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CONTRIBUTIONS IN THE FIELD OF PALAEOPALYNOLOGY AT THE BERNARD PRICE INSTITUTE, PAST, PRESENT AND FUTURE

by

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ABSTRACT

A brief chronological summary of the palynological research carried out by students and past members of the staff at the Bernard Price Institute for Palaeontological Research is presented. The contribution that each of these studies has made to the understanding of stratigraphic relationships in the southern African region is highlighted. A correlation chart of palynological biozones documented from South African localities is presented (Table 1).

KEYWORDS: Palaeopalynology, biostratigraphy, spores, pollen, acritarchs, Karoo Basin.

INTRODUCTION

Over the past 40 years palaeopalynological research has provided a powerful means of correlating sediments in southern Africa. Earlier studies employing this methodology in our country focused on the major coal-bearing beds of Permian age. Here the Karoo Basin, rich in its fossil floras, faunas and mineral deposits, provided an ideal setting for palaeopalynological research. More recently attention has shifted to the younger Cretaceous and Tertiary-aged sediments.

Many of the pioneering individuals who dedicated themselves to southern African palynology have, at one time or another, had links with the Bernard Price Institute for Palaeontological Research. It is through their efforts that future students have a solid foundation on which to build.

HISTORICAL REVIEW

Edna Plumstead was the first person associated with the BPI to become involved in palynological research. She documented the fossil floras of the southern African coal measures by illustrating certain spore genera typical of the coal-bearing strata of the Ecca Group (1957, 1966a, 1966b). Palynological endeavour, however, began in earnest at the BPI with the appointment of George Hart in 1965. A graduate of Sheffield University in the United Kingdom, he had already initiated research on the palynofloras of the Ketewaka-Mchuchuma Coalfield in Tanzania and was able to subdivide the coal-bearing strata there into one transitional and two major florizones. (Hart 1960, 1965a). He later used this scheme to correlate strata and the Songwe-Kiwiri Coalfield of that country (Hart 1965b) and clearly demonstrated the value of palynology in defining equivalent rock strata over a wide geographical area. His first publication on South African material (Hart 1963) documented an assemblage from a borehole in the Orange Free State and he concluded that it contained both Carboniferous and Permian species. His first subdivision of the South African Lower Karoo strata (Hart 1967) resulted in the definition of four zones, with subsequent papers (Hart 1969a, 1969b, 1971) enlarging the stratigraphic subdivision of the Lower Karoo and its equivalents in southern and central Africa. He produced various taxonomic papers (Hart 1964a, 1964b, 1966), but the most ambitious was a systematic revision and account of the distribution of Permian miospores (Hart 1965c).

The appointment of Roger Davey in November 1967 led to research on hystrichospheres of the Cretaceous sediments of Zululand. He demonstrated that stages in evolutionary development in three genera could be used to correlate sections of these strata. Two papers followed (Davey, 1969a, 1969b) documenting dinoflagellate cysts and hystrichospheres from the Upper Cretaceous of Zululand, but his stratigraphic results were not published due to the confidential nature of the project. Richard Pienaar, a student of the BPI at that time, documented the calcareous nannoplankton of these rocks (Pienaar 1969).

John Anderson was appointed in 1968 as a palynologist on the BPI staff, with financial support from SOEKOR (Southern Oil Exploration Corporation). His research on the miospores of the northern Karoo Basin in South Africa led him to propose eight zones and 21 subzones, ranging from the Permo-Carboniferous Dwyka to the *Daptocephalus* Zone (now *Dicynodon* Assemblage Zone) of the Beaufort Group in the Late Permian (Anderson 1977). He also provided a detailed correlation of these units.

Registration of Rosemary Falcon for a masters degree in 1970 led to the production of a thesis documenting the palyno-stratigraphy of the Mid-Zambesi Basin in Rhodesia (now Zimbabwe) (Falcon 1972, see also Falcon 1973, 1975). Continued research for a higher degree extended this correlation scheme to

CHRONOSTRATIGRAPHIC UNITS *vide* Harland *et al.* 1982				SOUTH AFRICA				
				N. Karoo Basin	Waterberg/ Pafuri	Main Basin	Main Karoo Basin	North Main
	EPOCH	AGE	CHRON	Aitken 1998	MacRae 1988	Hart 1967	Anderson 1977	Falcon 1978
TRIASSIC	EARLY TRIASSIC	Scythian		X				
				IX				
				VIII			ZONE 7	
				VII			ZONE 6	
		Tatarian		VI	F		ZONE 5	
	LATE PERMIAN					Striatiti Zone		h'
				V			ZONE 4	
		Kazanian						IV h
				IVB	E			
		Ufimian				Zonati Zone		d g
				IVA				c
			Irenian				ZONE 3	b
PERMIAN		Kungurian						
			Filpovian	III	D			a III f
						Cingulati Zone		
		Artinskian	Baigendzinian					
				II				d II e
	EARLY PERMIAN							
			Aktaskian					d
		Sakmarian	Sterlitamakian				ZONE 2	c
			Tastubian	I	B			b
		Asselian	Krumaian			Cavati Zone		
			Uskalikian					I b
			Surenan					a
CARBONIFEROUS	GZELIAN	Noginskian		Dwyka	A		ZONE 1	a
		Klazminskian						
	KASIMOVIAN	Dorogomilovskian						

TABLE 1.

Correlation chart of zones defined with international chronostratigraphic units and assemblages or biozones documented from South African localities (shaded areas = no information).

include sediments on both sides of the Rhodesian watershed (Falcon 1978). Correlation of these assemblages with similar material from many Gondwanan localities confirmed the Early Permian age of the coal-bearing strata equivalent to our Karoo. Falcon, in collaboration with other researchers, provided a palynological framework for the South African Witbank Basin coal measures and associated sediments, and related this to the Zimbabwe sections (Falcon, Pinheiro and Shepherd, 1984).

Also in 1970, Ian McLachlan registered for a higher degree (part-time) at the BPI. During this time he was still an employee of SOEKOR. He studied the problematic microfossils termed *Anellotubulata*, found in Lower Karoo beds. The term *Anellotubulata* was given to these microfossils as similar forms had been described from the Lias of Germany. Tests using X-ray diffraction and electron microprobe work showed that these microfossils were comprised mainly of iron, phosphorus and a small amount of calcium. Unfortunately they were of limited biostratigraphic use due to their long range. McLachlan (1973) reported similar forms from Cretaceous sediments in Eastern Australia. The nature of their depositional environment was questioned and conclusions indicated that Karoo anellotubulates flourished in fresh rather than marine waters. However, the presence of glauconite bands, spinose acritarchs and sponge spicules suggested that conditions were more saline at times, but the lack of recognisable marine faunas indicated that a connection with the sea was unlikely. In 1977 McLachlan published a palynological assessment of petroleum source rocks of the Mesozoic and Cenozoic on the coastal margin of South Africa.

Research for a masters degree by Colin MacRae, on the coal-bearing Karoo strata near Francistown, Botswana, resulted in the definition of three palynological biozones (MacRae 1978). He correlated these biozones with palynological schemes established for other African and Gondwanan localities. This highlighted the presence of coal seams in strata equivalent to the Lower Ecca Group: previously it was thought that coal seams were restricted to the Middle Ecca. MacRae extended his palynological research to the Waterberg, Pafuri and Springbok Flats Basins of South Africa for his doctorate. Six palynostratigraphic zones were defined and their distribution over a considerable distance correlated (MacRae 1988). These biozones were also compared with similarly defined units Gondwana-wide and an attempt was made to date the sections. His results challenged the generally accepted Early Permian age of the middle Ecca (Vryheid Formation equivalent horizons), favouring a slightly younger age. Broad palaeoenvironmental conclusions were drawn for the various units and some economic aspects and implications for future mining highlighted. Carboniferous sediments in South Africa were documented, and the location of the Carboniferous/Permian boundary in the Waterberg Basin was also identified (MacRae 1991).

Grigor Aitken recently completed palynological studies of the No. 4 and 5 seams (Vryheid Formation, Ecca Group) in the Witbank and Highveld Coalfields (Aitken, 1992, 1994). He included this work as part of a doctoral thesis and extended his research to include Beaufort Group sediments in the northern Karoo Basin. Ten biozones were presented and compared with the work of Hart, Anderson, Falcon and MacRae. A composite biostratigraphic section was proposed for the northern Karoo Basin extending from the Dwyka of Late Carboniferous age to the Beaufort of Late Permian/Triassic age.

Ann Cadman, a staff member of the BPI and Sue de Villiers, a PhD student presently registered at the Institute, are presently studying the Late Cretaceous/ Early Tertiary spore and pollen assemblages from the west coast and adjacent Namaqualand interior. These studies will provide valuable information about climatic and plant regimes during this time. So far, assemblages from the Koingnaas site in Namaqualand indicate a Palaeogene age and show that the climate was humid and subtropical. The vegetation was predominantly ancient rain forest which included gymnospermous elements of araucarian and podocarp affinity, with abundant angiosperm trees, shrubs and herbs (De Villiers 1994). Looking at assemblages from various sites on – and offshore, Ann Cadman was able to conclude that the diverse fern representatives and many angiosperm forms indicated conditions vastly different from present on the west coast of southern Africa (Cadman 1994).

CONCLUSIONS

The scope of palynological work still to be done in southern Africa remains unlimited. It is hoped that future research will continue to focus on the creation and refinement of biozonation schemes and that collaborative work will continue between the palaeontological and geological disciplines. A clearer understanding of the past can only be achieved by applying and integrating the research emanating from the various palaeontological subdivisions. Students and past staff members of the BPI have without doubt significantly contributed to the quest of unraveling the historical development of the earth's crust in southern Africa. It is sincerely hoped that the BPI will continue to foster palynological research and that in time many useful answers will be found in studying the fossil spores and pollen that were 'blowing in the wind' many millions of years ago.

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