Bruce Rubidge describes the extent and uniqueness of South Africa’s fossil heritage, a mecca for palaeontologists that is unmatched anywhere in the world.

Happy 60th birthday, BPI!

On 26 October 2005, the Bernard Price Institute for Palaeontological Research (BPI) at the University of the Witwatersrand turns 60. It was founded thanks to the infectious enthusiasm of one of South Africa’s greatest scientists combined with the foresight of a generous Johannesburg philanthropist.

In 1945, Robert Broom (employed at the Transvaal Museum) was a medical doctor with an intense interest in fossil mammal-like reptiles. He delivered a lecture at Wits, stressing the need to collect and preserve Karoo fossils because the country was losing much of its priceless palaeontological heritage to erosion every year. He blamed what he saw as an unwilling, unenlightened, and mean attitude on the part of state bureaucrats who, by failing to provide sufficient money to ensure that this heritage was properly cared for, were neglecting their duty to the nation. In the audience was Bernard Price, managing director of the Victoria Falls Power Company. He offered to donate £2 000 a year provided that the fossil material collected was curated by Wits. This led to the establishment, later that year, of the BPI, which today has international standing as a research institute and as South Africa’s only centre of palaeontological training. Its fossil collections make it also the custodian of a large part of the country’s palaeontological heritage, visited by scientists from across the globe.

The BPI’s strengths lie most particularly in the fields in which it has worked since its inception: the 200–300-million-year-old fossils from the Karoo and the younger, less than four-million-year-old rock record of human ancestry. Since 1958, the institute has also produced Palaeontologica africana, the only scientific journal in Africa dedicated to research relating to the continent’s palaeontological heritage.

The BPI has made major scientific contributions in the fields of Karoo vertebrate palaeontology (including the discovery and description of the most primitive anomodont mammal-like reptile, the earliest saurupod dinosaur, the earliest tortoise from the southern hemisphere, and the oldest dinosaur eggs); Karoo palaeobotany; micropalaeontology; Plio-Pleistocene palaeontology (including the first discovery of archaic Homo sapiens from the Cave of Hearths and the first discovery of Australopithecus africanus at Makapansgat); and the palaeoecology of the Orapa crater lake deposit in Botswana.

1 Supergroup: As the Earth’s crust responds to forces beneath the surface – such as submergence below sea level or volcanic uplift – layers of rock and sediment accumulate and erode, and the landscape changes. The name ‘supergroup’ is given to all those rocks deposited during the same period of subsidence (or ‘settling down’) due to a single event. They are normally named according to the region where they are particularly well exposed: hence the Karoo Supergroup, whose layers of different rock types underlie the Karoo region.

2 Pangaea, Gondwana, and Laurasia: About 300 Myr all of the Earth’s landmasses were a single supercontinent, which we call Pangaea, and which extended almost from the South to the North Pole. It then broke apart, initially forming two large fragments, Gondwana (south) and Laurasia (north). About 180 Myr these began to fragment further and drifted apart to produce the continents of today.

The Karoo: a fossil mecca

The name ‘Karoo’ comes from the Khoikhoi word meaning ‘aid’, ‘dry’, or ‘barren’ ground. Today’s flat semi-desert with its koppie outcrops, however, was once hot, humid, and extensive marshland, similar to the Okavango Delta of our own time. The fossils preserved in the Karoo rocks tell a remarkable story of changing landscapes and of the animals and plants that lived and died there over the millennia.

These rich fossil-bearing rocks cover two-thirds of the surface area of South Africa. At first glance they appear inhospitable, but their epic tale covers more than 100 million years. It recounts the ancestry of plants, tortoises, dinosaurs, the distant origins of mammals and, ultimately, of humans as the climate shifted from glacial polar conditions to subtropical desert. No other country in the world has such a complete, largely uninterrupted terrestrial rock record that covers the Carboniferous, Permian, Triassic, and Jurassic periods.

The rocks and their secrets

The Karoo Supergroup 1 comprises a succession of rocks several kilometres thick that extend over most of South Africa from Laingsburg in the southwest to Vereeniging in the northeast. When these rocks were deposited, from 300 to 180 million years ago (Myr), southern Africa was part of the huge supercontinent we call Gondwana 2 and was positioned between the southern tip of South America and east Antarctica. The area covered today by the Karoo Supergroup was then a lowland. The northern border of the Karoo basin was a highland area known as the Cargonian Highlands; its southern border was the extremely high Cape Mountain Belt, whose last remnants today form the Swartberg Range.

Because the Karoo rocks were deposited over such an extended period, they record changes in......
the environment from glaciers (in the case of the Dwyka, when southern Africa was positioned over the polar region around 300 Myr) to deltas supporting the rich flora that ultimately created the extensive coal deposits mined today in South Africa’s Free State, Gauteng, and KwaZulu-Natal provinces. Over time, the basin became smaller and the environment more arid; rivers deposited sand and silt that then became the rocks of the Beaufort Group and Molteno and Elliot formations of the Stormberg Group.

### South Africa’s fossil riches

Sixty years ago, palaeontology was a Cinderella science in southern Africa and the region’s great palaeontological potential had not yet been recognized. Now it is well known as the only area that has:
- the oldest evidence of life on Earth
- the oldest multi-cellular animals
- the most primitive land-living plants
- the most distant ancestors of dinosaurs
- the most complete record of the ancestry of mammals
- a remarkable record of human origins and of human achievements.

South Africa has over one-third of the entire fossil record of human evolution in Africa and spans more than three million years. Cave sites in the provinces of Gauteng, North West, and Limpopo hold evidence of the wide diversity of hominin species and an archaeological record including some of the world’s oldest stone tools and the earliest signs of the controlled use of fire.

It is impossible to examine the development of life on Earth without referring extensively to the South African fossil record. Recognizing this, government identified Palaeontology and Palaeoanthropology as one of five key research themes in its National Research and Development Strategy (August 2002).

### Geological periods of the Karoo rocks

<table>
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<tr>
<th>Age (Myr)</th>
<th>Period</th>
<th>Group</th>
<th>Formation</th>
<th>Environment in SA</th>
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<tr>
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<td>Stormberg</td>
<td>Elliot Clarens</td>
<td>Arid meandering rivers</td>
<td>Desert</td>
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Dinosaurs: New South African discoveries

- **The world’s oldest sauropod dinosaur.** Sauropods are the familiar giant, long-necked, plant-eating dinosaurs such as *Brachiosaurus* and * Diplodocus*. Their early history is poorly understood, as the first good specimens did not appear in the fossil record till the Middle Jurassic (about 170 Myr), by which time they were already highly specialized giants. Now, in 2003, we have discovered *Antetonitrus ingenipes*, a comparatively small, very primitive sauropod from the Late Triassic (about 210 Myr) of South Africa, which is answering many questions about the early evolution of the group.

- **The world’s oldest dinosaur eggs and embryos.** Research in the past year on dinosaur eggs (which were found by J.ames Kitching in the early 1970s) has revealed that they contain perfectly preserved embryonic skeletons. These embryonic dinosaur skeletons – the oldest in the world – reveal much about how early dinosaurs grew (see page 45).

- **The first complete skull of a Triassic dinosaur from South Africa.** This new find is exciting because it appears to be from an animal close to the ancestry of the sauropods, if not actually a sauropod itself.

- **A new large theropod dinosaur.** South Africa’s Early Jurassic rocks (aged about 185 million years) have long been known to contain the remains of a small (less than 2 metres long) theropod (meat-eating) dinosaur called *Coelophysis*. Just recently, in 2004, the bones of a much larger theropod (approximately 6 metres long) have been found in the same rocks. This new dinosaur, which has not yet been named, shows strong similarities to the bizarre, crested, theropod *Dilophosaurus* from the Early Jurassic of North America. - Adam Yates

The BPI’s Dr Adam Yates specializes in early sauropod dinosaurs (the group that includes all the really large long-necked dinosaurs). He recognized, in 2003, that the earliest member of this group is from South Africa. He named this dinosaur *Antetonitrus* to emphasize the fact that it occurs ‘before the thunder lizards’.

- **From mammal-like reptiles to mammals**

  The lineage for which South Africa is internationally renowned is that of the therapsids (informally called ‘mammal-like reptiles’). In a later age, this line gave rise to mammals but, in Permian times, before mammals appeared on Earth, therapsids dominated among land-living vertebrates. In as early as 1932, Robert Broom recognized the significance of our fossils: ‘The mammal-like reptiles from South Africa may be safely regarded as the most important fossil animals ever discovered, and their importance lies chiefly in the fact that there is little or no doubt that among them we have the ancestors of mammals, and the remote ancestors of man.’

  Current research supports his bold statement. In the past, the oldest and most primitive therapsids were thought to come from Russia, with the South African forms arising here by overland migration. In the last decade, however, Wits palaeontologists from the Bernard Price Institute for Palaeontological Research (BPI) have discovered a new and even more primitive therapsid fauna in the rocks of the Beaufort Group near Prince Albert, leading them to conclude that some therapsid families originated in this country and not in the northern hemisphere. At the other end of the time scale, from the mid-Triassic period (240 Myr), John Hancox has discovered near Sterkstroom an advanced type of dicynodont therapsid (*Shansiodon*) in rock of the upper Beaufort Group. The discovery of this type of animal, previously known only from China, proves the earlier links between countries that today are