

# ✓ Preliminary report on the first excavations at the new fossil site of Motsetse, Gauteng, South Africa

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**T**HE FOSSIL POTENTIAL OF MOTSETSE WAS first noted in 1999. This fossil-bearing breccia deposit is located about 16 km northeast of the Sterkfontein caves in the dolomites of the Eccles Formation. The site has been provisionally divided into Upper, Lower, and Middle deposits. Two short field seasons of excavation have been conducted at the site, focusing on the decalcified areas which have yielded more than 2000 macromammal specimens, most of which derived from the Lower deposit. No hominin or other primate remains have yet been recovered. Bovids and carnivores are abundant and equids are represented. Isolated teeth of an extinct felid have been attributed to *Dinofelis cf. piveteaui*. Preliminary descriptions of the fossil material excavated so far are presented here. Based on the presence of the *Dinofelis* species and its chronological correlation with East African records,<sup>11,16</sup> a provisional palaeontological age of the excavated material is estimated between c. 1.64 and 1.0 Myr. At this stage, no palaeoenvironmental or taphonomic interpretations of the faunal assemblage are suggested pending increased sample sizes and greater stratigraphic resolution of the site.

## Introduction

Excavations at a new fossil site, Motsetse, began in July 2000, conducted by the Palaeoanthropology Unit for Research and Exploration at the University of the Witwatersrand.

Motsetse (25°54'S, 27°50'E) is situated in the Pre-Cambrian dolomites of the Eccles Formation about 16 km northeast of the main Sterkfontein caves (Fig. 1). The site is located within the Cradle Game Reserve, part of the designated World Heritage Site area. We are not aware of any records of Motsetse as a fossil site prior to this study and no scientific excavations had taken place before the current work began. However, significant lime mining has taken place at the site and miners' rubble

covers much of the deposit.

Three main calcified breccia deposits and at least three other smaller fossiliferous areas were identified during the initial exploration of the site. The main areas extend over 50 m laterally and have been informally referred to as the Upper, Middle and Lower deposits (Fig. 2). These were exposed through the limestone mining during the early part of the 20th century. During one initial exploration, it was recognized that the main infills contained pockets of high densities of fossils,

including the axial skeleton and associated appendicular elements of a small carnivore and some large carnivore teeth. Fossilized pupae similar to material from the Makapansgat deposits described by Kitching<sup>1</sup> as dermestid beetles, are also exposed in the Lower deposits.

The cemented breccias vary in colour from dark brown, which is more predominant in the Middle deposits, to a lighter, almost pink colour in the Upper and Lower deposits. Fossil remains are found in all three deposits. The aims of the current excavations are to expose the extent of the breccia deposits and explore possible linkages between the Lower and Middle deposits. To this end, a 5 × 1.5 m trench has been excavated between the two areas.

Large clasts in the deposits consist mostly of chert, dolomite and quartz. Extensive areas of decalcified sediments surround the hard breccias. After removing overburden and sorting the miners' dumps, these decalcified sediments were targeted for excavation. To date, two short field seasons of excavation have been conducted at the site resulting in the recovery

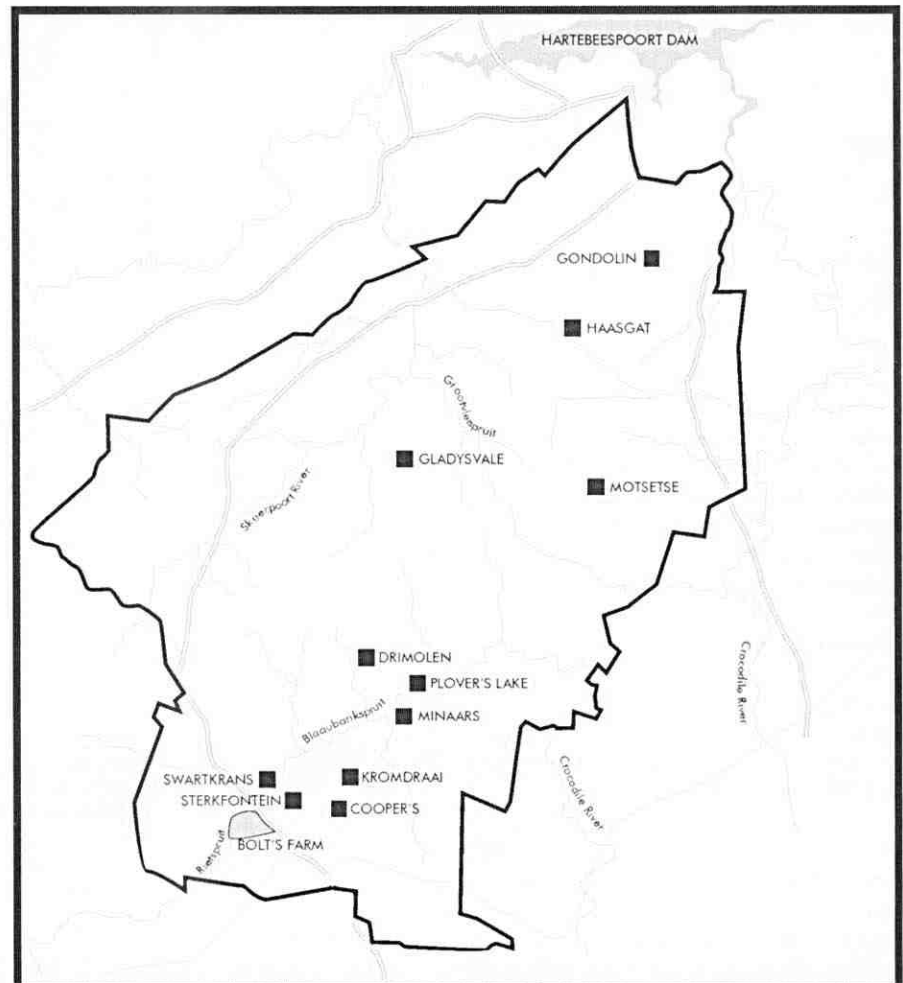


Fig. 1. The map indicates the location of the new fossil site of Motsetse in relation to other, well-known cave deposits in the Sterkfontein area.

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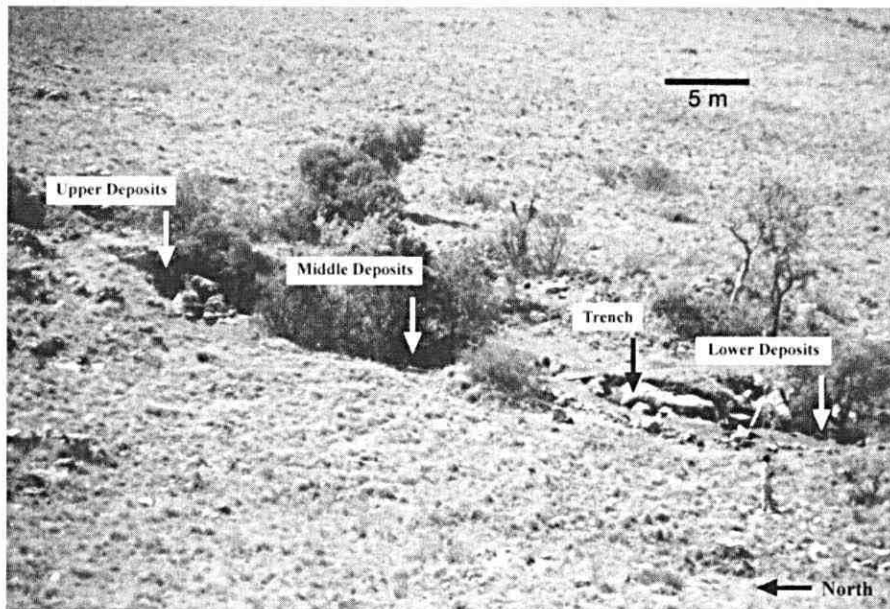


Fig. 2. The Motsetse deposits extend for about 50 m and have been provisionally described as Upper, Middle and Lower deposits, all of which are fossiliferous.

of over 2000 fossil specimens.

The preliminary discussion of the vertebrate remains presented below refers only to provenanced specimens recovered from the controlled excavations of the decalcified breccias. The fossil material contained in the *in situ* cemented breccia exposures as well as that derived from the dumps remains undescribed. However, it is worth noting that some *ex situ* blocks contain articulated bovid remains. These blocks have yet to be prepared. No archaeological artefacts have been recovered from the *in situ* excavations thus far.

During excavations, the position of each fossil was plotted using a total station theodolite prior to removal. Sieving was conducted using 4 × 8 mm and 1.3 × 1.3 mm screens. Material recovered from the Motsetse excavations bears the cataloguing prefix 'MT' and it is housed at the Bernard Price Institute for Palaeontological Research, University of the Witwatersrand

### Palaeontology

Over 2000 macromammal specimens have been recovered from the Motsetse site. Most of the material is very fragmentary and has been recovered from the decalcified deposits. Fossils in general have a dark brown appearance. No hominin material has been recovered. Not unexpectedly, the most abundant taxonomic group represented is the family Bovidae (Table 1). The bulk of this sample consists of postcranial elements and isolated teeth. Measurements of some identified specimens are given in Table 2.

Carnivores form an important component of the assemblage, with four genera represented, including a false sabre-toothed cat. Non-human primates have not been recovered from the decalcified areas to date. Hyraxes are abundant and are represented by the modern species, *Procavia capensis*.

### Order Carnivora

The genus *Dinofelis* is represented by a complete set of the left lower dentition including C, P<sub>3</sub>, P<sub>4</sub> and M<sub>1</sub> (MT 01, 04, 03 and 02, respectively) and some isolated maxillary teeth. Measurements are given in Table 2. Postcranial elements including a distal humerus (MT 09) and some bones of the manus and pes have been recov-

Table 1. Motsetse species list.

Carnivora
<i>Dinofelis</i> cf. <i>piveteaui</i>
<i>Crocota crocuta</i>
<i>Canis mesomelas</i>
<i>Genetta</i> sp.
Perissodactyla
<i>Equus</i> sp.
Procaviidae
<i>Procavia capensis</i>
Artiodactyla
<i>Connochaetes</i> cf. <i>taurinus</i>
<i>Damaliscus</i> sp.
Medium-sized alcelaphines
<i>Tragelaphus strepsiceros</i>
<i>Redunca</i> sp.
<i>Oreotragus</i> cf. <i>oreotragus</i>
<i>Antidorcas</i> sp.
cf. <i>Pelea capreolus</i>
Neotragini indet.

ered in association with the dentition. The maxillary teeth consist of both upper P<sup>3</sup> (MT 12, 06), a fragment of an upper canine (MT 1969) and a P<sup>4</sup> (MT 1966). The lower canines (MT 01, 1967, 1971) do not show any indication of crenulation on the anterior or posterior ridges, a condition typical of *Dinofelis*.<sup>2</sup> The P<sub>3</sub> is considerably smaller than the P<sub>4</sub>. A small accessory cuspid is present in the anterior cusp of the P<sub>4</sub> on the lateral side. The protoconid is the largest blade of the M<sub>1</sub>, which has a reduced talonid. The P<sup>4</sup> has a reduced protocone joined to the summit of the paracone by a ridge, and a large metastyle blade.

Representatives of the lower dentition, consisting of the canine (MT 01) and both P<sup>3</sup> were recovered during the excavations in 2000. The upper canine fragment and P<sup>4</sup>, two lower canines (MT 1967, 1971) and most of the bones of the hand and feet were recovered from the same area of the

Table 2. Measurements of identified specimens from Motsetse (in mm).

	Specimen no.	Element	Length	Breadth
<i>Dinofelis</i> cf. <i>piveteaui</i>	MT 02	Lower LM1	30.2	12.4
	MT 03	Lower LP4	22.5	10.0
	MT 04	Lower LP3	14.5	6.9
	MT 01	Lower LC	16.4	11.5
	MT 1966	Upper RP4	38.8	12.8
<i>Crocota crocuta</i>	MT 1531	Upper RP3	23.1	17.6
	MT 1532	Lower RP3	21.1	16.1
<i>Canis mesomelas</i>	MT 1497	Upper RP4	14.7	6.0
	MT 1333	Upper RP4	14.5	5.7
	MT 1381	Upper LM1	13.8	10.7
	MT 1353	Upper RM1	13.9	10.7
<i>Connochaetes</i> cf. <i>taurinus</i>	MT 1360	Lower RM3	34.0	12.2
	MT 931a,b	Upper LM3	26.9	16.5
	MT 996	Lower RM2	26.5	16.3
	MT 1958-59	Lower LM2	25.9	12.9
<i>Damaliscus</i> sp.	MT 1397	Upper RM3	18.0	11.3
	MT 12	Upper LM3	19.5	11.3
	MT 1960	Lower RM3	24.8	9.7
	MT 1962	Lower LM2	19.1	8.4
	<i>Tragelaphus strepsiceros</i>	MT 1955	Lower LM2	25.8
<i>Oreotragus</i> cf. <i>oreotragus</i>	MT 1366	Upper RM2	11.9	9.2

deposit two years later. The P<sup>4</sup> is sufficiently diagnostic to justify its attribution to *Dinofelis* cf. *piveteaui* Ewer, 1955, based on the reduced protocone and elongated metastyle.<sup>3-5</sup> The lower dentition of *D. piveteaui* is poorly recorded, making comparison difficult. This taxon is the only extinct species so far recovered from the Motsetse excavations. A more detailed analysis of this material is in preparation.

A metatarsal (MT 1319) and a phalanx (MT 1387) recovered are of a lion-sized felid.

An isolated right P<sup>3</sup> (MT 1531) and a right P<sub>3</sub> (MT 1532) have been assigned to spotted hyaena (*Crocuta crocuta*). The P<sup>3</sup> is large, although it falls within the range of other fossil spotted hyaena P<sup>3</sup> from the Sterkfontein Valley<sup>6</sup> and is smaller than the extinct *Pachycrocuta*.<sup>7</sup> A metatarsal bone (MT 1535) has been attributed to Hyaenidae indet.

The black-backed jackal is the most abundant carnivore in the Motsetse assemblage. The sample consists of upper and lower dentition (Table 2) (MT 83, 1333, 1353, 1359, 1381, 1497), a proximal femur (MT 1344) and a proximal ulnar fragment (MT 1400). The teeth are identical in size and morphology to *Canis mesomelas*, and at least two individuals are represented in the sample.

A left maxillary fragment with P<sub>4</sub> and M<sub>1</sub> has been assigned to *Genetta* sp. (MT 1534). The teeth are very similar to the small-spotted genet. However, the distal margin of the mandible below the M<sub>1</sub> on the Motsetse specimen differs, being less curved than in *G. genetta*.

### Order Hyracoidea

All specimens so far recovered from the current excavations have been attributed to the modern hyrax, *Procavia capensis*. Several mandibular and maxillary fragments with teeth have been recovered in addition to some postcranial elements (MT 106, 1534, 1557). Remains of a juvenile hyrax comprising part of the skull (MT 96), a complete mandible (MT 97) and both femora (MT 94, 95) were recovered during the first field season.

### Order Perissodactyla

An unworn right M<sup>3</sup> (MT 1963), an unworn mandibular tooth, probably deciduous, (MT 1964/65) and several unidentifiable fragments have been assigned to *Equus* sp. Features associated with the genus *Hipparion* (e.g. isolated protocone or ectostylid<sup>15</sup>), have not been observed in the Motsetse material. Postcranial elements consist of two carpal bones (MT 1470, 1403) and an accessory

**Table 3.** Data on alcelaphine M<sub>3</sub> length (mm) taken from Klein & Cruz-Uribe.<sup>8</sup>

	<i>n</i>	Max.	Min.	Mean	s.d.
<i>Megalotragus priscus</i>	6	52.8	37	46.5	1.3
<i>Connochaetes taurinus</i>	29	36	26	31.8	2.4
<i>Connochaetes gnou</i>	14	33.8	26.5	29.1	1.8
<i>Damaliscus dorcas</i>	26	26.6	19.4	22.4	1.8
<i>Damaliscus lunatus</i>	17	28.8	22.8	26.3	1.7
? <i>Damaliscus niro</i>	16	29.5	24	27.5	1.8

Although there is a high degree of variability, the length of the Motsetse alcelaphine M<sub>3</sub> were compared with the data shown here. The Motsetse specimen assigned to *C. taurinus* (Table 2) falls closest to the range for this species. The Motsetse M<sub>3</sub> assigned to *Damaliscus* sp. (Table 2) falls between *D. dorcas* and *D. lunatus*.

metapodial (MT 1352). The size and morphology of the postcranial elements are similar to those of the modern zebra, *Equus burchelli*.

### Family Bovidae

#### Tribe Alcelaphini

The most abundantly represented ungulate tribe in the Motsetse assemblage is the Alcelaphini. The samples consist of isolated dental remains, making the taxonomic assignment difficult because of the similar morphology and size of extant and extinct alcelaphine taxa.<sup>8,9</sup> The teeth are hypsodont with complicated central cavities and rounded lingual lobes, features typical of this tribe.<sup>14</sup> Material attributed to *Connochaetes* includes two M<sub>2</sub> (MT 996 and MT 1958/9), an M<sub>3</sub> (MT 1360) and an M<sup>3</sup> (MT 931 a/b). One of the four specimens attributed to *Damaliscus* sp., a lower M<sub>3</sub> (MT 1960), has a prominent circular entostylid, almost isolated. The hypoconulid is large and aligned with the main cusps. Other specimens assigned to *Damaliscus* sp. are two upper M<sup>3</sup> (MT 1397 and MT 12) and a lower M<sub>2</sub> (MT 1962). A number of teeth have been assigned to a medium-sized alcelaphine group (Table 1). The length of the alcelaphine M<sub>3</sub> specimens from Motsetse (Table 2) have been compared with data presented by Klein & Cruz-Uribe<sup>8</sup> on samples of extant and extinct alcelaphine taxa (Table 3). Results support the identification of the isolated alcelaphine teeth from Motsetse.

#### Tribe Reduncini

A right mandibular P<sub>2</sub> (MT 1956) has been attributed to the genus *Redunca*. The specimen is small, in mid-wear stage and

does not have a projecting parastylid.

#### Tribe Tragelaphini

Kudu, *Tragelaphus strepsiceros*, is represented by a left M<sub>2</sub> (MT 1955). The specimen is in early wear stage and has a posteriorly projecting entostylid. The tooth is brachyodont and has a small basal pillar, a condition typical of this species.<sup>13</sup> The length and breadth of this tooth are shown in Table 2. Twelve specimens of kudu and six eland M<sub>2</sub> were measured. The means and ranges of both are shown in Table 4. The Motsetse specimen (Table 2) falls comfortably within the kudu sample.

#### Tribe Antilopini

A number of isolated teeth have been assigned to *Antidorcas* based on their size, hypsodonty, simple occlusal area and absence of basal pillars. The sample includes a deciduous upper molar (MT 1552) and an unerupted M<sup>2</sup> (MT 1551). A maxillary fragment with M<sup>2</sup> and M<sup>3</sup> just reaching occlusion has also been assigned to *Antidorcas*. A mandibular second molar (MT 1503) of an individual with very slight wear and flat lingual wall has been assigned to this genus.

#### Tribe Neotragini

A left M<sup>2</sup> identical to the modern klip-springer has been attributed to *Oreotragus* cf. *oreotragus* (MT 1336). A deciduous left dp<sub>4</sub> has been classified as Neotragini indet. (MT 1517).

#### Tribe Peleini

A right frontlet preserving part of the orbit and frontal has been assigned to cf. *Pelea capreolus* (MT 1337). The medial aspect of the frontal slopes gently up-

**Table 4.** Descriptive statistics (mm) of modern samples of mandibular M<sub>2</sub> of kudu and eland.

	<i>n</i>	Min.	Max.	Mean	s.d.	
Kudu	Length	12	22.3	26.7	24.3	1.2
	Breadth	12	13.1	17.1	14.7	1.2
Eland	Length	6	25.2	28.4	27.5	1.2
	Breadth	6	15.4	17.4	16.3	0.8

The Motsetse specimen falls within the ranges of kudu (see Table 2) and thus it has been assigned to this species.

wards towards the suture. A deep groove is located at the base of the horn core on the posterior side. The horn core is about 6.5 cm long, with no transverse ridges and sloping backwards, but less so than in *Antidorcas*.

### Provisional age of Motsetse

Any indication of chronology, palaeo-environment or stratigraphic correlations of the fossil deposits of Motsetse must be interpreted broadly. No radiometric dating techniques have been applied to the exposed sediments or fossil teeth and thus chronological interpretations are restricted to the presence of key indicator species. The appearance of the genus *Equus* in Africa dates to 2.36 Myr<sup>10</sup> and this therefore places an upper limit on the age of this deposit. Similarly, the earliest record of *D. piveteaui* is set at 1.64 Myr in the Okote Member of the Koobi Fora Formation,<sup>16</sup> placing a maximum age on the infill if the designation of *D. piveteaui* stands. The most recent extinction date of *D. piveteaui* in Africa, which is also the last appearance of this genus on the African continent, has been established at c. 1.0 Myr<sup>12</sup> from recent excavations at Homa, southwestern Kenya. Thus, a lower temporal range can be placed on the Motsetse assemblage.

Excavations at the Motsetse site are still at a preliminary stage and do not allow for specific interpretations of the geology. It is therefore not possible to elucidate if the deposits exposed to date are temporally

associated or if they represent distinct geological units. The best current provisional age estimate based on the excavated faunal material, is established between c. 1.64 Myr<sup>16</sup> and 1.0 Myr, and no older than 2.36 Myr.<sup>10</sup> At this stage, any palaeoenvironmental or taphonomic interpretations are considered premature until sample sizes are increased. Work at the site will continue, focusing on exposing the geological extent of the deposits.

We thank Becky Ackermann for the invitation to participate in this special issue. This research has been funded largely by the Palaeo-Anthropology Scientific Trust (PAST) and the National Geographic Society and their financial assistance is greatly appreciated. The support of the Bailey family, of the Research Office and the School of Geosciences at the University of the Witwatersrand, The World Heritage Site Cradle of Humankind Committee, and the South African Heritage and Resources Agency is gratefully acknowledged. D.J. de Ruiter and M. Raath made useful comments on an earlier draft of this paper.

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### Forthcoming meetings

- The second ELTOSA (Environmental Long-term Observatories Network of Southern Africa) workshop will be hosted by the Harry Oppenheimer Okavango Research Centre in Maun, Botswana, 12–17 October 2003. To find out more about ELTOSA, please consult the website <http://www.nrf.za/saeon/eltosa/enter.htm> or the recently published position paper by Henschel *et al.*, *S. Afr. J. Sci.* 99, 100–108 (2003).

Further information is available from the workshop secretary, Karu Kandjii ([kkandjii@orc.ub.bw](mailto:kkandjii@orc.ub.bw)).

- National Symposium on Global Change and Regional Sustainability in South Africa (to be held in conjunction with the plenary meeting of the International Group of Funding Agencies for Global Change Research), Kirstenbosch Botanic Garden, Cape Town, 27–29 October 2003 (note change of venue from earlier notices). The meeting will address the implications of important drivers of global change for human and ecological systems.

A capacity building programme is also being planned, under the auspices of the National Research Foundation, with the aim of increasing the involvement of historically disadvantaged persons in the field of global change research. A limited number of delegates will accordingly be

fully or partly sponsored to attend the meeting. Further details about the symposium and associated activities are at <http://www.nrf.ac.za/saeon/globalchange/saglobal/htm>

- Southern African Association of Archaeologists, 2004 Biennial Meeting, 4–7 April 2004, McGregor Museum, Kimberley (P.O. Box 316, Kimberley 8300). Conference themes and sessions (provisional and incomplete): Early Stone Age (Acheulian), public archaeology, the South African Neolithic, and the origins of modern human behaviour.

The organizing committee is: L. Jacobson (053 839-2703; [jake@museumsnc.co.za](mailto:jake@museumsnc.co.za)), D. Morris ([dmorris@museumsnc.co.za](mailto:dmorris@museumsnc.co.za)), and K. van Reyneveld ([karen@museumsnc.co.za](mailto:karen@museumsnc.co.za)).

- Springbok Workshop and Colloquium on Adaptation in Desert Fauna and Flora, Victoria West, 25–29 August 2004. The workshop is aimed primarily at informing farmers of recent scientific discoveries about the springbok, which is becoming increasingly important in game ranching in arid regions.

Further information is available from the convenors of the meeting: John Skinner, Veterinary Wildlife Unit, University of Pretoria ([jskinner@op.up.ac.za](mailto:jskinner@op.up.ac.za)) and Norbert Juergens, Department of Botany, University of Hamburg ([norbert.juergens@t-online.de](mailto:norbert.juergens@t-online.de)).

### Botanical awards

The South African Association of Botanists has awarded its gold medal to **Chris Bornman** and its silver medal to **Otto Leistner**. Professor Bornman was born in Kenya and graduated from Stellenbosch University. In a long and varied career, he has held senior professorial positions in several centres, including Pietermaritzburg, Munich and Lund. He now lives in Denmark.

Dr Leistner was born in Leipzig and is another Stellenbosch graduate. He joined the Botanical Research Institute (now the National Botanical Institute) in Pretoria in 1955 and has been intimately associated with the institution ever since, both in its herbarium function and, for many years, as head of its very active publications section.

The Compton Prize for 2001 has been awarded to **Gael Campbell** and **Ben-Erik van Wyk**. The prize acknowledges the best paper published in the *South African Journal of Botany* in the year. The prizewinning paper in this case was on a taxonomic revision of *Rafnia*. Ms Campbell is a former graduate student, and Professor van Wyk is a lecturer, in the Botany Department at Rand Afrikaans University.

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