Palaeontological Impact Assessment for the proposed mine prospecting on Farm 84, Barkly West District, Northern Cape Province,

Desktop Study

For

Edward Matenga

21 August 2018

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Expertise of Specialist

The Palaeontologist Consultant is: Prof Marion Bamford
Qualifications: PhD (Wits Univ, 1990); FRSSAf, ASSAf
Experience: 30 years research; 22 years PIA studies

Declaration of Independence

This report has been compiled by Professor Marion Bamford, of the University of the Witwatersrand, sub-contracted by Edward Matenga, South Africa. The views expressed in this report are entirely those of the author and no other interest was displayed during the decision making process for the Project.

Specialist: Prof Marion Bamford

Signature: 

Executive Summary

A palaeontological Impact Assessment was requested for the mine prospecting rights for diamonds by Messina Diamonds (Pty) Ltd in the Barkly West District, Northern Cape Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development of a sand mining area. The farm affected is e a portion of the remaining extent of the Farm 85.

The proposed site lies on the volcanic rocks of the Allanridge Formation, Ventersdorp Supergroup which does not contain fossils. In the near vicinity are the limestones of the Vryburg Formation and possible stromatolites of the Schmidtsdrif Formation, basal Transvaal Supergroup. Shales and mudstones of the nearby Prince Albert formation, Ecca Group, Karoo Supergroup could potentially contain marine and terrestrial fossils although none has been reported from this area. Sands of the Quaternary group would not preserve fossils. Since there is a very small chance of finding fossils a Chance Find Protocol should be added to the EMPr. Based on this information it is recommended that no palaeontological site visit is required and a mine prospecting right be granted.

Table of Contents

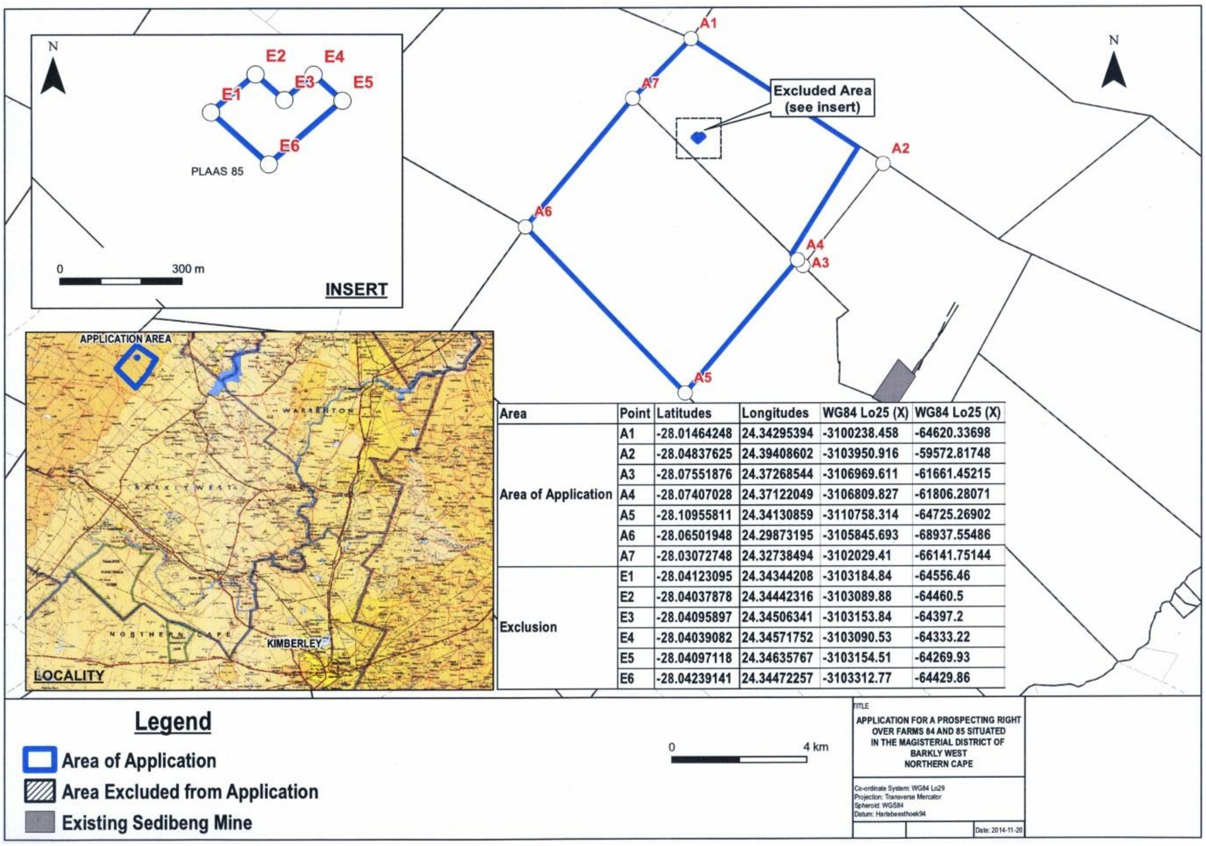
1. Background

A palaeontological Impact Assessment was requested for the mine prospecting rights for diamonds by Messina Diamonds (Pty) Ltd in the Barkly West District, Northern Cape Province. To comply with the South African Heritage Resources Agency (SAHRA) in terms of Section 38(8) of the National Heritage Resources Act, 1999 (Act No. 25 of 1999) (NHRA), a desktop Palaeontological Impact Assessment (PIA) was completed for the proposed development of a sand mining area. The farm affected is a portion of the remaining extent of the Farm 85.

Table 1: Specialist report requirements in terms of Appendix 6 of the EIA Regulations (2014)

A specialist report prepared in terms of the Environmental Impact Regulations of 2014 must contain:	**Relevant section in report**
Details of the specialist who prepared the report	Appendix B
The expertise of that person to compile a specialist report including a curriculum vitae	Appendix B
A declaration that the person is independent in a form as may be specified by the competent authority	Page 1
An indication of the scope of, and the purpose for which, the report was prepared	Section 1
The date and season of the site investigation and the relevance of the season to the outcome of the assessment	N/A
A description of the methodology adopted in preparing the report or carrying out the specialised process	Section 2
The specific identified sensitivity of the site related to the activity and its associated structures and infrastructure	Section ii **Error! Reference source not found.**
An identification of any areas to be avoided, including buffers	N/A
A map superimposing the activity including the associated structures and infrastructure on the environmental sensitivities of the site including areas to be avoided, including buffers;	N/A
A description of any assumptions made and any uncertainties or gaps in knowledge;	Section 5
A description of the findings and potential implications of such findings on the impact of the proposed activity, including identified alternatives, on the environment	Section 4
Any mitigation measures for inclusion in the EMPr	n/a
Any conditions for inclusion in the environmental authorisation	n/a
Any monitoring requirements for inclusion in the EMPr or environmental authorisation	Section 8
A reasoned opinion as to whether the proposed activity or portions thereof should	N/A

be authorised	
If the opinion is that the proposed activity or portions thereof should be authorised, any avoidance, management and mitigation measures that should be included in the EMPr, and where applicable, the closure plan	N/A
A description of any consultation process that was undertaken during the course of carrying out the study	N/A
A summary and copies if any comments that were received during any consultation process	N/A
Any other information requested by the competent authority.	N/A



Area	Point	Latitudes	Longitudes	WG84 Lo25 (X)	WG84 Lo25 (X)
Area of Application	A1	-28.01464248	24.34295394	-3100238.458	-64620.33698
	A2	-28.04837625	24.39408602	-3103950.916	-59572.81748
	A3	-28.07551876	24.37268544	-3106969.611	-61661.45215
	A4	-28.07407028	24.37122049	-3106809.827	-61806.28071
	A5	-28.10955811	24.34130859	-3110758.314	-64725.26902
	A6	-28.06501948	24.29873195	-3105845.693	-68937.55486
	A7	-28.03072748	24.32738494	-3102029.41	-66141.75144
Exclusion	E1	-28.04123095	24.34344208	-3103184.84	-64556.46
	E2	-28.04037878	24.34442316	-3103089.88	-64460.5
	E3	-28.04095897	24.34506341	-3103153.84	-64397.2
	E4	-28.04039082	24.34571752	-3103090.53	-64333.22
	E5	-28.04097118	24.34635767	-3103154.51	-64269.93
	E6	-28.04239141	24.34472257	-3103312.77	-64429.86

Figure 1: Map of the proposed site for the mine prospecting with farm boundaries shown in blue. Map supplied by Edward Matenga.

2. Methods and Terms of Reference

The Terms of Reference (ToR) for this study were to undertake a PIA and provide feasible management measures to comply with the requirements of SAHRA.
The methods employed to address the ToR included:

1. Consultation of geological maps, literature, palaeontological databases, published and unpublished records to determine the likelihood of fossils occurring in the affected areas. Sources included records housed at the Evolutionary Studies Institute at the University of the Witwatersrand and SAHRA databases;
2. Where necessary, site visits by a qualified palaeontologist to locate any fossils and assess their importance (*not applicable to this assessment*);
3. Where appropriate, collection of unique or rare fossils with the necessary permits for storage and curation at an appropriate facility (*not applicable to this assessment*); and
4. Determination of fossils' representivity or scientific importance to decide if the fossils can be destroyed or a representative sample collected (*not applicable to this assessment*).

3. Geology and Palaeontology

i. Project location and geological context

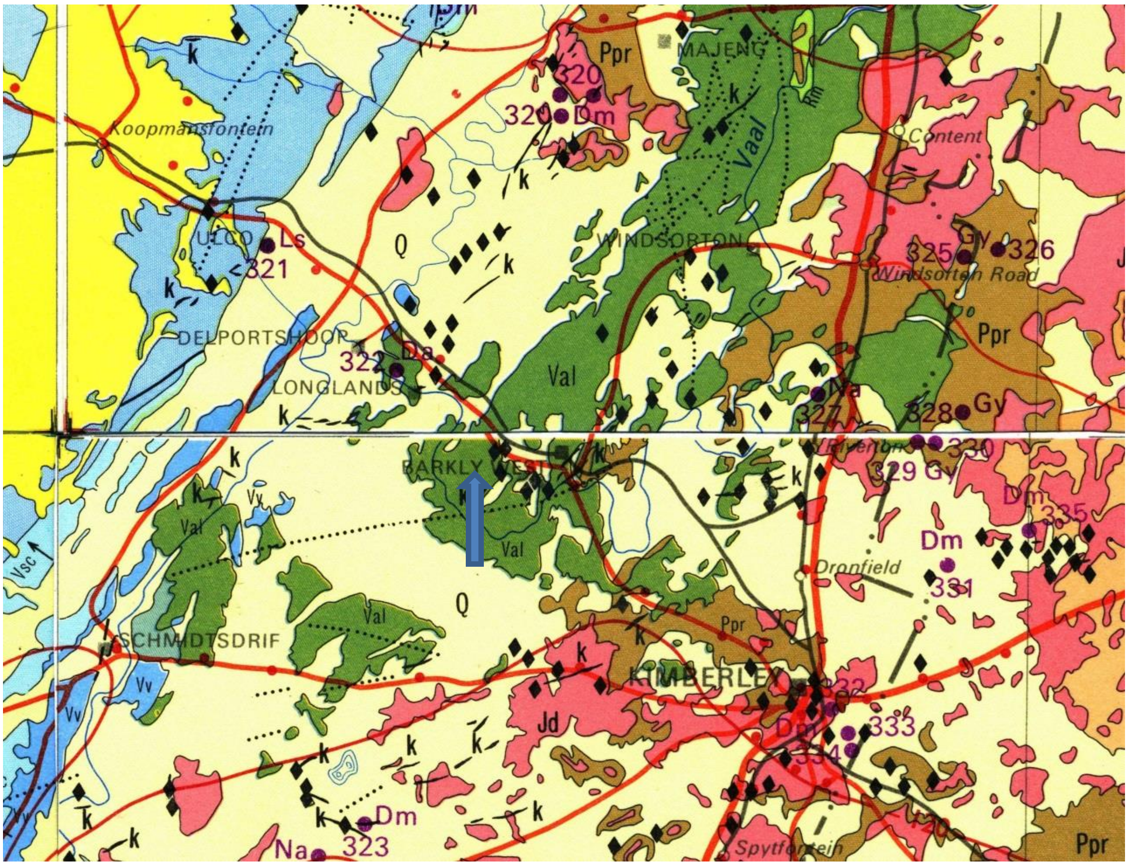


Figure 2: Geological map of the area around Barkly West. The location of the proposed project is indicated with the arrow. Abbreviations of the rock types are explained in Table 2. Map enlarged from the Geological Survey 1: 1 000 000 map 1984.

Table 2: Explanation of symbols for the geological map and approximate ages (Johnson et al., 2006; van der Westhuizen et al., 2006). SG = Supergroup; Fm = Formation.

Symbol	Group/Formation	Lithology	Approximate Age
Q	Quaternary	Alluvium, sand, calcrete	Neogene, ca 25 Ma to present
Jd	Jurassic dykes	Dolerite dykes, intrusive	Jurassic, approx. 180 Ma
Ppr	Prince Albert Fm, early Ecca, Karoo SG	Shales, mudstones	Lower Permian, early Ecca
Vsc	Schmidtsdrif subgroup, Ghaap Group, Transvaal SG	Dolomite, shale	
Vv	Vryburg Fm, Transvaal SG	Shale, sandstone, andesite	<2650 Ma
Val	Allanridge Fm, Ventersdorp SG	Andesite, Mafic lava, tuff, amygadaloidal	>2650 Ma

The Ventersdorp Supergroup is essentially made up of a number of lava flows that have been extensively altered as a result of greenschist facies metamorphism (van der Westerhuizen et al., 2006). At the top of this sequence is the Allanridge Formation with a variety of lavas. The prospecting site is predominantly on these rocks.

On top of these rocks is the Vryburg Formation which comprises a basal transgressive conglomerate, quartzites, shales and some stromatolitic carbonates, capped in some places by basaltic or andesitic lavas. The environment has been interpreted as a fluvial to marginal marine setting (van der Westhiuzen et al., 2006). Above the Vryburg Fm in the Prieska and Ghaap Plateau sub-basins is the Schmidtsdrif Subgroup comprising the lower Boomplaas Formation (limestone) and upper Clearwater formation (shales, tuffites and banded ironstone-like cherts).

Farther away from Barkly West are the shales of the Prince Albert Formation representing post-glacial melting and fluvial to lacustrine deposits. Younger intrusive Jurassic dolerites were formed during the massive Drakensberg volcanic outpourings.

Kalahari sands are deep and have covered large areas of the north-western Cape; they are of Cenozoic age.

ii. Palaeontological context

The palaeontological sensitivity of the area under consideration is presented in Figure 3. The site for mine prospecting is in the Allanridge Formation of the Ventersdorp Supergroup. Since these rocks comprise a variety of volcanic rocks and have been metamorphosed there is no chance of fossils being preserved in them.

In the vicinity are the Vryburg Formation stromatolitic carbonates which are trace fossils of ancient algal colonies that formed in shallow marine settings. Although some stromatolites preserve the cells of the microscopic algae these are rare and can only be seen under the microscope from petrographic thin sections. The limestones of the Boomplaas Formation, Schmidtsdrif Subgroup, are stromatolitic and oolitic platform carbonates and were also formed by algal colonies so there is a small chance that the microscopic algae have been preserved in some facies.

Being much younger the Prince Albert Formation could potentially preserve body fossils and these have been recorded from isolated sites, for example from near Douglas, some 100km to the southwest of Barkly West (Anderson and McLachlan, 1973; Johnson et al., 2006; McLachlan and Anderson, 1976). Marine fossils such as cephalopods, lamellibranchs and brachiopods, and terrestrial fossils such as early *Glossopteris* leaf impressions and silicified woods were recovered from Douglas. Dolerite dykes destroy any fossils in their immediate vicinity.

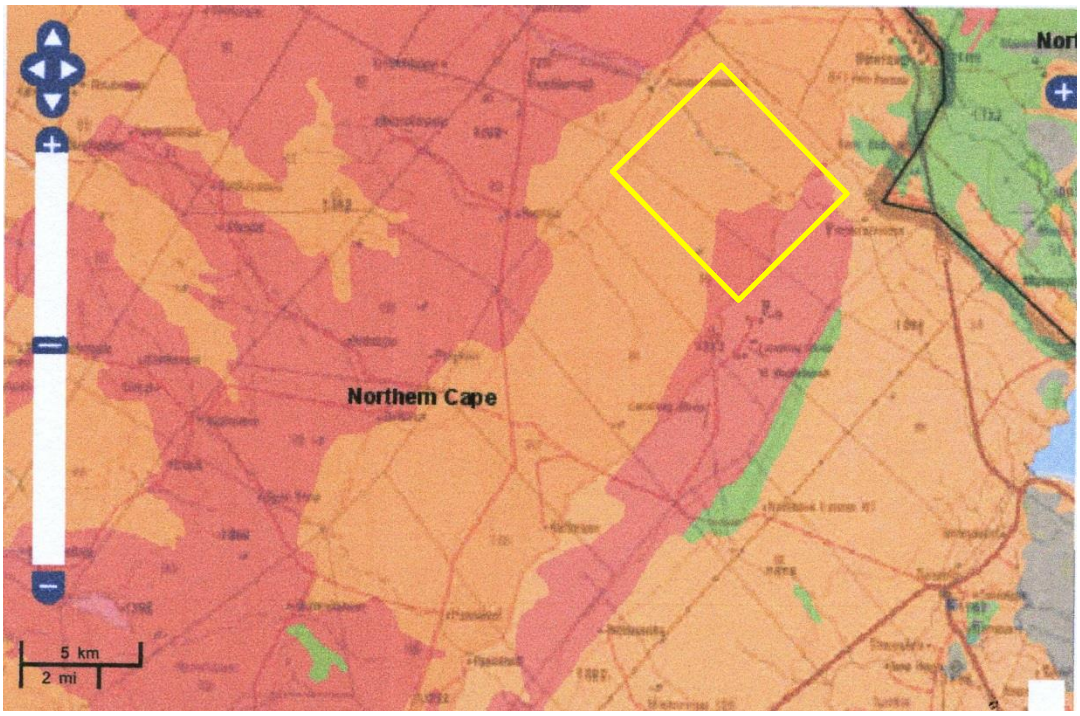


Figure 3: SAHRIS palaeosensitivity maps for the site for the proposed mine prospecting shown within the yellow rectangle. Colours indicate the following degrees of sensitivity: red = very highly sensitive; orange/yellow = high; green = moderate; blue = low; grey = insignificant/zero.

From the SAHRIS map above the area is indicated as palaeontologically sensitive to highly sensitive but the geology does not correlate with this entirely. According to the geological map the site is on ancient volcanics of the Allanridge Formation.

4. Impact assessment

An assessment of the potential impacts to possible palaeontological resources considers the criteria encapsulated in Table 3:

TABLE 3A: CRITERIA FOR ASSESSING IMPACTS

PART A: DEFINITION AND CRITERIA		
Criteria for ranking of the SEVERITY/NATURE of environmental impacts	**H**	Substantial deterioration (death, illness or injury). Recommended level will often be violated. Vigorous community action.
	M	Moderate/ measurable deterioration (discomfort). Recommended level will occasionally be violated. Widespread complaints.
	L	Minor deterioration (nuisance or minor deterioration). Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	L+	Minor improvement. Change not measurable/ will remain in the current range. Recommended level will never be violated. Sporadic complaints.
	M+	Moderate improvement. Will be within or better than the recommended level. No observed reaction.
	H+	Substantial improvement. Will be within or better than the recommended level. Favourable publicity.
Criteria for ranking the DURATION of impacts	**L**	Quickly reversible. Less than the project life. Short term
	M	Reversible over time. Life of the project. Medium term
	H	Permanent. Beyond closure. Long term.
Criteria for ranking the SPATIAL SCALE of impacts	**L**	Localised - Within the site boundary.
	M	Fairly widespread – Beyond the site boundary. Local
	H	Widespread – Far beyond site boundary. Regional/ national
PROBABILITY (of exposure to impacts)	**H**	Definite/ Continuous
	M	Possible/ frequent
	L	Unlikely/ seldom

TABLE 3B: IMPACT ASSESSMENT

PART B: ASSESSMENT		
SEVERITY/NATURE	**H**	-
	M	-
	L	The stromatolites are trace fossils and rarely preserve fossil algae; Prince Albert rocks may contain marine of terrestrial fossils of early Permian age; Loose sands (Quaternary) do not preserve plant fossils; so far there are no records from this area so the impact would be very unlikely.
	L+	-
	M+	-
	H+	-
DURATION	**L**	-
	M	-
	H	Where manifest, the impact will be permanent.
SPATIAL SCALE	**L**	Since only the possible fossils within the area would be marine fossils or fossil plants from the *Glossopteris* flora in the shales, the spatial scale will be localised within the site boundary.
	M	-
	H	-

PART B: ASSESSMENT		
PROBABILITY	H	-
	M	-
	L	It is unlikely that any fossils would be found in the limestones but there is a small chance that marine fossilsand fossil plants could occur in the Prince Albert shales that are nearby. Therefore a chance find protocol should be added to the eventual EMPr.

The geological structures suggest that the rocks are mostly too old or volcanic to contain fossils. The SAHRIS map and geological map do not correlate but as there are potentially fossiliferous rocks in the vicinity a Chance find protocol has been added to this report. Taking account of the defined criteria, the potential impact to fossil heritage resources is extremely low.

5. Assumptions and uncertainties

Based on the geology of the area and the palaeontological record as we know it, it can be assumed that the formation and layout of the lavas and dolerite dykes do not contain fossils but the dolomites, sandstones, shales and sands are typical for the country and could contain marine fossils, fossil plant, insect, invertebrate and vertebrate material in the Prince Albert Formation. The sands of the Quaternary period would not preserve fossils.

6. Recommendation

Based on experience and the lack of any previously recorded fossils from the area, it is extremely unlikely that any fossils would be preserved in the loose sands of the Quaternary Kalahari or in the limestones and stromatolites of the Allanridge and Vryburg Formations or the Schmidtsdrif Subgroup. There is a very small chance that fossils may occur in the adjacent shales or mudstones of the early Permian Prince Albert Formation so a Chance Find Protocol should be added to the EMPr: if fossils are found once prospecting has commenced then they should be rescued and a palaeontologist called to assess and collect a representative sample. Prospecting may proceed as far as the palaeontology is concerned.

7. References

Anderson, A.M., McLachlan, I.R., 1976. The plant record in the Dwyka and Ecca Series (Permian) of the south-western half of the great Karoo Basin, South Africa. Palaeontologia africana 19, 31-42.

Johnson, M.R., van Vuuren, C.J., Visser, J.N.J., Cole, D.I., Wickens, H.deV., Christie, A.D.M., Roberts, D.L., Brandl, G., 2006. Sedimentary rocks of the Karoo Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. Pp 461 – 499.

McLachlan, I.R., Anderson, A., 1973. A review of the evidence for marine conditions in southern Africa during Dwyka times. Palaeontologia africana 15(2), 37-64.

Plumstead, E.P., 1969. Three thousand million years of plant life in Africa. Geological Society of southern Africa, Annexure to Volume LXXII. 72pp + 25 plates.

Van der Westhuizen, W.A., de Bruiyn, H., Meintjes, P.G., 2006. The Ventersdorp Supergroup. In: Johnson, M.R., Anhaeusser, C.R. and Thomas, R.J., (Eds). The Geology of South Africa. Geological Society of South Africa, Johannesburg / Council for Geoscience, Pretoria. pp 187-208.

8. Chance Find Protocol

Monitoring Programme for Palaeontology – to commence once the prospecting begins.

1. The following procedure is only required if fossils are seen on the surface and when drilling/excavations/mining commence.
2. When excavations begin the rocks and must be given a cursory inspection by the environmental officer or designated person. Any fossiliferous material (shells, fish, plants, insects, bone, coal) should be put aside in a suitably protected place. This way the mining activities will not be interrupted.
3. Photographs of similar fossils can be provided to the developer to assist in recognizing the various fossils in the shales and mudstones (for example see Figures 4-9). This information will be built into the EMP's training and awareness plan and procedures.
4. Photographs of the putative fossils can be sent to the palaeontologist for a preliminary assessment.
5. If there is any possible fossil material found by the developer/environmental officer/miners then the qualified palaeontologist sub-contracted for this project, should visit the site to inspect the selected material and check the dumps where feasible.
6. Fossil plants or vertebrates that are considered to be of good quality or scientific interest by the palaeontologist must be removed, catalogued and housed in a suitable institution where they can be made available for further study. Before the fossils are removed from the site a SAHRA permit must be obtained. Annual reports must be submitted to SAHRA as required by the relevant permits.
7. If no good fossil material is recovered then the site inspections by the palaeontologist will not be necessary. Annual reports by the palaeontologist must be sent to SAHRA.
8. If no fossils are found and the drilling or excavations have finished then no further monitoring is required.

Appendix A – marine fossils and fossil plants that have been found from the Douglas area. Figures 4-7 from McLachlan and Anderson (1973) and figures 8-9 from Anderson and McLachlan (1976) showing fossil plants.

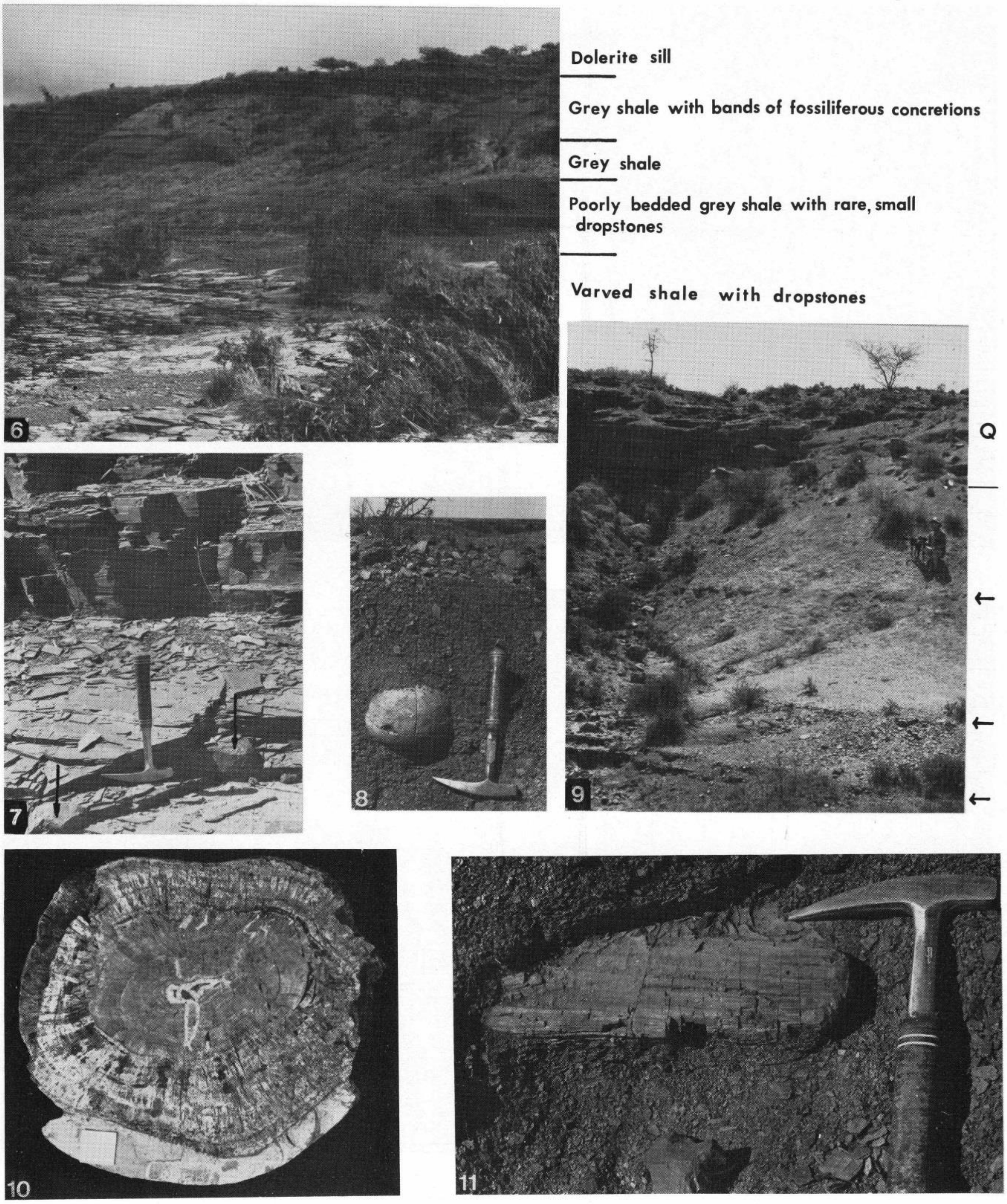
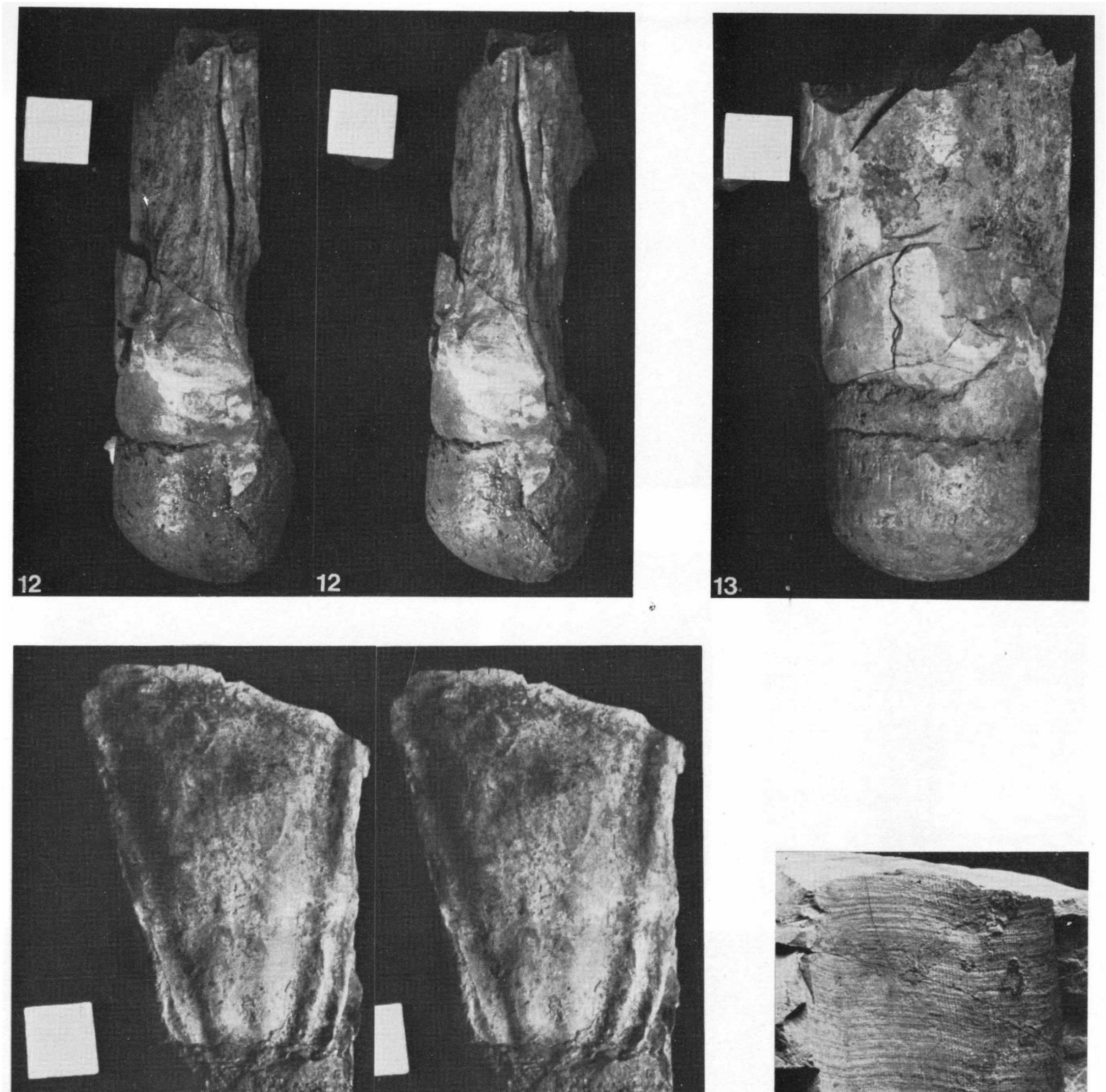


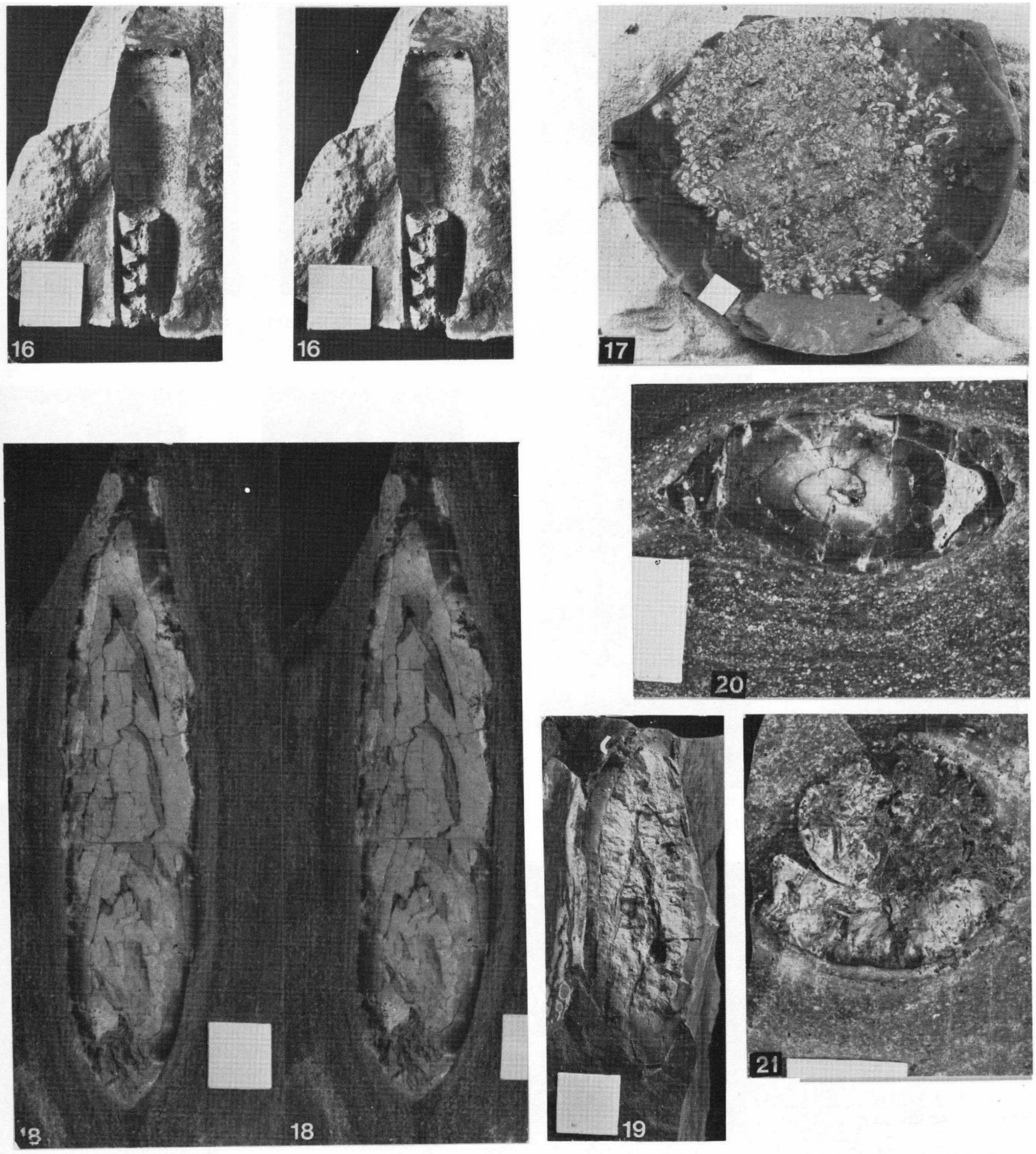
Fig. 6: Blaauw Krantz Site viewed from the east, showing stratigraphy.
Fig. 7: Varved shale at Blaauw Krantz. Dropstones to the right and left of hammer head, arrowed.
Fig. 8: Concretion in situ at Blaauw Krantz.
Fig. 9: Fossiliferous zone at Blaauw Krantz. "Q" indicates Quaternary sediments. The arrows indicate fossiliferous concretion horizons.
Fig. 10: Fossil wood from Blaauw Krantz (Specimen BK3). Transverse section (x½).
Fig. 11: In situ fossil wood at Olie Rivier. Note rounded end.

Figure 4 from Anderson and McLachlan (1973)



Orthocerid cephalopods—Blaauw Krantz
Figs. 12–14: Internal moulds of body chamber (x1).
Fig. 12—Lateral view I.3 (Stereopair x1).
Fig. 13—Dorsal view I.3 (x1).
Fig. 14—Ventral view I.3 (Stereopair x1).
Fig. 15: External mould, showing ornamentation I.4 (x2).

Figure 5 from Anderson and McLachlan (1973)



Blaauw Krantz fauna

Fig. 16: Orthocerid cephalopod. External cast and partly preserved septa and siphuncle, I.9 (Stereopair x1).

Fig. 17: Coprolite, consisting partly of fish scales P.44 (x½).

Figs. 18–21: "Spiral coprolites"

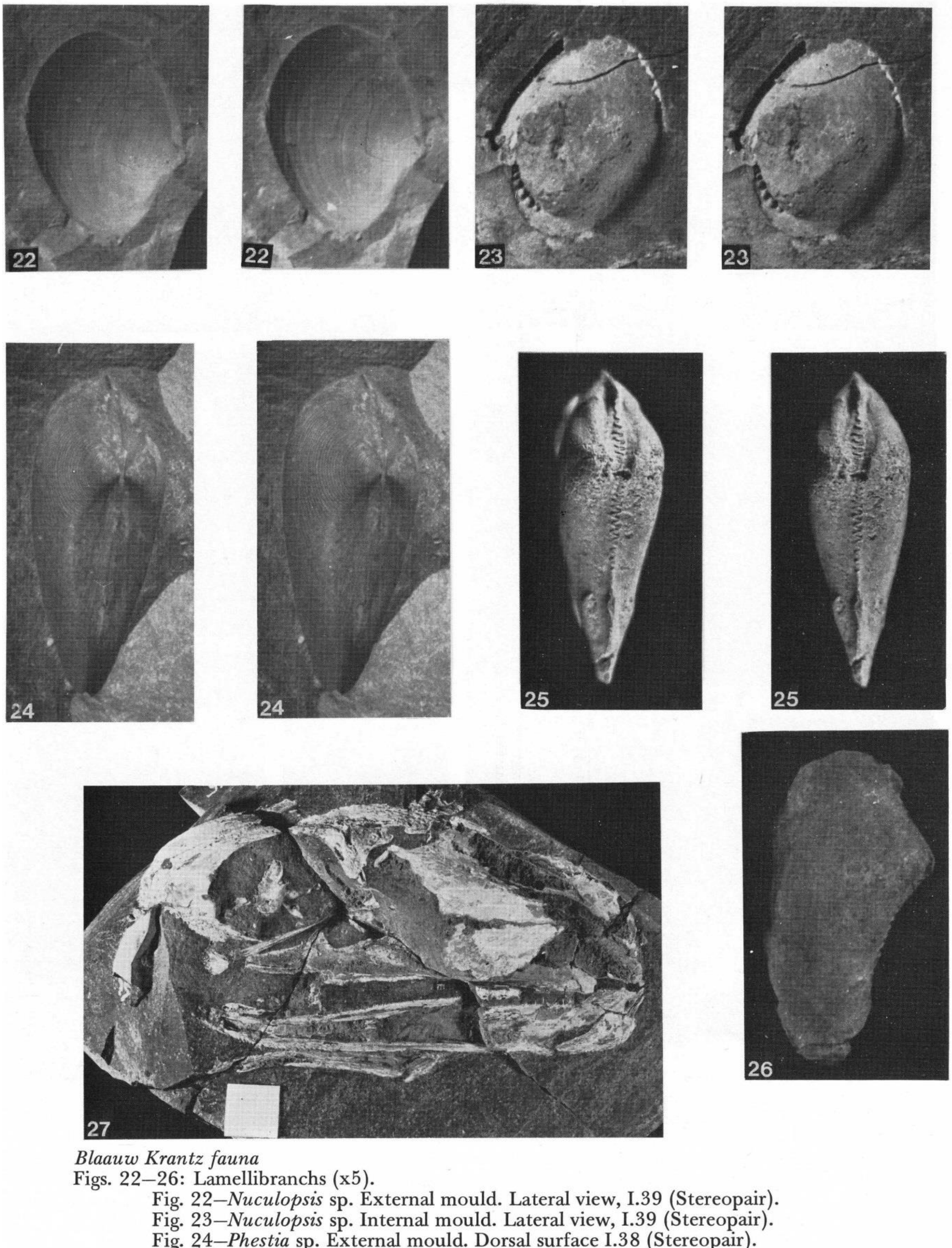
Fig. 18–Longitudinal section of heteropolar spiral coprolite ("enterospira" of Williams, 1972) I.20 (Stereopair x1).

Fig. 19–Longitudinal section showing more coarsely coiled structure I.24 (x1).

Fig. 20–Transverse section of coprolite with finely coiled structure I.18 (x2).

Fig. 21–Transverse section of more coarsely coiled coprolite I.26 (x2).

Figure 6 from Anderson and McLachlan (1973)



Blaauw Krantz fauna
Figs. 22–26: Lamellibranchs (x5).
Fig. 22–*Nuculopsis* sp. External mould. Lateral view, I.39 (Stereopair).
Fig. 23–*Nuculopsis* sp. Internal mould. Lateral view, I.39 (Stereopair).
Fig. 24–*Phestia* sp. External mould. Dorsal surface I.38 (Stereopair).
Fig. 25–*Phestia* sp. Internal mould. Dorsal view I.38 (Stereopair).
Fig. 26–*Phestia* sp. Internal mould. Lateral view I.38.
Fig. 27: Palaeoniscoid fish skull in concretion. Lateral view P.15 (x1).

Figure 7 from Anderson and McLachlan (1973)

EXPLANATION OF ILLUSTRATIONS

PLATE I

Figure 3. Scrap of lamina found by Du Toit (1906) in shale near the top of the Dwyka Tillite Stage at Koodoes Berg Drift. The leaf appears to have torn along the midrib on the left. The venation lineation spreads towards the margin on the right. Even if the margin on the right is not intact, the spread of the venation is too wide to conform with the typical elongate *Glossopteris* leaf form; it is more likely that the fragment is one pinnule from a *Gondwanidium*-like frond. (×2, South African Museum specimen number K1136.)

Figure 4. Stereopair of the concretion containing leaves from Blaauw Krantz locality. It has been split open along the widest section of the flattened concretion. (×0,5, Bernard Price Institute, B.K. 7.)

Figure 5. Detail of reticulate venation and ill-defined midrib from one of the *Gangamopteris* leaves in the Blaauw Krantz concretion (×2.)

Figure 6. Polished section, perpendicular to the section shown in Figure 4, of the Blaauw Krantz concretion. The dark rimmed oval feature in the top right hand quadrant of the picture is a stem in which the cellular structure is preserved. The smooth curving line at the bottom of the picture is the outer surface of the concretion. The sinuous hair-fine lines between it and the stem are leaves in cross section (×1.)

Figure 7. Tip of *Glossopteris* leaf from the Middle Ecca Stage at Ecca Pass, north of Grahamstown. It has a persistent midrib and the secondary veins leave it at a wide angle. The meandering lines crossing the leaf are intrasediment burrows. (×2, C. S. Kingsley, field specimen number 70/7/1.)

Figure 8. Stereopair of two *Glossopteris* leaves from the Upper Ecca Stage at Ecca Pass, north of Grahamstown. (×0,5, C. S. Kingsley, field specimen number 75/63/1.)

Figure 9. Detail of the midrib and reticulate secondary venation of one of the leaves shown in Figure 8 (×2).

Figure 10. Well-preserved seed from the Lower Ecca on the farm Bosfontein, west of Grahamstown. The body of the seed has a peaked apex (pointing towards the top of the page in the photograph). A marginal flange, probably a wing, surrounds the body of the seed. It is widest towards the apex and absent at the base where the seed was attached to the parent plant. (×2, C. S. Kingsley.)

PLATE II

Figure 11. Leaf-like impression with spreading venation from Drie Koppe, probably from the Upper Dwyka Shales. (×1, Bernard Price Institute, D.K. 1.)

Figure 12. Dichotomising leafy twig from the White Band at Brandhoek. (×1, R. D. F. Oosthuizen, specimen number G 38.)

Figure 13. *Gondwanidium*-like pinnule from the White Band on the farm Damascus. The reticulate venation spreads from the torn edge on the left towards the smooth curving intact margin on the right. (×2, Bernard Price Institute, Da. 1.)

Figure 14. Basal portion of "advanced" *Glossopteris* leaf from the *Mesosaurus* horizon on Gellap Ost in South West Africa. The midrib is well defined. (×2, B. Oelofsen, field collection number USS 6/4/4.)

Figure 15. Problematic structure from the White Band on Aussenkjer in southern South West Africa. (×1, B. Oelofsen, field collection number USS 6/6/2.)

Figure 16. Problematic "fucoid strap" from the White Band near Calvinia. The tip, near the top of the picture, is bluntly rounded. There is a suggestion of a coarse reticulate venation towards the top/left. (×1, B. Oelofsen, field collection number USS 1/10/4.)

Figure 17. Problematic "fucoid strap", with "blocky" surface texture, from the White Band near Calvinia. (×1, B. Oelofsen, field collection number USS 1/7/4.)

Legend for figures 8 and 9 following (from McLachlan and Anderson, 1976)

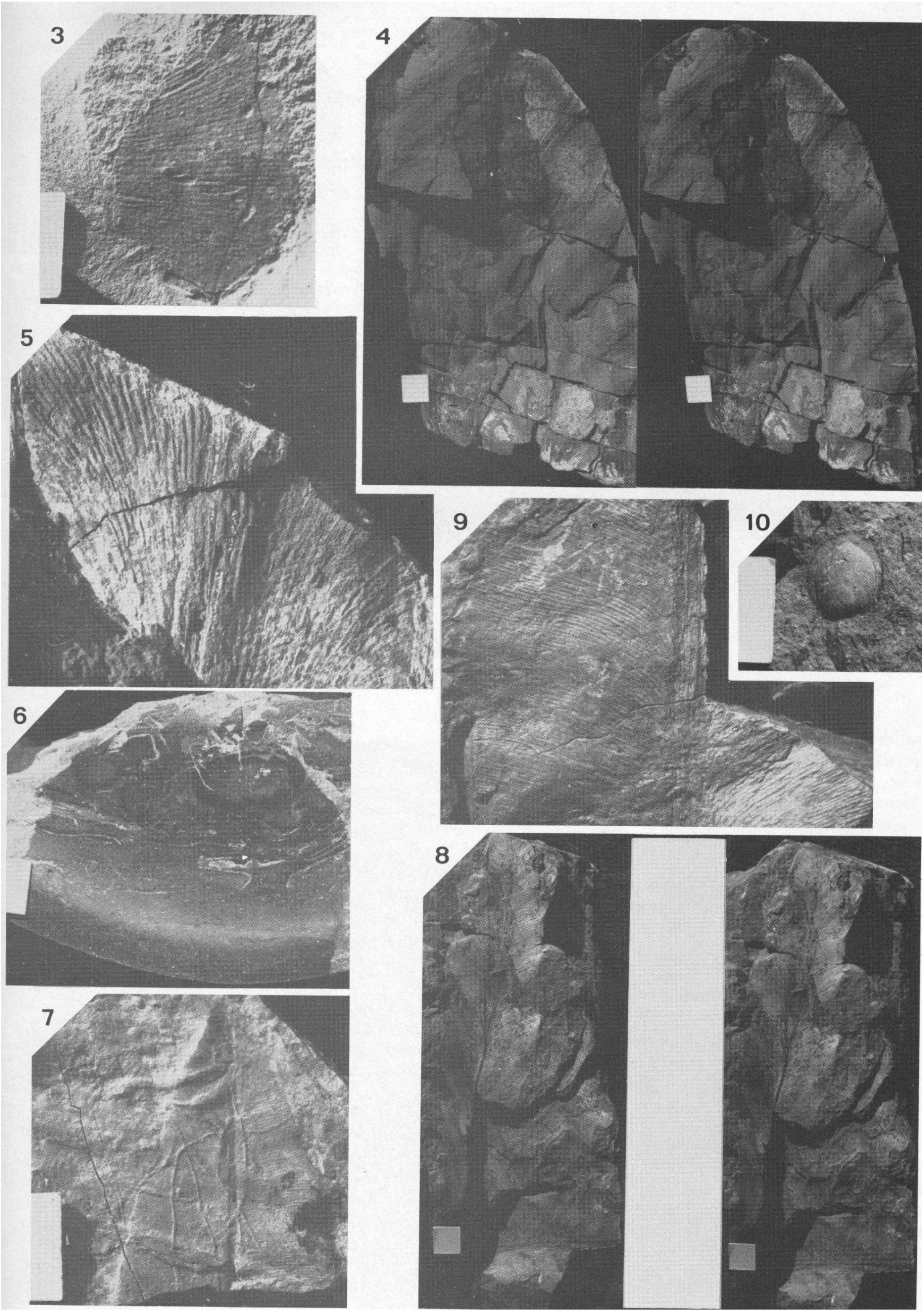


Figure 8 from McLachlan and Anderson (1976) – see legend on page 16.

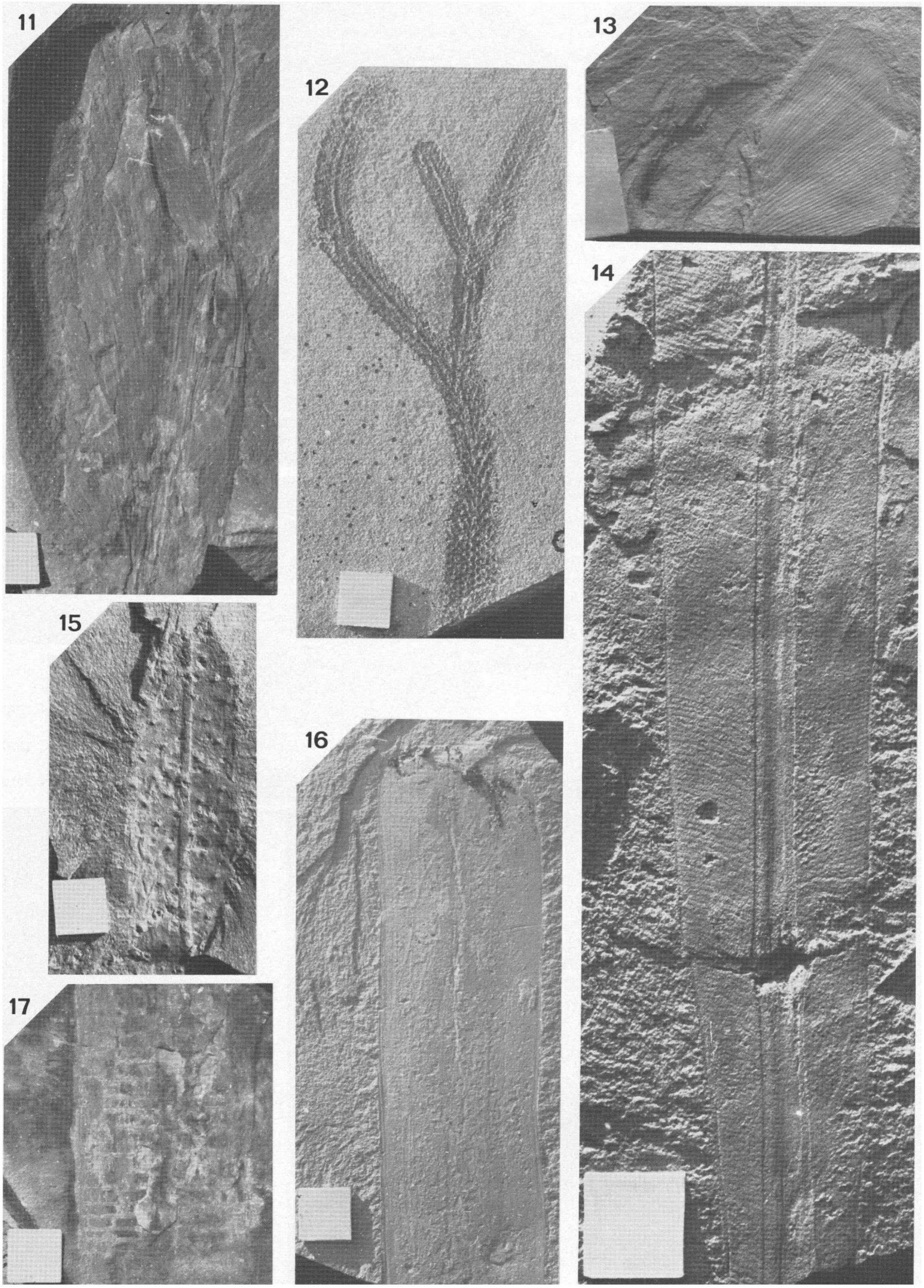


Figure 9 from McLchlan and Anderson (1976) – see legend on page 16.

Appendix B – Details of specialist

Curriculum vitae (short) - Marion Bamford PhD
June 2018

I) Personal details

Surname	:	**Bamford**
First names	:	**Marion Kathleen**
Present employment	:	Professor; Director of the Evolutionary Studies Institute. Member Management Committee of the NRF/DST Centre of Excellence Palaeosciences, University of the Witwatersrand, Johannesburg, South Africa-
Telephone	:	+27 11 717 6690
Fax	:	+27 11 717 6694
Cell	:	082 555 6937
E-mail	:	marion.bamford@wits.ac.za ; marionbamford12@gmail.com

ii) Academic qualifications

Tertiary Education: All at the University of the Witwatersrand:
1980-1982: BSc, majors in Botany and Microbiology. Graduated April 1983.
1983: BSc Honours, Botany and Palaeobotany. Graduated April 1984.
1984-1986: MSc in Palaeobotany. Graduated with Distinction, November 1986.
1986-1989: PhD in Palaeobotany. Graduated in June 1990.

iii) Professional qualifications

Wood Anatomy Training (overseas as nothing was available in South Africa):
1994 - Service d'Anatomie des Bois, Musée Royal de l'Afrique Centrale, Tervuren, Belgium, by Roger Dechamps
1997 - Université Pierre et Marie Curie, Paris, France, by Dr Jean-Claude Koeniguer
1997 - Université Claude Bernard, Lyon, France by Prof Georges Barale, Dr Jean-Pierre Gros, and Dr Marc Philippe

iv) Membership of professional bodies/associations

Palaeontological Society of Southern Africa
Royal Society of Southern Africa - Fellow: 2006 onwards
Academy of Sciences of South Africa - Member: Oct 2014 onwards
International Association of Wood Anatomists - First enrolled: January 1991
International Organization of Palaeobotany – 1993+

Botanical Society of South Africa
South African Committee on Stratigraphy – Biostratigraphy - 1997 - 2016
SASQUA (South African Society for Quaternary Research) – 1997+
PAGES - 2008 –onwards: South African representative
ROCEEH / WAVE – 2008+
INQUA – PALCOMM – 2011+onwards

vii) Supervision of Higher Degrees

All at Wits University

Degree	Graduated/completed	Current
Honours	6	1
Masters	8	1
PhD	10	2
Postdoctoral fellows	9	3

viii) Undergraduate teaching
Geology II – Palaeobotany GEOL2008 – average 65 students per year
Biology III – Palaeobotany APES3029 – average 25 students per year
Honours – Evolution of Terrestrial Ecosystems; African Plio-Pleistocene Palaeoecology; Micropalaeontology – average 2-8 students per year.

ix) Editing and reviewing
Editor: Palaeontologia africana: 2003 to 2013; 2014 – Assistant editor
Guest Editor: Quaternary International: 2005 volume
Member of Board of Review: Review of Palaeobotany and Palynology: 2010 –
Cretaceous Research: 2014 -

Review of manuscripts for ISI-listed journals: 25 local and international journals

x) Palaeontological Impact Assessments

Selected – list not complete:

- Thukela Biosphere Conservancy 1996; 2002 for DWAF
- Vioolsdrift 2007 for Xibula Exploration
- Rietfontein 2009 for Zitholele Consulting
- Bloeddrift-Baken 2010 for TransHex
- New Kleinfontein Gold Mine 2012 for Prime Resources (Pty) Ltd.
- Thabazimbi Iron Cave 2012 for Professional Grave Solutions (Pty) Ltd
- Delmas 2013 for Jones and Wagener
- Klipfontein 2013 for Jones and Wagener
- Platinum mine 2013 for Lonmin
- Syferfontein 2014 for Digby Wells
- Canyon Springs 2014 for Prime Resources
- Kimberley Eskom 2014 for Landscape Dynamics

- Yzermyne 2014 for Digby Wells
- Matimba 2015 for Royal HaskoningDV
- Commissiekraal 2015 for SLR
- Harmony PV 2015 for Savannah Environmental
- Glencore-Tweefontein 2015 for Digby Wells
- Umkomazi 2015 for JLB Consulting
- Ixia coal 2016 for Digby Wells
- Lambda Eskom for Digby Wells
- Alexander Scoping for SLR
- Perseus-Kronos-Aries Eskom 2016 for NGT
- Mala Mala 2017 for Henwood
- Modimolle 2017 for Green Vision
- Klipoortjie and Finaalspan 2017 for Delta BEC
- Ledjadja borrow pits 2018 for Digby Wells
- Lungile poultry farm 2018 for CTS
- Olienhout Dam 2018 for JP Celliers
- Isondlo and Kwasobabili 2018 for GCS
- Kanakies Gypsum 2018 for Cabanga
- Nababeep Copper mine 2018
- Glencore-Mbali pipeline 2018 for Digby Wells
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xi) Research Output

Publications by M K Bamford up to June 2018 peer-reviewed journals or scholarly books: over 120 articles published; 5 submitted/in press; 8 book chapters.
Scopus h index = 26; Google scholar h index = 28;
Conferences: numerous presentations at local and international conferences.

xii) NRF Rating

NRF Rating: B-2 (2016-2020)
NRF Rating: B-3 (2010-2015)
NRF Rating: B-3 (2005-2009)
NRF Rating: C-2 (1999-2004)