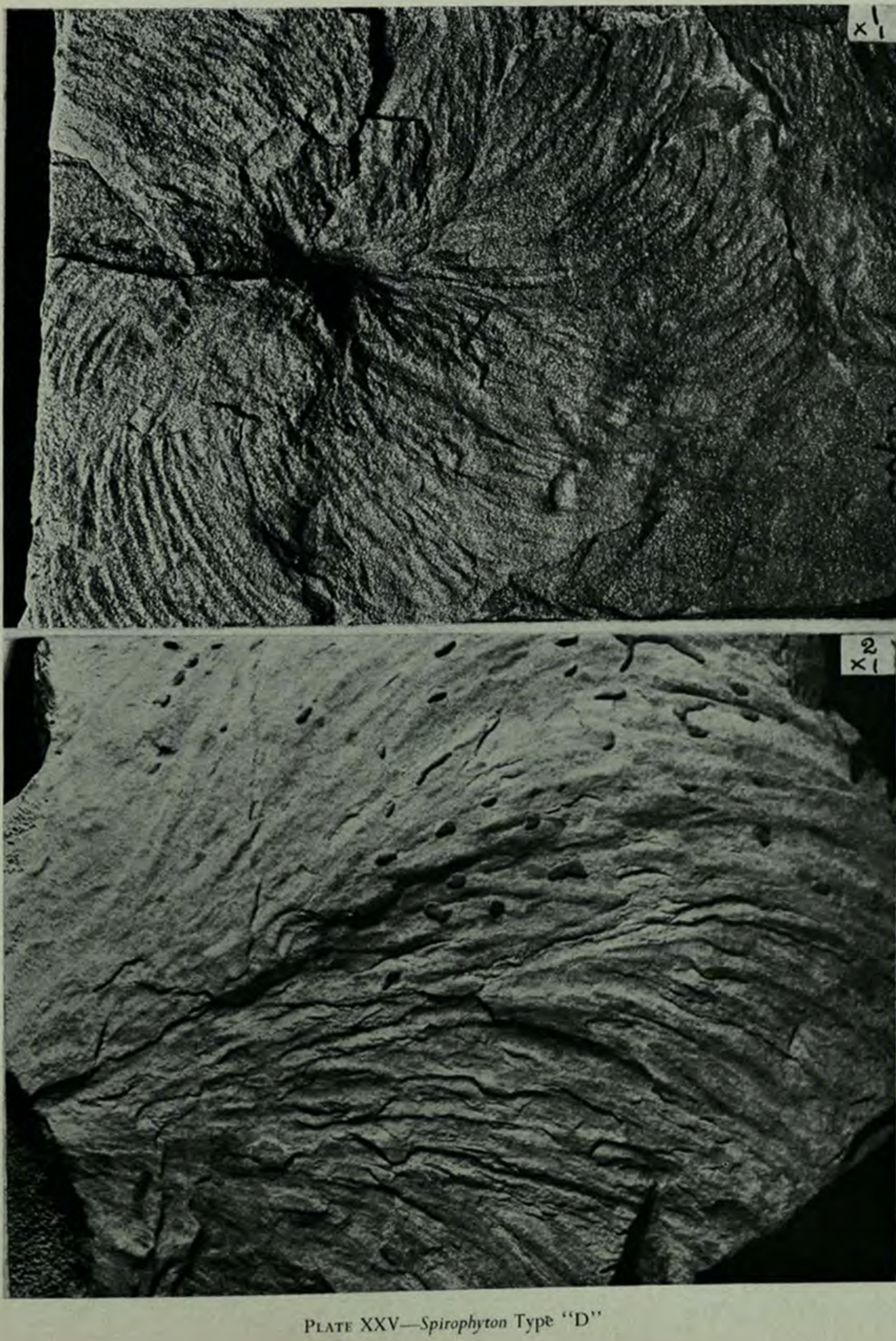

PLATE XXV—*Spirophyton* Type "D"