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Plumstead, Edna P.

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Bernard Price Institute for Palaeontological Research
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SECTION II—A BRIEF SURVEY OF THE GEOLOGY OF THE CAPE SYSTEM

A. THE CAPE PROVINCE FOLD BELT

1. Distribution and Folding

The main occurrence of the Cape System in South Africa is confined to the Cape Province where a threefold division is recognised, namely the Table Mountain Series, or T.M.S., the Bokkeveld Series and, at the top, the Witteberg Series. The rocks occur along the western and southern margins of the sub-continent (*see* map on p. 10) where they lie with marked unconformity on older formations with granite intrusives. In the south and southwest, the Cape System dips beneath and is overlain conformably by the tillite of the Dwyka Series which forms the base of the Karroo System, but along the western margin the tillite when followed northwards, gradually overlaps the various series of the Cape System and finally lies directly on pre-Cape rocks.

The whole system has been folded with a general N-S strike on the West and more intensely with a general E-W strike in the south with especially complex crumpling in the SW in the vicinity of Ceres and the Hex River Mountains, where the two fold axes meet. The folds in the south are frequently overturned, and are sometimes isoclinal. Usually lateral folds display a fairly steep pitch with the result that they are shortened, outcrops occur *en echelon* and a particular horizon may reappear a number of times in a traverse across the system.

Pressure has resulted in the alteration of organic matter to graphite in many cases and the complete destruction of microflora. Dr. G. F. Hart, formerly palynologist of this University, was unable to find spores in any of the Cape sediments he investigated.

At the eastern end, the highly folded Cape System rocks disappear under the Indian ocean between Port Elizabeth and Port Alfred where the straight coast-line trends NE obliquely across the folds.

Along the northern margin of the southern fold belt, the rocks of the Cape System dip northwards at fairly steep angles beneath the Karroo sedimentary basin, the lowermost members of which are equally involved in the folding.

Three divisions are recognised: The Table Mountain Series, the Bokkeveld and the Witteberg in order of age.

2. The Table Mountain Series or T.M.S.

The Table Mountain Series or T.M.S. is the dominant member of the System and is primarily arenaceous. The results of a number of detailed traverses have recently shown that it varies considerably in thickness from point to point and

is often very much thicker than the 5,000 feet previously accepted as an average figure, e.g.:

Citrusdal, 12,000-12,200 feet.
Ceres, de Doorns, 9,000 feet.
Montague, 9,000 feet.
Villiersdorp, 5,800 feet.
Steenbras, 6,000 feet.
Prince Albert, 10,500 feet.
Great Winterhoek, Uitenhage, 17,500 feet.

The series is extremely resistant so that the outcrops give rise to spectacular scenery and many prominent peaks and ranges. In the upper half of the series the Upper Shale Band occurs which can normally be distinguished at the outcrop by a gentle slope of the mountain side. It consists of two minor shale horizons separated by a glacial zone, including scratched and facetted boulders, which is normally about 100 feet in thickness but in the west reaches 200-300 feet and is extraordinarily persistent throughout the province.

The tillite is of importance as a marker but especially as an indication of climatic conditions.

Fossils are rare and are confined to the upper portion. A few very poorly preserved shells and worm burrows have been recorded, and Taljaard (1962) has illustrated a remarkable occurrence of invertebrate tracks which he attributes to trilobites.

In this publication the first probable fossil plant which is believed to be of algal origin is recorded.

Since none of these fossils offers any clear evidence of the age of the series it must be based on the overlying lower Devonian sediments of the Bokkeveld Series. The Table Mountain Series is therefore variously regarded as being of lowest Devonian or more probably of upper Silurian age.

3. The Bokkeveld Series

The Bokkeveld Series is much less resistant to erosive agents than the T.M.S. so that the outcrops normally occupy valleys in the fold mountains. The series is generally recognised as being 2,500 feet in thickness and where typically developed in the west consists of five shales—each several hundred feet thick alternating with four sandstones. These numbers may, however, vary. In the Wuppertal district in the west Swart (1950) recorded six shale horizons while in the Willowmore District, Theron (1962) found only 3 shale and 2 sandstone horizons but the total thickness was 2,817 feet. The series becomes increasingly argillaceous when followed eastwards.

Both shales and sandstones are fossiliferous. The lower two-fifths is marine with a wealth of invertebrate fossils and an occasional plant fragment. In the upper three-fifths the fossils are almost wholly of plant origin. When followed eastwards the marine bands become less conspicuous and in the Port Alfred

area Mountain (1962) states that no T.M.S. occurs and no marine invertebrates were found in the Bokkeveld. In this area, however, Cretaceous and younger rocks occupy the eroded fold valleys and mask sub-outcrops of the underlying Cape System rocks.

4. The Witteberg Series

The Witteberg Series is approximately 3,000 feet thick and includes a very massive and resistant quartzite known as the Main Witteberg Sandstone which forms prominent ranges in the northern portion of the Cape fold belt and in which casts and moulds of plant stems are fairly common. At the base there is a softer portion with some intercalated shales which so much resemble some of the Upper Bokkeveld Beds that the division is arbitrary and often difficult to define on either lithological or palaeontological grounds. A number of plant fossils has been recovered from this zone. Above the Main Witteberg Sandstone there is another argillaceous zone known as the Upper Witteberg Shales but for a long time this was included in the Karroo System as the Lower Dwyka Shales. It terminates at the base of the Dwyka Tillite. Some significant plant fossils have been recovered from this zone also.

The age of the Witteberg Series has been variously described as Upper Devonian or more often as Carboniferous. The bearing of the plants, described in this record, on the age of the Series will be discussed in the final chapter. The evidence definitely supports the older estimate.

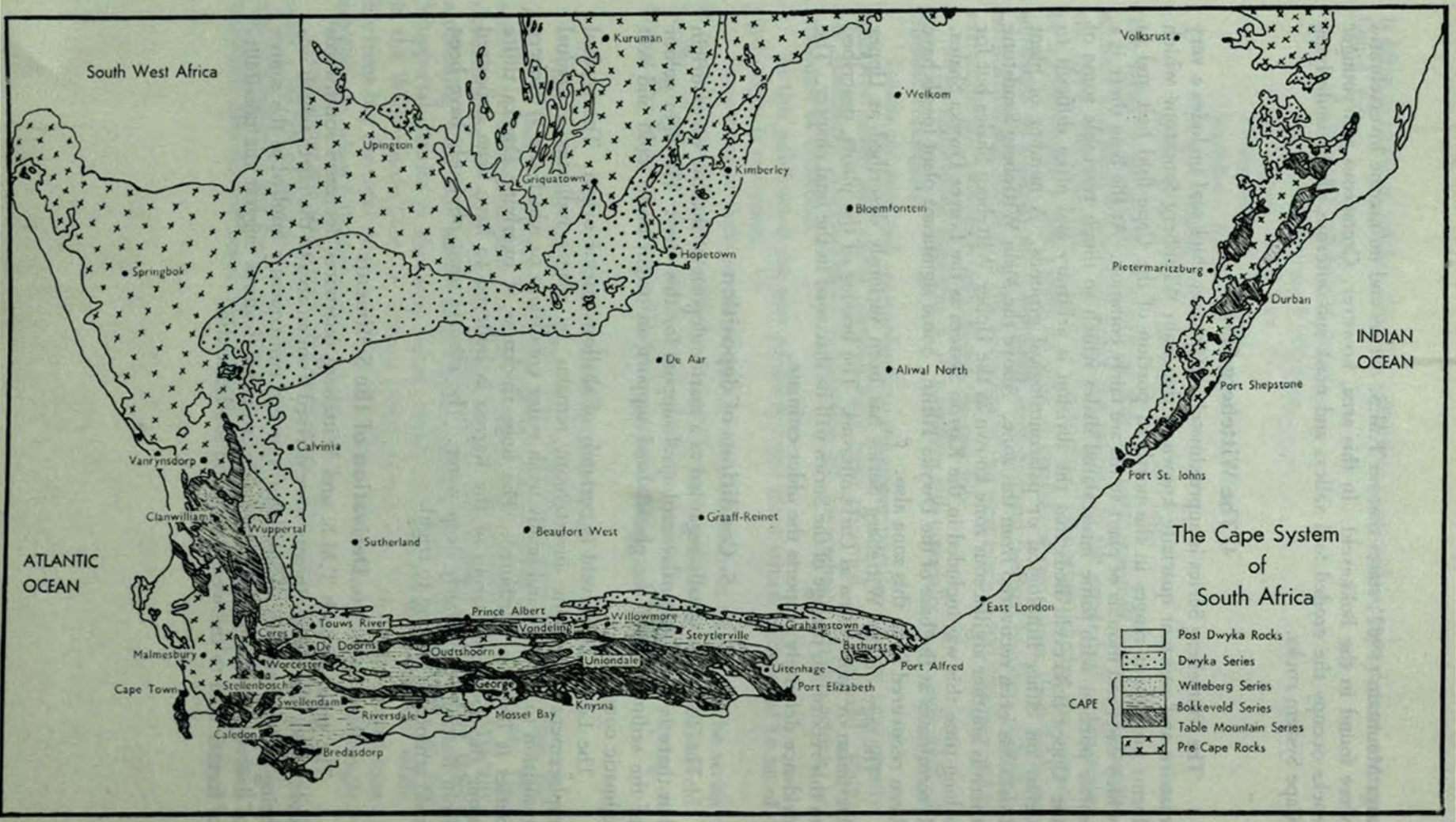
5. Conditions of deposition

The T.M.S. is usually regarded as a marine deposit of shallow water origin but there is very little palaeontological support for this view. The light colour of the sediments and the glacial band support an origin under cold and wet climatic conditions.

The Lower Bokkeveld is certainly of shallow marine origin. The gradual replacement of marine invertebrate remains by plants indicates a gradual transition to brackish and finally fresh water conditions to which the Witteberg Series is likewise attributed. The huge thickness of overlying Dwyka tillite along the southern margin of the Karroo is believed to have been deposited from floating ice in fairly deep water. The climate must obviously have been cold temperate ranging to frigid.

6. Derivation of the Sediments

The grain of both T.M.S. and Witteberg quartzites decreases southwards and implies that the sediments were derived from an area to the north which was being actively eroded. A northern source is consequently implied as the source of drifted plant fragments but certain structural features suggest the possibility of former land to the west, south and southeast also.


South West Africa
Kuruman
Volksrust
Welkom
Upington
Griquatown
Kimberley
Bloemfontein
Springbok
Hopetown
Pietermaritzburg
Durban
INDIAN OCEAN
De Aar
Aliwal North
Port Shepstone
Calvinia
Vanrynsdorp
Port St. Johns
Clanwilliam
Wuppertal
Graaff-Reinet
Sutherland
Beaufort West
ATLANTIC OCEAN
The Cape System of South Africa
East London
Prince Albert
Willowmore
Touws River
Vondeling
Grahamstown
Ceres
Steytlerville
Malmesbury
De Doorns
Oudtshoorn
Bathurst
Worcester
Uniondale
Uitenhage
Port Alfred
Cape Town
Stellenbosch
George
Port Elizabeth
Swellendam
Knysna
Riversdale
Mossel Bay
Caledon
Bredasdorp
Post Dwyka Rocks
Dwyka Series
CAPE
Witteberg Series
Bokkeveld Series
Table Mountain Series
Pre Cape Rocks

7. Map

Places mentioned in the text are marked on the map on p. 10. It has only been possible to record the main outcrops of the three series of the Cape System on a map of this scale. There are probably many small inliers and outliers in the asymmetrically folded and rugged area which have never been mapped and may yet reveal rewarding discoveries.

B. NORTHERN EXTENSION OF THE CAPE SYSTEM

1. In Natal

In the east of South Africa, extending from Port St. Johns to northern Natal, there is a thick arenaceous formation which lies unconformably on older granites and ancient sediments. It is overlain unconformably by tillite forming the base of the Karroo System. The sandstones are usually felspathic with a reddish colouration but have long been considered to be the northeastern extension of the T.M.S. No fossils have been found and no sign of any succeeding Bokkeveld or Witteberg Series.

The Natal T.M.S. forms a monocline of which the axis has been eroded so that the outcrops tend to occur in two strips with a N-S strike of which the eastern limb dips gently beneath the Indian Ocean.

2. In Malawi

Further north in Malawi there is a group of sediments known as the Nachipere Beds which lies unconformably below the tillite of the Karroo System. It is regarded as being a northern equivalent of the Cape System. Poorly preserved plant remains have been found but Dr. Schelpe of Cape Town University who examined them considered that all were indeterminable (*see* Bloomfield 1954).

3. In the Orange Free State

In the last decade gold mining operations beneath the northern half of the Karroo basin have revealed in certain shafts and deep boreholes in the Orange Free State and Southern Transvaal patches of horizontal sediments forming the base of the Karroo, and at present incorporated with that System. These rocks are associated with tillites and contain a pre-*Glossopteris* flora of Lycopods comparable with several of the fossil plants previously believed to be confined to the Cape System, but they are in a much better state of preservation than those in the Cape Fold belt. The sediments may represent a northern extension of the Witteberg Series or may be contemporaneous with some of the lower glacial sediments of the southern Dwyka. I hope to discuss this interesting plant

assemblage and its relationship to Cape and Karroo Systems in a subsequent publication.

C. STRATIGRAPHICAL POSITION OF THE FOSSIL PLANTS OF THE CAPE FOLD BELT

All the plants described in this monograph are from the Cape Province and their stratigraphical position in the Cape System has been plotted as accurately as possible in the accompanying table. Unfortunately the exact horizon of many of the older specimens is not known and has had to be estimated.

All older survey reports and all other known records have been studied for references to plant fossils but only those of which the specimens are still preserved in some collection, or of which the generic determinations are regarded as reliable, have been included in the accompanying table.

The particulars about each occurrence listed will be found in the descriptive text of Section III.

TABLE 1

DISTRIBUTION OF FOSSIL PLANT SPECIES IN CAPE SYSTEM

Based on measurements by Theron 1960 in the Willowmore District

Dwyka Tillite																							
CAPE SYSTEM	WITTEBERG SERIES	Upper	Sandstones and Shales	Ganoid Fish Zone								×								×			
																				×			
		Middle	Main Sandstone										×	×			×						
																							×
		Lower	Sandstone and Shale	Howison's Poort			×								×				×		×		
	BOKKEVELD SERIES	Upper	From 3-6 Shales alternate with sandstones	Schietkraal					×				×			×					×		
				Sweet Fountain					×							×		×					
				Port Alfred	×	×				×	×					×	×						
		Lower	Marine in West					×								×							×
	T. M. S.		Upper Sandstone																				
			Upper Shale Tillite Upper Shale																			×	
			Main Sandstone approx. 4,000 ft.																				
			Major unconformity																				

Dutoitia pulchra Hoeg
Dutoitia alfreda sp. nov.
Dutoitia maraisia sp. nov.
Psilophytalean axes
Palaeostigma sewardi Krausel and Weyland
Drepanophycus schwarzi sp. nov.
Drepanophycus kowiense sp. nov.
Protolepidodendron eximium Frenguelli
Protolepidodendron theroni sp. nov.
Archaeosigillaria caespitosum Schw. nov. com.
Leptophloeum australe (McCoy) Walton
Haplostigma irregulare Seward
Unidentifiable lycopods
Calamophyton capensis sp. nov.
Platyphyllum albanense sp. nov.
Unidentifiable stems
Branched stems
cf. *Tontalia zollneri* Frenguelli
Spirophyton

TABLE 2

CLASSIFIED LIST OF PLANT FOSSILS KNOWN FROM THE CAPE SYSTEM
(in order of description)

	DIVISION	SUB-DIVISION	ORDER	GENUS	SPECIES
VASCULAR PLANTS	PSILOPHYTA	PSILOPSIDA	Psilophytales	*Dutoitia* Hoeg	*Dutoitia pulchra* Hoeg
					Dutoitia alfreda sp. nov.
					Dutoitia maraisia sp. nov.
				Unclassified psilophytalean axes	
				Palaeostigma Kräusel and Dolianiti	*Palaeostigma sewardi* Kräusel and Dolianiti
	LYCOPODOPHYTA	LYCOPSIDA	Archaeolepidophytales	*Drepanophycus* Goppert	*Drepanophycus schwarzi* sp. nov.
					D. kowiense sp. nov.
			Protolepidophytales	*Protolepidodendron* Krejci	*Protolepidodendron eximium* Frenguelli
					P. theroni sp. nov.
				Archaeosigillaria Kidston	*Archaeosigillaria caespitosum* Schwarz nov. com.
				Leptophloeum Dawson	*Leptophloeum australe* (McCoy) Walton
			Uncertain classification	*Haplostigma* Seward	*Haplostigma irregulare* (Schwarz) Seward
	ARTHROPHYTA	SPHENOPSIDA	Protoarticulatales	*Calamophyton* Kräusel and Weyland	*Calamophyton capensis* sp. nov.
	Problematical Megaphyllous Devonian Plants			*Platyphyllum*	*Platyphyllum albanense* sp. nov.
	Stems of Uncertain Affinities				A. B. C. D. E.
Non Vascular Plants	THALLOPHYTA	ALGAE		*Tontalia*	cf. *Tontalia zollneri* Frenguelli
		? ALGAE		*Spirophyton*	*Spirophyton* Types A. B. C. & D.