THE MICROSCOPIC IDENTIFICATION OF MAMMAL SPECIES FROM HAIR SAMPLES

by

KONUTE JACKSON CHAKA

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In the Faculty of Natural and Agricultural Sciences
Department of Animal, Wildlife and Grassland Sciences
University of the Free State
Bloemfontein

Promoter: Prof. G.N. Smit

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CHAPTER 1

INTRODUCTION

Hair is one of the most conspicious and characteristic features of mammals, being present as the general body covering in almost all members of this group. Often the only identifiable remains of prey species in predator scats are hair fibres and pieces of bone (Perrin and Campbell 1980). Identification of prey species using teeth and bone fragments may provide information on the age and sex of the prey species. However, as demonstrated by Richards (1977), bone fragments in the scats of predators are often too small to be of diagnostic value. Subsequently the ability to identify mammal species from hair samples alone is prefereable and has a number of practical applications, e.g for forensic purposes (De Broom & Dreyer 1953), taxonomy (Keogh 1975) and ecological studies (Day 1966). Scat pellet analysis provides a method of gaining information on the feeding habits of predators (Day 1966; Stuart 1976; Avenant & Nel 1998; 2002) and provides information on the composition of the mammalian fauna of a particular area and even indicate how habitat has changed over a number of years (Friend 1978).

With the expansion of the game ranching industry in South Africa, predators such as the leopard *(Panthera pardus)* are receiving increased attention. The shift towards game ranching has benefitted predators through expanding habitat availability and increased availability of prey animals. With game fetching record prices at game auctions with an average country wide increase of 15% per annum for the period of 1992 – 2001 (Eloff 2002) game losses due to predators is often viewed by land owners in a more serious light than stock loses. This is especially true in the case of rare game species such as roan (*Hippotragus equinus)* and sable antelope (*Hippotragus niger*). This has led to increased killing of the leopard.

Commercial land use in the extensive, northern savanna areas of South Africa recently shifted from cattle dominated mono-cultures to include, or be replaced by, indigenous ungulate species (Robinson & Lademann 1998; Van der Waal & Dekker 2000). Currently, there are some 5 000 game ranches and more than 4 000 mixed game and livestock ranches in South Africa. These cover some 13.0% of the country's total land area, compared to the 5.8% of officially declared conservation areas (ABSA 2002).

The region in South Africa with the most wildlife ranches is the Limpopo Province, comprising almost half (49.0%) of all South Africa's wildlife ranches (Bothma 2002). A survey conducted during 1998 showed that at the time some 2 300 ranches had already been fenced with game-proof fences. This represent an area of approximately 3.6 million ha (26% of the total area of the province) (Van der Waal & Dekker 2000). Most of the Limpopo Province of South Africa is located in the savanna biome of southern Africa, which extends from north of 22^0S into northern Namibia, Botswana, Mozambique and South Africa. The biome is large, comprising about 959 000 km^2 or 46% of southern Africa (Rutherford & Westfall 1994).

In an attempt to address the conflict between predators (notably the leopard) and game- and livestock farmers, a research project on leopards was initiated (Smit 2002; Van Wyk 2003). As part of this larger research project, the need has arisen to be able to identify the remains of mammal prey species in the scats of leopards. The study on the leopards will be conducted in two areas. The first area is located on the farm "The Beacon", situated approximately 15 km north of Gravelotte in the Limpopo Province, South Africa. The vegetation of the area is classified as Mixed Lowveld Bushveld (Low & Rebelo 1996). The second area is located on the farm "Masequa" situated in the Soutpansberg, approximately 43 km north of Louis Trichardt, also in the Limpopo Province. The savanna vegetation is described as Soutpansberg Arid Mountain Bushveld (Low & Rebelo 1996).

A list of potential prey species of predators, notably the leopard, that potentially occur in these savanna study areas, was compiled (see Chapters 2 and 4). With this species list as basis this study was conducted with the following objectives:

(i) to prepare hair samples from these selected mammal species for microscopic analyses with a view to obtain detailed illustrations of the cuticular scale patterns and cross-sections of the hairs,

(ii) to study and describe the taxonomic features of the hair of the various mammal species,

(iii) to investigate possible variation in the microscopic characters of hair from different body parts of the same mammal species, and

(iv) to compile a key that can assist with the identification of these selected mammal species from microscopic analyses of hair samples.

CHAPTER 2

REVIEW OF SELECTED MAMMAL SPECIES

2.1 MAMMAL SPECIES INCLUDED IN THE STUDY

A list of potential prey species of predators, notably of leopards (Kruuk & Turner 1967; Norton *et al.* 1986; Le Roux & Skinner 1989; Bothma & Le Riche 1994) that potentially occur in the identified savanna study areas (Mixed Lowveld Bushveld and Soutpansberg Arid Mountain Bushveld) was compiled. Inclusion of specific species was based on their known distribution range (Skinner & Smithers 1990) and availability of museum specimens in the Transvaal Museum in Pretoria (see Table 4.1 in Chapter 4 for the complete list). The distribution range, habitat and actual documented cases of predation of these selected mammal species are briefly reviewed here.

2.2 REVIEW OF SELECTED MAMMAL SPECIES

2.2.1 Sable antelope (*Hippotragus niger)*

2.2.1.1 Distribution and habitat

Sable antelope occur in northern and north-eastern Botswana and have a wide distribution range in Zimbabwe, except on the central plateau from which they have retreated in the face of development. It is also widespread in Mozambique south of the Zambezi River, although absent in the extreme south and parts of the southeast. In South Africa it is confined to the Kruger National Park and the Letaba District in the Limpopo Province, but has since been widely introduced into other parts of the country. Sable antelope is a savanna woodland species, dependent on cover and the availability of water. It prefers open woodland with adjacent vleis or grassland with medium to high stands of grass. It avoids areas where the tree density is high and areas where the grass is short, caused by over utilization or other causes. (Skinner & Smithers 1990).

2.2.1.2 Predation on Hippotragus niger

Pienaar (1969) documented that lion *(Panthera leo)* preyed upon sable antelope in the

Kruger National Park. It is also known that young animals are being preyed upon by various other smaller predators, if given the opportunity.

2.2.2 Gemsbok (*Oryx gazella)*

2.2.2.1 Distribution and habitat

Gemsbok is commonly found in open country in the arid central and north-western parts of the subregion. It is commonly found in Namibia with a wide distribution range in Botswana where it is confined to the more arid and semi-arid areas. Gemsbok is also truly desert adapted and can survive in the Kalahari and Namib desert without surface water. As a popular game ranch species, it is widely translocated, sometimes to unsuitable habitat where it suffers seasonal nutritional stress and heavy infestation of ticks. In the Kgalagadi Transfrontier Park, gemsbok shows a preference for the sand dunes, which have only a sparse cover of vegetation (Skinner & Smithers 1990).

2.2.2.2 *Predation on* Oryx gazella

Eloff (1984) reported that gemsbok are often preyed upon by lion *(Panthera leo)* in the Kalahari. Bridgeford (1985) documented that lions also prey on gemsbok in the Skeleton Park of Namibia. Bothma & Le Riche (1994) identified gemsbok remains in the scats of leopards *(Panthera pardus)* in the southern Kalahari.

2.2.3 Waterbuck (*Kobus ellipsiprymnus)*

2.2.3.1 Distribution and habitat

The waterbuck has a limited distribution range in the northern and north-eastern parts of the subregion. It prefers floodplains, reed beds, grassland, woodland and rocky areas within 2 km of water. These areas can be degraded by nyala and impala to the detriment of waterbuck (Skinner & Smithers 1990).

2.2.3.2 Predation on Kobus ellipsiprymnus

Pienaar (1969) documented that lion *(Panthera leo)* do prey on waterbuck in the Kruger National Park. Whateley & Brooks (1985) also documented waterbuck as a prey species of lion, leopard *(Panthera pardus)* and cheetah *(Acinonyx jubatus)* in the Umfolozi and

Hluhluwe game reserves. According to Le Roux & Skinner (1989) waterbuck was recorded as one of the prey species of the leopard (*Panthera pardus*) in the Londolozi game reserve.

2.2.4 Greater kudu (*Tragelaphus strepsiceros*)

2.2.4.1 Distribution and habitat

The distribution range of the greater kudu is extensive and it occurs widespread in the northern, north-eastern and parts of the central sector of the subregion. It prefers savanna woodland, including rocky areas and slopes, but does not occur in forest, desert, grassland or short shrub unless there is woodland nearby to provide cover. The valley bushveld in the Eastern Cape Province supports high densities of kudu. It can survive on farmland provided sufficient cover remains. Greater kudus are browsers and feed on a wide range of plants, including aloes, and they are independent of surface water as long as food with adequate moisture levels is available (Skinner & Smithers 1990).

2.2.4.2 Predation on Tragelaphus strepsiceros

In a study conducted by Bouliere (1981) in the Kruger National Park the greater kudu was documented as a prey species of the lion (*Panthera leo*). According to Whateley & Brooks (1985) lions also preyed on kudu in the Hluhluwe game reserve. Skinner *et al.* (1992) recorded the remains of kudu in the scats of the spotted hyena (*Crocuta crocuta*) in KwaZulu-Natal. Since kudu is fairly common within their distribution range, it can be expected that other predators like the leopard *(P. pardus)* will readily prey on this species.

2.2.5 Nyala (*Tragelaphus angasii)*

2.2.5.1 Distribution and habitat

The distribution range of the nyala only includes the north-eastern parts of the subregion, but it has been translocated to several other regions beyond its normal distribution rage. In the north-eastern regions of KwaZulu-Natal it is common, especially in the Ndumu game reserve, in the vicinity of Lake St Lucia and in the Mkuzi, Hluhluwe and Umfolozi game reserves (Skinner & Smithers 1990). They prefer thickets in savanna woodland, including forest patches and dense riverine bush. Nyala benefits from shifting agriculture where abandoned fields and overgrazing causes bush encroachment and the growth of

preferred fodder plants. It is not dependent on surface water as long as there is enough green foliage available (Furstenburg 2002).

2.2.5.2 Predation on Tragelaphus angasii

In the study conducted by Skinner *et al.* (1992) nyala was documented as a prey species of the spotted hyena (*Crocuta crocuta*). Whateley & Brooks (1985) documented that the nyala was preyed upon by lion (*Panthera leo*), leopard (*Panthera pardus*) and cheetah *(Acinonyx jubatus)* in the Umfolozi and Hluhluwe game reserves.

2.2.6 Bushbuck (*Tragelaphus scriptus*)

2.2.6.1 Distribution and habitat

Bushbuck habitats are concentrated around the equator (between 12^0 N and 18^0 S), central east Africa and the eastern and southern coastline of Africa (Furstenburg 2002). Bushbuck occurs in the northern, eastern and southern coastal areas of the subregion. It prefers dense cover in the underbrush of woodland and forest near permanent water. They occasionally undertake short seasonal movements away from permanent water when surface water is temporarily unavailable. Forest edges are important sources of food. Bushbuck is able to survive in farmland and even close to large cities as long as dense cover and water are available (Skinner & Smithers 1990).

2.2.6.2 Predation on Tragelaphus scriptus

Le Roux & Skinner (1989) reported five incidents where leopards *(Panthera pardus*) have captured bushbuck in the Londolozi game reserve. According to Whateley & Brooks (1985) a bushbuck was preyed upon by lion (*Panthera leo*) in the Umfolozi and Hluhluwe game reserves.

2.2.7 Impala (*Aepyceros melampus*)

2.2.7.1 Distribution and habitat

Impala commonly occurs in the northern savanna areas of South Africa as far north as the Uasa Nyero River in Kenya and southern Uganda, and from the coast of the Indian Ocean to the Rift Valley and Lake Victoria. Impala prefers the ecotone between open

grassland and savanna woodland, especially *Acacia* woodland. Grassland is often preferred during the rainy season, while woodland areas are preferred during the dry season. Impala has a high requirement for fodder, moisture, shade and cover and habitat quality causes large variation in its density (Estes 1991).

2.2.7.2 Predation on Aepyceros melampus

According to Whately and Brooks (1985) impala is commonly preyed upon by cheetah *(Acinonyx jubatus)* in the Hluhluwe and Umfolozi game reserves. Le Roux and Skinner (1989) recorded impala as a preferred prey species of the leopard (*Panthera pardus*) in the Londolozi game reserve. Analysis of leopard scats from the Kruger National Park found that 67% contained ungulate remains, of which 60% were Impala (Bailey 1993). Impala is a common, high density species and thus an important prey species for many other predator species.

2.2.8 Southern reedbuck (*Redunca arundinum)*

2.2.8.1 Distribution and habitat

The distribution range of the southern reedbuck includes the northern and eastern parts of the subregion. It occurs in considerable numbers on the eastern shores of Lake St Lucia, KwaZulu-Natal. The distribution range of southern reedbuck extends southwards to the Cape Province as far as Komgha district, but it is now extinct west of this district.

Southern reedbuck prefers wet vleis and grassland near permanent watercourses. It is dependent on tall grasses or scrub for cover and free access to water. It also shows a preference for burnt areas for feeding (Skinner & Smithers 1990).

2.2.8.2 *Predation on* Redunca arundinum

Whateley & Brooks (1985) documented that lion *(Panthera leo)* and leopard *(Panthera pardus)* preyed on southern reedbuck in the Umfolozi and Hluhluwe game reserves. Skinner *et al.* (1992) recorded reedbuck as a prey species of the spotted hyena *(Crocuta crocuta)* in the Mkuzi game reserve.

2.2.9 Klipspringer (*Oreotragus oreotragus)*

2.2.9.1 Distribution and habitat

The klipspringer is restricted by its very specific habitat requirements and its distribution is scattered and discontinuous in rocky areas. It is confined to rocky areas, but sometimes moves out onto flatter areas to feed. Klipspringers are strict browsers and are independent of water (Skinner & Smithers 1990).

2.2.9.2 Predation on Oreotragus oreotragus

Pienaar (1969) reported from 420 recorded kills by leopards (*Panthera pardus)* in the Kruger National Park that klipspringer constituted one of the preferred prey species. Norton *et al.* (1986) recorded a number of klipspringer killed by leopards in four areas of the Cape Province (Cedar, Gamka, Jonkershoek and Wemmershoek).

2.2.10 Common duiker (*Sylvicapra grimmia)*

2.2.10.1 Distribution and habitat

The common duiker has a wide distribution range and occurs throughout the whole subregion. It occurs throughout Namibia - penetrating the coastal Namib desert along dry watercourses – as well as Botswana, Zimbabwe and Mozambique south of the Zambezi River. It prefers scrub, woodland with an under storey of bushes, grassland with patches of bush or dense grass and forest fringes. It can survive in agricultural areas as long as some cover is available and is independent of surface water (Skinner & Smithers 1990).

2.2.10.2 Predation on Sylvicapra grimmia

Bothma & Le Riche (1994) identified common duiker from scat analyses as one of the prey species of the leopard (*Panthera pardus*) in the Kgalagadi Transfrontier Park.

2.2.11 Steenbok (*Raphicerus campestris)*

2.2.11.1 Distribution and habitat

The steenbok has a wide distribution range and occurs throughout the subregion, except

the extreme north-eastern parts. It prefers grassland with dense patches of taller grass or bushes for cover. Steenbok also occurs in open woodland and may penetrate into desert along watercourses. It avoids forest, dense woodland and rocky areas and is independent of surface water as long as green food is available. The territorial organisation of both male and female steenbok disperses the population evenly over the mosaic of available habitat (Furstenburg 2003).

2.2.11.2 Predation on Raphicerus campestris

Norton *et al.* (1986) reported that steenbok were preyed upon by leopards (*Panthera pardus*) in four areas of the Cape Province. Le Roux & Skinner (1989) also recorded steenbok as one of the prey species of leopard in the Londolozi game reserve. Given their small size it can be expected that other, smaller predators will readily prey on this species.

2.2.12 Sharpe's grysbok (*Raphicerus sharpei*)

2.2.12.1 Distribution and habitat

Sharpe's grysbok occurs widely in Zimbabwe - except in the dry western parts of the country – as well as commonly in the extreme north-eastern parts of Botswana and Mozambique south of the Zambezi River. In South Africa it occurs in the Limpopo Province. It prefers areas with low growing scrubs and grass of medium height, avoiding areas with dense stands of grass (Skinner & Smithers 1990).

2.2.12.2 Predation on Raphicerus sharpei

In a study conducted by Kruuk & Turner (1967) Shape's grysbok was recorded to be preyed upon by a lion (*Panthera leo*) in the Serengeti game reserve in East Africa. Due to its small size, it can be expected that other, smaller predators will readily prey on this species, if given the opportunity.

2.2.13 Red duiker (*Cephalophus natalensis*)

2.2.13.1 Distribution and habitat

The red duiker occurs only in the eastern and north-eastern parts of the subregion with an

isolated population in the Soutpanberg in the Limpopo Province. It prefers forest, thickly wooded riverine and dense coastal bush in warm moist areas. In East Africa the red duiker also prefers these areas and occurs in montane forest as well (Skinner & Smithers 1990).

2.2.13.2 Predation on Cephalophus natalensis

In a study conducted by Skinner *et al.* (1992) in the Mkuzi game reserve, a spotted hyena *(Crocuta crocuta)* preyed upon red duikers, as identified from scat analyses. It is also known that young animals are being preyed upon by various other smaller predators, if given the opportunity.

2.2.14 Blue duiker (*Philantomba monticola)*

2.2.14.1 Distribution and habitat

Blue duikers have a wide distribution which extends from the coastal areas of the Cape Province to parts of West Africa. Because of their specialised habitat requirement their distribution is discontinuous and patchy. They are confined to forests, thickets, dense coastal bush and within this association they frequent forest glades and the slightly more open parts of the underbrush cover, but require denser underbrush cover to lie up in or in which to take cover when disturbed (Skinner & Smithers 1990).

2.2.14.2 Predation on Philantomba monticola

Forest-haunting crowned eagles (*Stephanoaetus coronatus)* prey on adult and young blue duiker, and the skulls are often found beneath the nests of these birds. African Rock Pythons *(Python sebae sebae)*, caracals (*Caracal caracal*) and leopards (*Panthera pardus*) also prey on blue duikers (Goss 1990).

2.2.15 Suni (*Neotragus moschatus)*

2.2.15.1 Distribution and habitat

Suni only occurs in the extreme eastern and north-eastern parts of the subregion. They prefer dry woodland with thickets and underbrush along rivers and drainage lines. Their

habitat is threatened by increased browsing by nyala. They are independent of surface water (Skinner & Smithers 1990).

2.2.15.2 Predation on Neotragus moschatus

Skinner *et al.* (1992) documented that a suni was preyed upon by a spotted hyena (*Crocuta crocuta)* in the Mkuzi game reserve. Given their small size it can be expected that many smaller predators will readily prey on this species, if given the opportunity.

2.2.16 Bushpig (*Potamochoerus larvantus)*

2.2.16.1 Distribution and habitat

The distribution range of the bushpig includes the northern, eastern and southern coastal sectors of the subregion. They do not occur in Namibia and in Botswana but are confined to the Okavango swamps and adjacent river system such as the Chobe River in Botswana. They occur widespread in parts of eastern and western KwaZulu-Natal and in a narrow strip along the coast of the eastern Cape Province. Their specific habitat requirement makes their distribution very patchy. They prefer forests, thickets, dense growth along rivers, reed beds and tall grass and similar dense cover, but regularly move out of their habitat if necessary. They are independent of surface water (Skinner & Smithers 1990).

2.2.16.2 Predation on Potamochoerus larvantus

Skinner *et al.* (1992) reported that in two game reserves, namely Umfolozi and Mkuzi that bushpig was preyed upon by spotted hyena (*Crocuta crocuta*). Fulk *et al.* (1992) documented that bushpig was preyed upon by chimpanzees (*Pan troglodytes*) in the Gombe game reserve.

2.2.17 Common warthog (*Phacochoerus africanus)*

2.2.17.1 Distribution and habitat

Common warthog are common in the northern, north-eastern and eastern parts of the subregion, preferring open woodland, grassland, vleis and floodplains. The bulk of their

diet consists of grass, but also includes seeds, roots and underground stems (Skinner & Smithers 1990).

2.2.17.2 Predation on Phacochoerus africanus

Skinner *et al.* (1992) reported that spotted hyena (*Crocuta crocuta*) preyed upon warthog in the Umfolozi and Mkuzi game reserves. Le Roux & Skinner (1989) reported that in the Londolozi game reserve leopard (*Panthera pardus*) commonly preyed on warthogs. Whateley & Brooks (1985) documented that cheetah *(Acinonyx jubatus)* and leopard preyed on warthog in the Umfolozi and Hluhluwe game reserves. It is also well known that lion commonly prey on warthogs.

2.2.18 Rock hyrax (*Procavia capensis)*

2.2.18.1 Distribution and habitat

The rock hyrax has a wide distribution range and occurs throughout the subregion where there is suitable rocky habitat. Colour varies with locality: light grey in the south, darker, slightly reddish and brown in the north, paler and yellow in northern Namibia. It occupies a very wide range of habitat from sea level to the high Drakensberg mountains, and from high rainfall areas in the east and south to the Namib desert in the west. It occurs on the fringes of forests, but not in forest itself. Its only definite requirements are for shelter among rocks, drains, culverts and similar structures that provide adequate cover, allowing it to live in the suburbs of some cities. It is independent of surface water as long as green or succulent vegetation is available, otherwise it has to drink (Skinner & Smithers 1990).

2.2.18.2 Predation on Procavia capensis

Norton *et al.* (1986) reported that rock hyrax were preyed upon by leopard (*Panthera pardus*) in four different areas of the Western Cape Province. Skinner *et al.* (1992) recorded a hyrax preyed upon by a spotted hyena *(Crocuta crocuta)* in the Namib desert.

2.2.19 Rock dormouse (*Graphiurus platyops)*

2.2.19.1 Distribution and habitat

The rock dormouse has a wide distribution range, but is absent from the more arid parts

of the subregion. It has been recorded on the central plateau of Namibia, from Kaokoland in the northwest to the Orange River in the south, eastern Botswana, Zimbabwe and with two records from central Mozambique south of the Zambezi River. It is usually found in rocky areas and also nests in trees, outbuildings and overnight huts on hiking trails (Skinner & Smithers 1990).

2.2.19.2 Predation on Graphiurus platyops

Perrin & Bodbijl (2001) recorded a rock dormouse preyed upon by a gaboon adder (*Bitis gabonia)* in the Zululand area. It can be expected that it will be preyed upon by various other smaller predators, if given the opportunity.

2.2.20 Springhare *(Pedetes capensis)*

2.2.20.1 Distribution and habitat

Springhares occur widely in Namibia and Botswana, while in Zimbabwe they are common but do not occur further east than the Harare district. In South Africa they occur in the Limpopo and North-West Province, but are absent in the southwest. They are also found in the Free State and KwaZulu-Natal. An important habitat requirement is a substrate of compacted sandy soil in which to dig their burrows. They avoid hard ground and prefer areas with sandy soil (Skinner & Smithers 1990).

2.2.20.2 Predation on Pedetes capensis

Mills (1984) documented that springhares are predated by most of the large carnivores in the southern Kalahari. Bothma & Le Riche (1994) documented that springhares are being predated by leopards *(Panthera pardus*) in the Northern Cape.

2.2.21 Scrub hare *(Lepus saxatilis)*

2.2.21.1 Distribution and habitat

The scrub hare is widely distributed in the west and south-west of the subregion and in localised areas in the north and east. It prefers savanna woodland habitat, mixed grass and scrub, avoiding areas of open grass and is thus not found in true desert. Shrub hare is common in agricultural developed areas, concentrating in the vicinity of growing crops,

as well as in fallowed and derelict lands where there is bush regeneration (Skinner & Smithers 1990).

2.2.21.2 Predation on Lepus saxatilis

In the Londolozi game reserve it was documented by Le Roux & Skinner (1989) that a scrub hare was preyed upon by a leopard (*Panthera pardus*). In another study by Skinner *et al.* (1992) in the same game reserve, it was observed that spotted hyena *(Crocuta crocuta)* preyed upon scrub hares. It can be expected that they will be preyed upon by various other smaller predators.

2.2.22 South African ground squirrel (*Xerus inauris)*

2.2.22.1 Distribution and habitat

The South African ground squirrel is widely distributed in Namibia, but absent from the coastal areas and parts of the south-west and north-east. In the Northern Cape Province it is confined to the northern and north-eastern parts of the province and southwards to the Graaff Reinet district, which marks the most southerly limit of its distribution range. It has a preference for open terrain with a sparse bush cover and a hard substrate, generally avoiding loose sandy areas for making its burrow, but it does occur in the dunes of the Kalahari (Skinner & Smithers 1990).

2.2.22.2 *Predation on* Xerus inauris

Skinner *et al.* (1992) recorded the South African ground squirrel as a prey species of the spotted hyena *(Crocuta crocuta)* and Goss (1990) reported that South African ground squirrels can be prey to predators such as black-backed jackal (*Canis mesomelas*) and side-striped jackal (*Canis adustus*) and other carnivores.

2.2.23 Greater canerat (*Thryonomys swinderianus)*

2.2.23.1 Distribution and habitat

Greater canerat occur in the northern, north-eastern and eastern parts of the subregion. They are common in West Africa from Gambia to adjacent parts of the Cameroon and in parts of the Central African Republic, southern Sudan, Kenya and are wide spread in

Angola, excluding the coastal desert. They prefer reed beds and thick, tall grass near water and crops such as maize and sugar cane. They can become a pest by eating cereals and root crops such as potatoes and ground nuts (Skinner & Smithers 1990).

2.2.23.2 Predation on Thryonomys swinderianus

Skinner *et al.* (1992) recorded that greater canerat are preyed upon by spotted hyena (*Crocuta crocuta*) in the Umfolozi and Mkuzi game reserves. Boshoff *et al.* (1995) recorded the greater canerat as prey species of forest-haunting crowned eagles *(Stephanoaetus coronatus)* in the savanna and forest biome of South Africa and according to Goss (1990) cane rats are preyed upon by leopards *(Panthera pardus).*

2.2.24 Gambian giant rat (*Cricetomys gambianus*)

2.2.24.1 Distribution and habitat

The distribution of the Gambian giant rat is restricted to the north-eastern and eastern parts of the subregion. They are recorded widely in Mozambique south of the Zambezi River, excluding the more arid south-western parts of the country. They also occur in north-eastern and eastern Zimbabwe, the Limpopo Province and KwaZulu-Natal Province, which marks the most southerly limit of its distribution range. They prefer evergreen forest or woodland habitat which receive more than 800 mm of rain annually and can tolerate temperatures above 34 °C (Skinner & Smithers 1990).

2.2.24.2 Predation on Cricetomys gambianus

Perrin & Bodbijl (2001) recorded Gambian giant rats as a prey species of the gaboon adder (*Bitis gabonica*) in northern KwaZulu-Natal.

2.2.25 Red veld rat *(Aethomys chrysophilus)*

2.2.25.1 Distribution and habitat

The distribution of the red veld rat is extensive in the more northerly parts of the subregion. They have a wide habitat tolerance, but prefer grassland and savanna woodland and depend on some cover in the form of rock piles, holes or thick grass and sometimes move into outbuildings and houses (Skinner & Smithers 1990).

2.2.25.2 Predation on Aethomys chrysophilus

Nel *et al.* (1997) documented the black-back jackal (*Canis mesomelas*) as a predator of these rodents. In a study conducted by Perrin & Bodbijl (2001) they reported the red veld rat as a prey species of the gaboon adder (*Bitis gabonica*) in northern KwaZulu-Natal.

2.2.26 Bushveld gerbil (*Tatera leucogaster)*

2.2.26.1 Distribution and habitat

The bushveld gerbil has an extensive distribution rage in the northern parts of the sub-region. It prefers light sandy or alluvial soil with a very wide range of vegetation, from open grassveld to woodland, with rainfall above 250 mm per year. Gerbils do particularly well where burning has reduced the vegetation and litter and it is commonly found in abandoned cultivated areas (Skinner & Smithers 1990).

2.2.26.2 Predation on Tatera leucogaster

Nel *et al.* (1997) recorded gerbils predated by black-backed jackals (*Canis mesomelas*) in the Namib desert. Given their small size many other predators will prey on this species, if given the opportunity.

2.2.27 Woodland thicket rat (*Grammomys murianus)*

2.2.27.1 Distribution and habitat

The woodland thicket rat is found in the eastern and north-eastern parts of the subregion. In Zimbabwe it occurs in the Harare district and in Mozambique south of the Zambezi river, where it is widely distributed, as well as south to the northern Gaza and Inhambane district with no record further to the south. The woodland mouse has a preference for denser and well developed woodland and forests (Skinner & Smithers 1990).

2.2.27.2 Predation on Grammomys murianus

In a study conducted by Nel *et al.* (1997) black-backed jackal *(Canis mesomelas*) is documented as a species that preys extensively on rodents. Perrin & Bodbijl (2001) documented that gaboon adders (*Bitis gabonia*) preyed on woodland thicket rat in

northern KwaZulu-Natal. Given their small size, many other predators will prey on this species, if given the opportunity.

2.2.28 Mozambique thicket rat (*Grammomys cometes)*

2.2.28.1 Distribution and habitat

The Mozambique thicket rat has been recorded northern in the Beira, western and southern Vila Peri, south-eastern Mbabane, the Maputo district in Mozambique, Limpopo Province as well as northern and north-eastern KwaZulu-Natal. It has a preference for denser and well developed woodland and forests. It is nocturnal and probably has similar habits than the woodland mouse (Skinner & Smithers 1990).

2.2.28.2 Predation on Grammomys cometes

In a study conducted by Nel *et al.* (1997) it is documented that black-backed jackal (*Canis mesomelas*) prey extensively on rodents. Given their small size, many other predators will prey on this species, if given the opportunity.

2.2.29 Four-striped grass mouse (*Rhabdomys pumilio)*

2.2.29.1 Distribution and habitat

The four-striped grass mouse occurs throughout Namibia, in the vicinity of the Okavango Delta and in the extreme northern parts of Botswana, extending eastwards through Zimbabwe. There are many material records from South Africa. It occurs from sea level in the Cape Province to an altitude of over 2 700 m in the Drakensberg mountains, in areas with a mean annual rainfall of less than 100 mm in Namibia, to over 1 200 mm in eastern Zimbabwe and Western Mozambique (Skinner & Smithers 1990).

2.2.29.2 *Predation on* Rhabdomys pumilio

According to Avenant & Nel (1986) the four-striped grass mouse was preyed upon by four synoptic carnivores in strandveld ecosystems, namely caracal (*Caracal caracal*), water mongoose (*Atilax paludinosus*), small grey mongoose (*Galerella pulverulenta*) and yellow mongoose (*Cynictis penicillata*). Given their small size, many other predators will prey on this species, if given the opportunity.

2.2.30 Sykes' monkey (*Cercopithecus albogularis)*

2.2.30.1 Distribution and habitat

Sykes' monkeys occur from the Eastern Cape Province, north-eastward to the KwaZulu-Natal midlands. They are common in Mozambique north of the Zambezi River, in Malawi, Zambia, Kenya, southern Somalia and northern Angola. Samango monkeys are closely confined to a forest habitat, seldom moving away from this habitat, except temporarily when in transit or foraging (Skinner & Smithers 1990).

2.2.30.2 Predation on Cercopithecus albogularis

No specific record of predation has been found, but doubtlessly it can be predated on by opportunistic animals like the leopard *(Panthera pardus).*

2.2.31 South African large-spotted genet (*Genetta tigrina*)

2.2.31.1 Distribution and habitat

Unlike the small-spotted genet, this species avoids arid country and occurs in the more mesic north-eastern and southern parts of the subregion. It prefers forests and forest fringes and depends on the availability of surface water. The South African large-spotted genet also occurs in plantations and other stands of exotic trees and commonly lives near human dwellings, especially if there is dense vegetation. It may even shelter in buildings (Skinner & Smithers 1990).

2.2.31.2 Predation on Genetta tigrina

Skinner *et al.* (1992) documented that spotted hyenas (*Crocuta crocuta*) preyed upon South African large-spotted genet in the Mkuzi game reserve.

2.2.32 Banded mongoose (*Mungos mungo)*

2.2.32.1 Distribution and habitat

The distribution range of the banded mongoose includes the northern and eastern parts of the subregion where they prefer open woodland where there is substrate detritus such

as fallen logs and other vegetation debris. They are at least seasonally independent of surface water. The banded mongoose has a wide habitat tolerance, but does not occur in desert or semi-desert and is therefore absent from large parts of the south-western arid zone (Skinner & Smithers 1990).

2.2.32.2 Predation on Mungos mungo

In the study conducted by Le Roux & Skinner (1989) they reported the banded mongoose as a prey species of the leopard *(Panthera pardus)*. Skinner *et al.* (1992) identified the remains of banded mongoose in the scats of the spotted hyena in the Umfolozi and Mkuzi game reserves.

2.2.33 Dwarf mongoose *(Helogale parvula)*

2.2.33.1 Distribution and habitat

The dwarf mongoose occurs in northern Namibia and is widespread in Botswana throughout the northern parts of the country, being common in the Okavango Delta. They are common in Mozambique, south of the Zambezi River and occur in the extreme north-eastern parts of KwaZulu-Natal as well as large parts of the Limpopo province. The dwarf mongoose is a savanna species associated with semi-desert and dry open woodland and grassland. They require termite mounds or rock crevices for den sites (Skinner & Smithers 1990).

2.2.33.2 Predation on Helogale parvula

No specific record of predation has been found, but it is known that it can be preyed upon by opportunistic predators such as the leopard (*Panthera pardus*). When out foraging the dwarf mongoose is potential prey for many carnivores and birds of prey as a result of their small size (Goss 1990).

2.2.34 Striped polecat (*Ictonyx striatus*)

2.2.34.1 Distribution and habitat

Striped polecats have a wide distribution range that includes Mozambique south of the Zambezi river, Botswana, Namibia and throughout the remainder of the subregion. The

striped polecat has a wide habitat and occurs in almost any habitat. It may even penetrate desert along drainage lines (Skinner & Smithers 1990).

2.2.34.2 Predation on Ictonyx striatus

Skinner *et al.* (1992) recorded striped polecat as a prey species of the spotted hyena *(C rocuta crocuta*) in the Mkuzi game reserve.

2.2.35 African striped weasel (*Poecilogale albinucha)*

2.2.35.1 Distribution and habitat

African striped weasels are common in the eastern part of Zimbabwe with a few records from Namibia. They occur in the Limpopo Province, in the eastern parts of the Free State and widely in KwaZulu-Natal, their distribution range extending into the Eastern Cape Province. The African striped weasel is a savanna species, particularly associated with moist grassland areas of an annual rainfall of 600 mm (Skinner & Smithers 1990).

2.2.35.2 Predation on Poecilogale albinucha

No specific records of predation have been found, but it can be expected to be preyed upon by opportunistic animals such as the caracal *(Caracal caracal).*

2.2.36 Caracal *(Caracal caracal)*

2.2.36.1 Distribution and habitat

Caracal have a wide distribution range and occur in the northern, north-eastern and southern parts of Namibia, the northern, eastern and southern parts of Botswana, Mozambique and most of South Africa. They have a wide habitat range, which includes open country and savanna woodland, but are absent from forested areas and true desert (Skinner & Smithers 1990).

2.2.36.2 Predation on Caracal caracal

Fuller & Nicholls (1995) recorded a caracal killed by African wild dogs (*Lycaon pictus*) in Kenya.

2.2.37 Serval (*Reptailurus serval)*

2.2.37.1 Distribution and habitat

The serval has a wide distribution on the continent south of the Sahara, with a relict population in the mountainous areas from Morocco to Tunisia. It is common in Mozambique, Zimbabwe, northern Botswana, and north-eastern Namibia. In South Africa it is found in Mpumalanga, Limpopo Province and the western region of KwaZulu-Natal. The proximity to water is an essential requirement, coupled with the availability of adequate cover - whether in the form of stands of tall grass, underbrush or reed beds - in which they lie up during the day. They are also found in high mountain moorland, edges of forests and montane grassland (Orben 2001).

2.2.37.2 *Predation on* Reptailurus serval

No specific record of predation has been found, but it is expected that it can be predated on by opportunistic animals such as the leopard *(Panthera pardus).*

2.2.38 African wild cat (*Felis silvestris)*

2.2.38.1 Distribution and habitat

The African wild cat occurs widely throughout the subregion, except in the desert. In drier western parts of the subregion its colour is light sandy with an indistinct pattern of the transverse reddish brown bands on the limbs and a black tipped tail. In the eastern parts it is much greyer. It depends on cover to hide in during the day, such as holes in trees, thickets of burrows dug by other animals (Skinner & Smithers 1990).

2.2.38.2 Predation on Felis silvestris

In the study conducted by Bowland & Bowland (1991) the African wild cat was recorded as a prey species of the caracal (*Caracal caracal*).

2.2.39 Aardvark (*Orycteropus afer*)

2.2.39.1 Distribution and habitat

Aardvark has a wide distribution on the continent south of the Sahara, but is nowhere

common. Owing to its nocturnal and secretive habits, there are relatively few specimens in collections and it is rarely seen. Its distribution is governed to some extent by the availability of food. Aardvark is found in open woodland, scrub and grassland and is especially associated with sandy soil and heavily utilized grassland where there are termite populations. It will utilize the raised sandy islands in flood plains, both for digging a permanent burrow and for feeding on termitaria, which are common features of these islands (Skinner & Smithers 1990).

2.2.39.2 Predation on Orycteropus afer

Skinner *et al.* (1992) documented that spotted hyenas *(Crocuta crocuta)* preyed upon aardvark in the Umfolozi game reserve. Bothma & Le Riche (1994) also recorded the aardvark as a prey species of the leopard *(Panthera pardus)* in the Northern Cape.

CHAPTER 3

TAXONOMOMY OF MAMMAL HAIR

3.1 INTRODUCTION

The hair of mammals are epidermal structures and distinguishes mammals from all other vertebrates (Ryder 1973). Hair act as mechanical protection between the organism and its environment and it also assists with body temperature regulation (Amerasinghe 1983). The pelage of mammal hair consists of a number of different types of hair of which the scale patterns and cross-section shapes differ. The pattern of arrangement of the scales in the mid-region of a hair, in combination with the cross-section of the hair, appeared to be more useful for taxonomic characterization of the hair (Perrin & Campbell 1980).

3.2 TAXONOMIC DESCRIPTION OF HAIR

Hair can be classified into two main groups, namely long, thick outer hair (*guard hair*), and short fine *under fur hair*. The guard hair originate in primary follicles, while the under hair originate in secondary follicles. Guard hair are distributed over the body, with each one being associated with several under hairs. Guard hair (outer coat), which are long and coarse, can be divided into: (1) *spines* – very large and often defensive, e.g. quills; (2) *bristles* – stiff, heavily pigmented typical protective outer hairs (also include mane hair); and (3) *awns* – hair with coarse, often flattened tip, but finer base (Keogh 1979; 1983). Under hairs are shorter, fine and softer, and can be divided into: (1) *vellus* – shortest and finest hair or 'down'; (2) *fur* – thick, fine and relatively short; and (3) *wool* – longer, soft and usually curly (Keogh 1975; 1983).

Hair is formed in the primary and secondary follicles of the skin. The follicle develops into a tubular epidermal structure, and the walls form an inner and outer sheath of the hair. This inner sheath that grows with the hair, has two layers (inner Huxley layer and outer Henle layer), and a thin cuticle. The cells of the cuticle interlock with the scales of the hair cuticle (Ryder 1973).

Transverse sections of a hair show that it is composed of a thin outer cuticle and an inner cortex (Ryder 1973). Some hairs have a third structure, namely that of a central medulla. The medulla is usually absent from the finer tip and root portions of hairs, therefore a hair

has three concentric parts, that of a cuticle, cortex and a medulla (Fig. 3.1). It is the variation in these features, which are commonly used to identify hair.

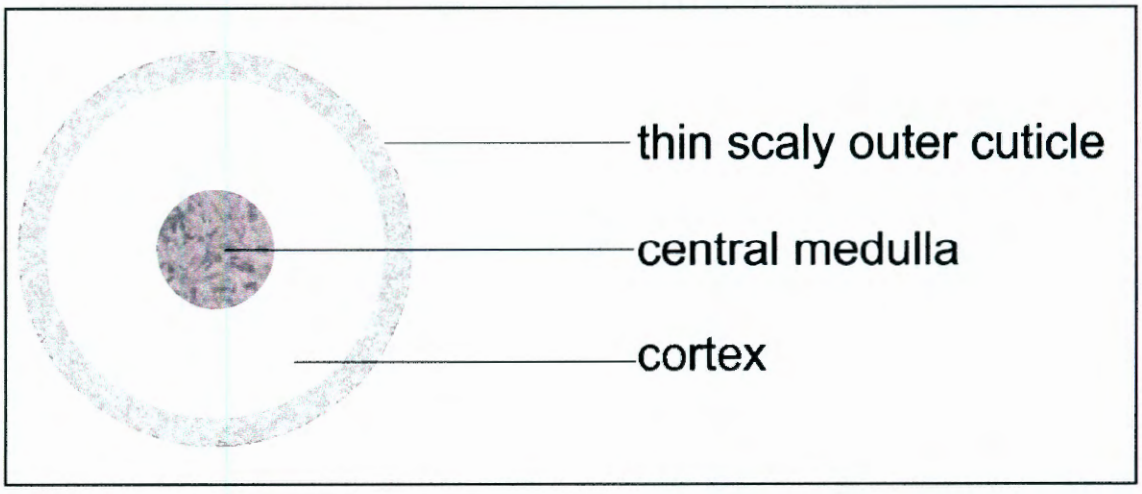


Figure 3.1 The main parts of a mammal hair (Ryder 1973)

The cortex is composed of non-nucleated cells, filled with hard α-keratin (Keogh 1983). However, these cells are not clearly visible, and can only be seen by electron microscope, and not with normal light transmission microscopes. The spindle-shaped cells are arranged concentrically and electron-dense substances fill intracellular spaces. The cortex, as such, is not often a diagnostic character but its size, relative to the medulla (Keogh 1983), as well as the shape of the cross-section are used in hair identification (refer to Fig. 3.2).

The medulla is made up of soft or β-keratin in the early stages of development. As the medulla grows slower than the cortex and cuticle, air spaces are formed in it (Keogh & Haylett 1983). These air spaces in the medulla appear black by transmitted light, and this might obscure the actual structure of the medulla. By expelling this air, the various arrangement of the medulla can be observed. These arrangements can be classified and used as a diagnostic criterion (Keogh 1983).

The cells of the cuticle are flat, and are known as scales. The scale cells are non-nucleated and keratinized. These scales overlap each other, which is as a result of complicated differential forces during growth. These forces involve an upward movement of the inner sheath, which drags the outer part of each hair cuticle over the one above it in the follicle. Therefore this overlapping of the scale edges point towards the tip of the hair (refer to Fig. 3.3).

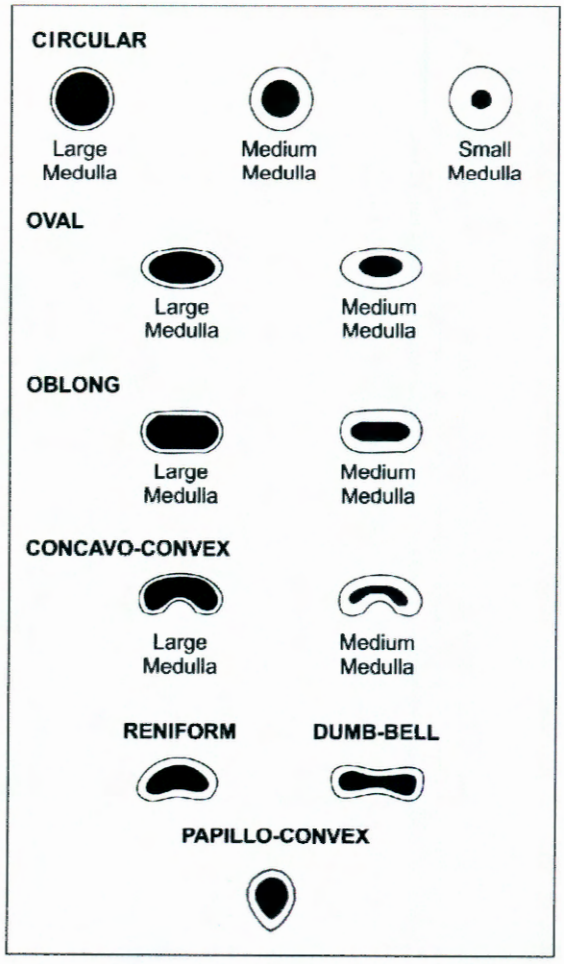


Figure 3.2 Most commonly found cross-section shapes of mammal hair (Keogh 1983)

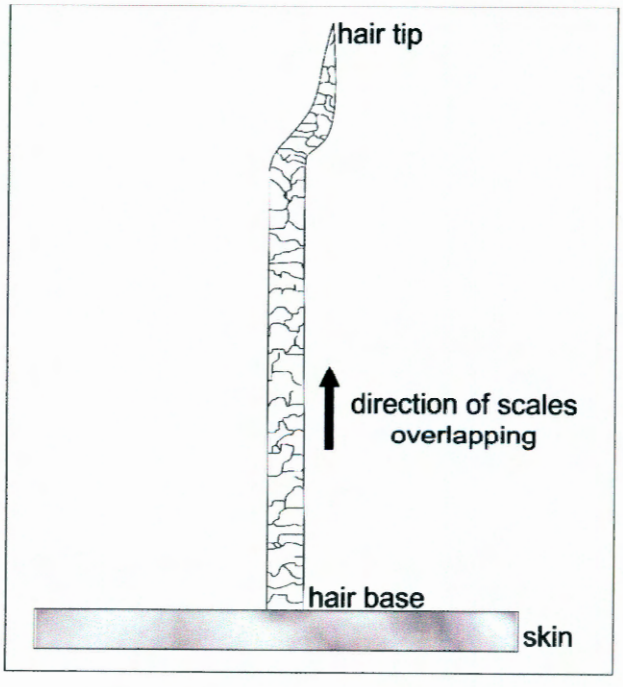


Figure 3.3 Figure illustrating the scale pattern direction of a hair (Ryder 1973)

The arrangement and shape of scales form patterns that vary between types of hair and between species (Ryder 1973). De Broom & Dreyer (1953) found that distinct differences exist between the main body hairs (that of guard hairs and under hairs), of the various mammal species. However, the basic morphology of these hairs from different regions of the body of one species is the same, except for the mane and tail hairs, which was found to differ from the body hairs. Dreyer (1964) found that there were no significant differences between the hair of males and females.

It has been suggested that the difference in cuticular scale pattern is a result of different growth rates, but this has been rejected by Ryder (1973), stating that the difference is due to abrasion of the scale as the hair grows above the skin surface. According to Keogh (1979), Treavor-Deutch (1970) reported that there was no deterioration of hairs of two specimens of vole, which were over a hundred years old and mammoth hairs also showed no apparent deterioration over a very long period of time. The pattern made by the scale cells around the length of the hair, their shape, size and type of margin, have been recognized and used for identification purposes (Keogh 1983). Three characteristics are used in describing a scale pattern, namely: (1) the form of the scale margin; (2) the distance between margins; and (3) the overall pattern.

The form of the scale margin refers to the free distal edge of an individual scale (Fig. 3.4). It can be either (a) smooth, (b) crenate – having shallow indentations; or (c) rippled – having deep indentations.

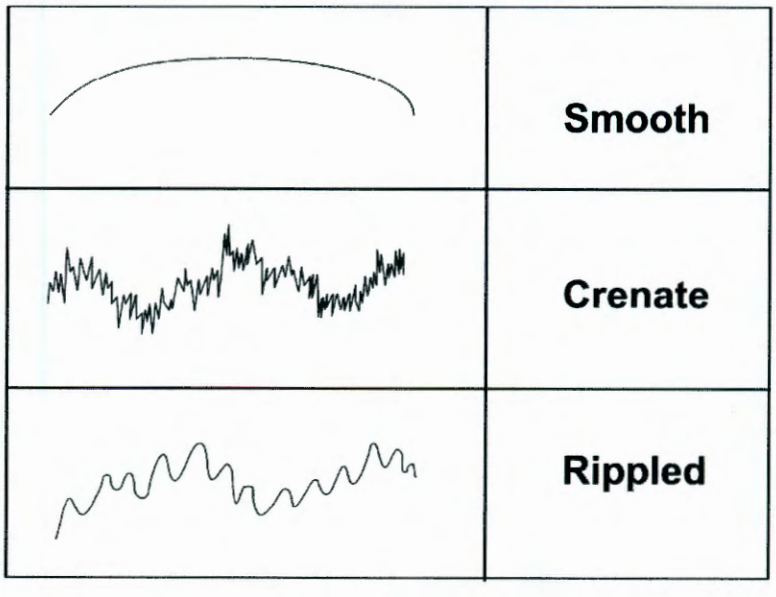


Figure 3.4 Figure illustrating the different forms of the scale margins (Keogh 1983)

The distance between margins can be (a) almost touching, (b) closely spaced, or (c) widely spaced (refer to Fig. 3.5). According to Keogh (1983), this is a distinctive feature of the scale patterns, but cannot be easily quantified.

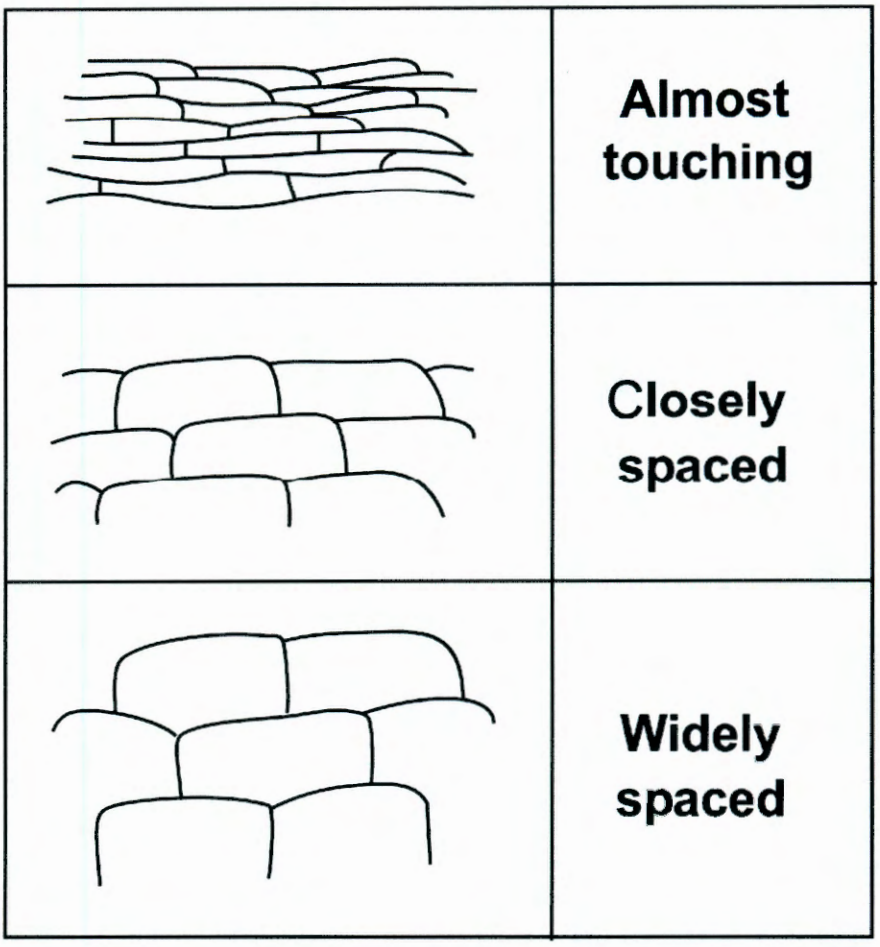


Figure 3.5 Figure illustrating the distances between scale margins (Keogh 1983)

The *overall pattern* of scale imprints of a mammal hair can be either: (a) mosaic, (b) chevron, (c) coronal, (d) pectinate, or (e) petal shaped (Fig. 3.6). In the case of a *mosaic cuticular pattern*, the pattern is composed of a number of units. This pattern is further divided into regular (of which the units are approximately the same size), and irregular (of which the units have a random mixture of different scale sizes) patterns. A *chevron cuticular scale pattern*, is a waved pattern. This pattern can either be a single chevron (with either the troughs or the crests forming a narrow "V"), or a double chevron (with both the troughs and crests forming a "V" shape). *Coronal cuticular scale patterns* are usually a single scale, sometimes two, across the width of the hair. These scales are often evenly spaced across the hair width. The margins are transverse and smooth or slightly indented (Keogh 1983). With a *pectinate cuticular scale pattern*, the pattern is comb-like.

This pattern can be divided further into a coarse pectinate (in which the "teeth" are wider) and a lanceolate pectinate (in which the "teeth" are long and narrow). In a *pectal cuticular scale pattern*, the scales have the appearance of overlapping flower petals and the scales may also be diamond or narrow diamond shaped.

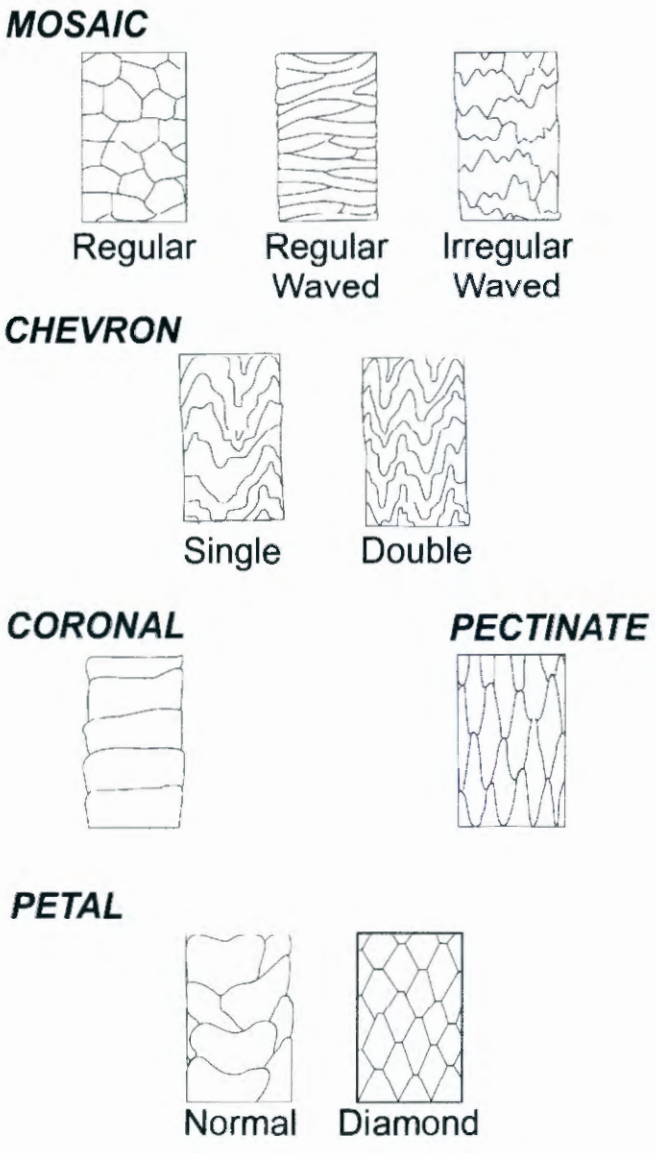


Figure 3.6 Figure illustrating the cuticular scale patterns of mammal hair (Keogh 1983)

The colouration of the hair is due to the pigment melanin. According to Ryder (1973), two kinds of melanin are recognized, namely eumelanin (brown-black) and phaemelanin (yellow red). Different shades of brown and grey could exist due to the differences in the size, density and distribution of the brown-black melanin pigment. The colour pigment occurs in the cuticle, cortex and medulla, but is considered to be more common in the cortex. Changes in an animal coat colour from e.g. summer to winter do occur and are

bought about mainly by the growth of different coats. It is also possible that changes in pigmentation may take place along the length of the hair. This results in animals having banded or agouti patterned hair.

3.3 NOMENCLATURE, TERMS AND DEFINITIONS

The following nomenclature, terms and definitions were adopted from the descriptions by Hausman (1930); Mayer (1952); Dreyer (1964); Khemelevskaya (1965); Perrin & Campbell (1979); Keogh (1975; 1983) and Bryce (1994):

- ***Coronal:*** Usually a single scale, occasionally two scales, across the width of the hair, scales are often evenly spaced. The margins are transverse and smooth or slightly indented.

- ***Chevron*:** A waved pattern. In a single chevron either the troughs or the crests are narrow 'V' shaped. In a double chevron both the troughs and the crests are 'V' shaped.

- ***Mosaic:*** A pattern composed of a number of units. This type is divided into regular (in which the units are approximately the same size) and irregular (in which the mosaic has a random mixture of different scale size).

- ***Pectinate:*** A comb-like pattern. This type is divided into coarse pectinate and inanceolatae pectinate, in which the "teeth" are long and narrow.

- **Petal:** A pattern in which the scales have the appearance of overlapping flower petals and which may also be diamond or narrow diamond shaped.

- ***Guard hairs:*** Are longer and courser than under hairs and are often pigmented. In many smaller mammals the guard hairs have a groove running longitudinally along one side of the hair; this groove usually occurring at the region of the widest shaft diameter.

- ***Under hairs:*** Under hairs are shorter and finer than guard hairs and unlike guard hairs they show little tempering along their length. In the pelage of smaller mammals, under hair are frequently more numerous than guard hairs, while in

larger mammals they may be totally absent. Under hairs may possess a groove and are usually less pigmented than guard hairs.

- ***Cuticle*:** Cuticle is the outermost structure of a hair and is composed of layers of overlapping scales. The shape and imbrications (overlap) of the scales can be diagnostic.

- ***Hair Cortex:*** Hair cortex lies beneath the cuticle and provides the major structural strength of a hair. Cortical features, if present, are diagnostically important. They are pigment granules and regosities or pegs that appear to hold the medullary units in place.

- ***Medulla:*** The medulla is the innermost part of the hair structure. The medullary cells in the hairs occurred in series of discontinuous units and give the hairs a striated appearance.

- ***Oval:*** Egg shaped, longer than it is broad and broadest near one end. It is subdivided into (a) short, (b) flat, and (c) long.

- ***Periform:*** Pear shaped.

- ***Angular:*** Having corners.

- ***Biconcave:*** Concave on both sides.

- ***Concavo-convex:*** A few typical shapes can be distinguished under this category: (a) fabiforus (bean shaped; Claister), (b) reniform (kidney-shaped, Glaister), (c) Cordiform (heart-shaped), and (d) unguliform (hoof-shaped).

- ***Leneo concave:*** One side is flat and the other side is curved inwards.

- ***Leneo convex:*** One side is flat and the other side is rounded.

- ***Papillo-convex:*** One side is projection shaped like a papilla and the other side is rounded.

- ***Frilateral:*** Bearing a rough resemblance to a triangle.
- ***Quadrilateral:*** Roughly resembling a square or rectangle.
- ***Dumb-bell shaped:*** As the name indicates, it resembles a dumb-bell-shape.

CHAPTER 4

PROCEDURE

4.1 MAMMAL SPECIES INCLUDED IN THE STUDY

Leopards occur relatively wide spread in central and southern Africa and their distribution range includes countries such as Botswana, Malawi, Mozambique, Namibia, Zambia, Namibia and South Africa (Skinner & Smithers 1990). Leopards are mainly carnivores, feeding on a wide range of prey species ranging from small rodents, antelopes, birds, reptiles to insects. The diet of the leopards is well documented in Africa, but may vary from region to region (Kruuk & Turner 1967; Norton *et al.* 1986; Le Roux & Skinner 1989; Bothma & Le Riche 1994). The mammal species included in this study (Table 4.1) were selected because, based on their known distribution range, they may occur in the area where the leopard study described in Chapter 1 will be conducted. The objectives of that particular study require that the remains of mammals prey species, mainly hair, in the feaces of the experimental leopards be identified.

4.2 COLLECTION OF HAIR SAMPLES

Hair samples were taken from the dried skins of specimens of 39 of the selected mammal species that were hosted at the Transvaal Museum in Pretoria (Table 4.1). The hair samples were removed from the mid-dorsal area between the shoulders with the aid of forceps. However, due to the limited museum skin samples, hair samples of the gemsbok, sable antelope, suni and Sharpe's grysbok were taken from the legs and the hair samples of the nyala were taken from the neck area. Hair samples were placed in plastic bags, which were labeled and sealed.

4.3 PREPARATION OF HAIR SAMPLES FOR MICROSCOPIC ANALYSIS

4.3.1 Hair washing

For the microscopic examination of hair samples and the making of cuticular imprints, it is essential that the hair samples be clean and dry. The hair was first rinsed in 90% alcohol (ethanol) and dried with a paper towel. This was followed by a rinsing in distilled water where after they were dried with paper towels.

4.3.2 Scale imprints

A thin coating of colourless nail polish was applied to a glass microscope slide using a flat brush. Clean dry hairs were placed on the nail polish and the nail polish was allowed to dry for 15 minutes. The hairs were then gently removed from the slide by holding individual hairs with forceps, thus leaving a permanent impression of the cuticular scales on the microscope slide for viewing under a light microscope, with magnification of 100x.

In preparation for electron microscope inspection, hair samples were cut in 5 mm lengths and mounted on electron microscope stubs. The hair segments were coated with gold in a BIORAD SEM COATING SYSTEM, to make the biological samples electronically conductive for examination with a scanning electron microscope.

4.3.3 Cross-section analysis

Hairs were sectioned according to the technique described by Keogh (1983). Stainless steel slides of approximately 76 x 25 x 0.5 mm, with three 0.8 mm holes drilled at equal intervals along centre line, were used. After drilling the holes, they were slightly chamfered to remove sharp cutting edges. A loop of cotton was threaded through the hole, whereafter hair samples were placed in the centre of the cotton and gently pulled through the hole. Cotton rather than nylon thread was favoured, as the amount of hair which can be pulled through the hole, is more easily regulated. In the case of nylon, hairs are forced through the hole, resulting in over-packing and hence distortion of the hairs. The protruding hair bundles were cut flush on each side using a microtome blade. For viewing nail polish was applied on both sides of the sections. It also served as protection of the hairs when stored. For practical reasons a microtome blade instead of a cut throat razor was used to make the cross-section cuts.

4.4 MICROPHOTOGRAPHY

Cuticular scale patterns were photographed using a JEOL JSM 6400 scanning electron microscope with magnification ranging from 230x to 3000x. The study was conducted at the centre for Confocal and Electron microscope of the University of the Free State. Photographs were taken of the mid-shaft of the hair, as this was considered the most typical part of the hair. Cross-sections were photographed by using a Nikon Digital camera fitted to a Nikon Microphoto-FXA microscope, with magnifications of 100x. This facility is located at the Department of Zoology at the University of the Free State.

Table 4.1 Mammal species included in the hair identification with reference to the museum specimens from which the hair samples were obtained.

English name	Scientific name	Family	Museum number	Body part	Locality
Sable antelope	*Hippotragus niger*	Bovidae	TM 3282	Leg	Manyolele Zoo
Gemsbok	*Oryx gazella*	Bovidae	TM 3284	Leg	Sabi Game Reserve
Waterbuck	*Kobus ellipsiprymnus*	Bovidae	TM 3291	Dorsal	Gazaland
Greater kudu	*Tragelaphus strepsiceros*	Bovidae	TM 16658	Dorsal	5 min of Numbi gate
Nyala	*Tragelaphus angasii*	Bovidae	TM 19414	Neck	Malelane Game Reserve
Bushbuck	*Tragelaphus scriptus*	Bovidae	TM 3253	Dorsal	Steyndorp
Impala	*Aepyceros melampus*	Bovidae	Own samples	Various	Bloemfontein district
Southern reedbuck	*Redunca arundinum*	Bovidae	TM 11562	Dorsal	Shagombo
Klipspringer	*Oreotragus oreotragus*	Bovidae	TM 3133	Dorsal	Sabi Game Reserve
Common duiker	*Sylvicapra grimmia*	Bovidae	TM 16669	Dorsal	Vostershoop
Steenbok	*Raphicerus campestris*	Bovidae	TM 16671	Dorsal	Malelane Game Reserve
Sharpe's grysbok	*Raphicerus sharpei*	Bovidae	TM 3455	Leg	Sekorokoro
Red duiker	*Cephalophus natalensis*	Bovidae	TM 7246	Dorsal	Maputa
Blue duiker	*Philantomba monticola*	Bovidae	TM 3111	Dorsal	Gazaland
Suni	*Neotragus moschatus*	Bovidae	TM 3167	Leg	Sekorokoro
Bushpig	*Potamochoerus larvatus*	Suidae	TM 4700	Dorsal	Umfolozi Game Reserve

Table 4.1 continue.....

Table 4.1 continue.....

English name	Scientific name	Family	Museum number	Body part	Locality
Common Warthog	*Phacochoerus africanus*	Suidae	TM 3355	Dorsal	Umfolozi Game Reserve
Rock hyrax	*Procavia capensis*	Procaviidae	TM 11963	Dorsal	Nkurwe berg
Rock dormouse	*Graphiurus platyops*	Gliridae	TM 40064	Dorsal	Junction of Sashe and Limpopo River
Springhare	*Pedetes capensis*	Pedetidae	TM 44925	Dorsal	Gazaland
Scrub hare	*Lepus saxatilis*	Leporidae	TM 20352	Dorsal	75 km w, farms Greefs 37
South African ground squirrel	*Xerus inaurus*	Sciuridae	TM 27771	Dorsal	13 km w, farm Ratseg
Greater Cane rat	*Thryonomys swinderianus*	Thryonomidae	TM 42486	Dorsal	23 Avenue Menlopark
Gambian Giant rat	*Cricetomys gambianus*	Muridae	TM 44604	Dorsal	Happy Rest Nature Reserve
Red veld rat	*Aethomys chrysophilus*	Muridae	TM 45492	Dorsal	Alldays
Bushveld gerbil	*Tatera leucogaster*	Muridae	TM 45419	Dorsal	Alldays
Woodland thicket rat	*Grammomys dolichurus*	Muridae	TM 40877	Dorsal	De Hoek Forest
Mozambique woodland mouse	*Grammomys cometes*	Muridae	TM 31485	Dorsal	Ngorongo crater

Table 4.1 continue.....

Table 4.1 continue.....

English name	Scientific name	Family	Museum number	Body part	Locality
Four-Striped grass mouse	*Rhabdomys pumilio*	Muridae	TM 45575	Dorsal	Hendrina, Pullens Hope station
Sykes' monkey	*Cercopithecus albogularis*	Cercopithecidae	TM 25857	Dorsal	Entabene State Forest
South African large spotted genet	*Genetta tigrina*	Viverridae	TM 39551	Dorsal	5 km n. BLIJDS
Banded mongoose	*Mungos mungo*	Viverridae	TM 10406	Dorsal	Messina
Dwarf mongoose	*Helogale parvula*	Viverridae	TM 5868	Dorsal	Nyellele River
Striped polecat	*Ictonyx striatus*	Mustelidae	TM 19924	Dorsal	2 Misi. Private Nature Reserve
African striped weasel	*Poecilogale albinucha*	Mustelidae	TM 20060	Dorsal	Wakkerstroom
Caracal	*Caracal caracal*	Felinae	TM 6277	Dorsal	Brits
Serval	*Leptailurus serval*	Felinae	TM 4713	Dorsal	Satara (KNP)
African wild cat	*Felis silvestris*	Felinae	TM 23848	Dorsal	15 km n, Renosterpoort P.N.R
Aardvark	*Orycteropus afer*	Orycteropodidae	TM 20319	Dorsal	32 km. E Farm Scrut 23 MT

CHAPTER 5

RESULTS

5. 1 TAXONOMIC DESCRIPTION OF THE HAIR

5.1.1 Sable antelope (*Hippotragus niger)*

A light microscopic photograph of a cross-section of the hair of the sable antelope is presented in Figure 5.1. *Cross-section*: Owing to the wiry texture of the hair, they show as dark circles. Under light microscopy the medulla of the hair appear small and very dark. The cortex is heavily pigmented and black with occasional yellowish colouration.

Electron microscopic photographs of the cuticular scale pattern of the hair of the sable antelope are presented in Figure 5.2. *Cuticular scale pattern*: Irregular waved mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

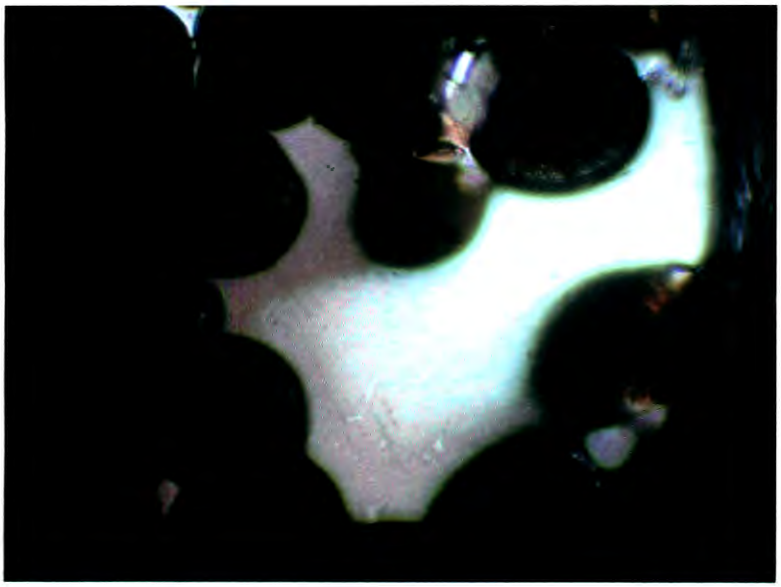


Figure 5.1 Light microscopic photograph of a cross-section of the hair of the sable antelope (100x).

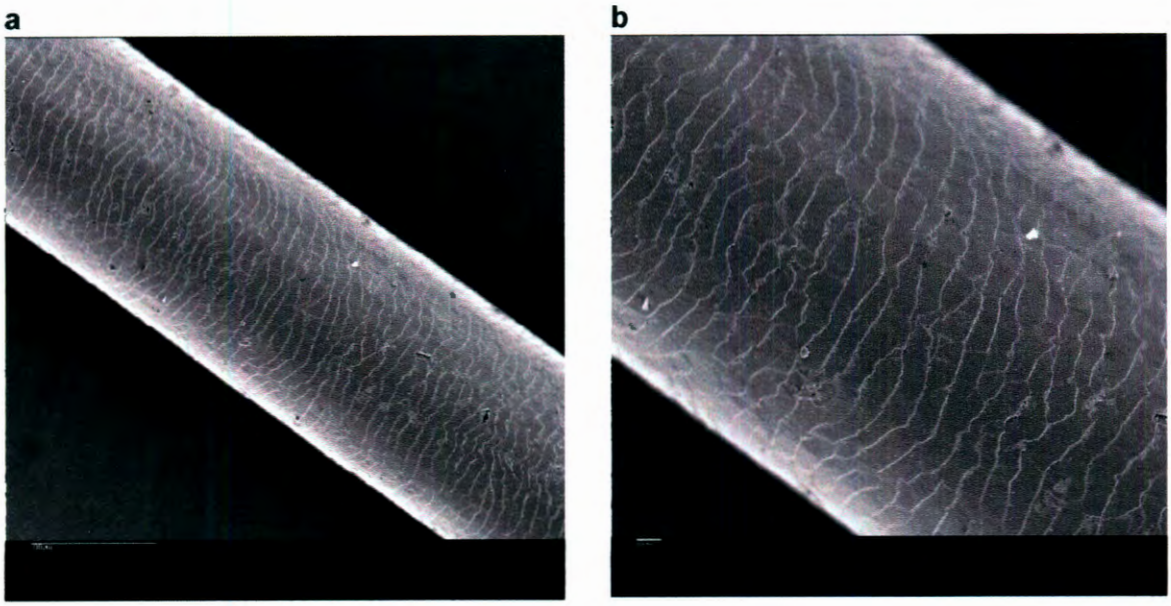


Figure 5.2 Electron microscopic photographs of the cuticular scale pattern of the hair of the sable antelope (a = 270x, b = 550x).

5.1.2 Gemsbok (*Oryx gazella)*

A light microscopic photograph of a cross-section of the hair of the gemsbok is presented in Figure 5.3. *Cross-section*: The hair appear oval to oblong with the medulla ranging from large to medium. The medulla appear black, while the cortex appear reddish in colour. Under fur hair have small medulla with a yellowish cortex.

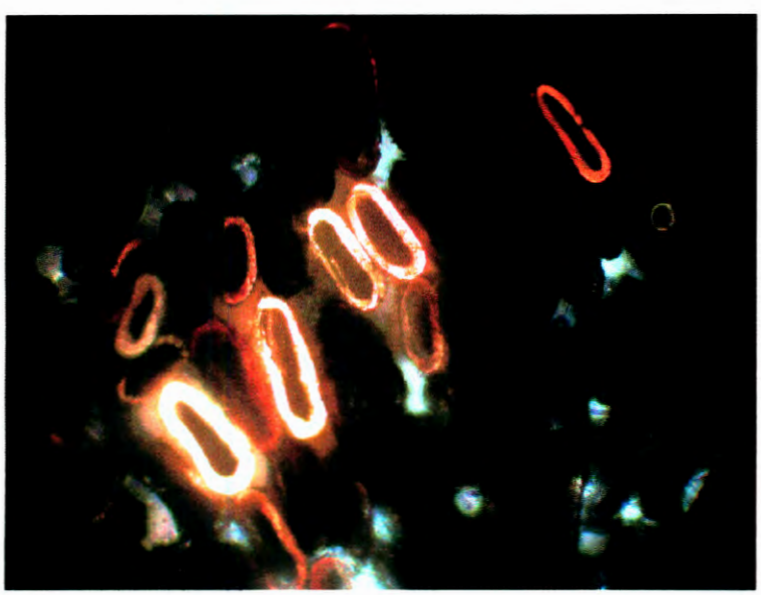


Figure 5.3 Light microscopic photograph of a cross-section of the hair of the gemsbok (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the gemsbok are presented in Figure 5.4. *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

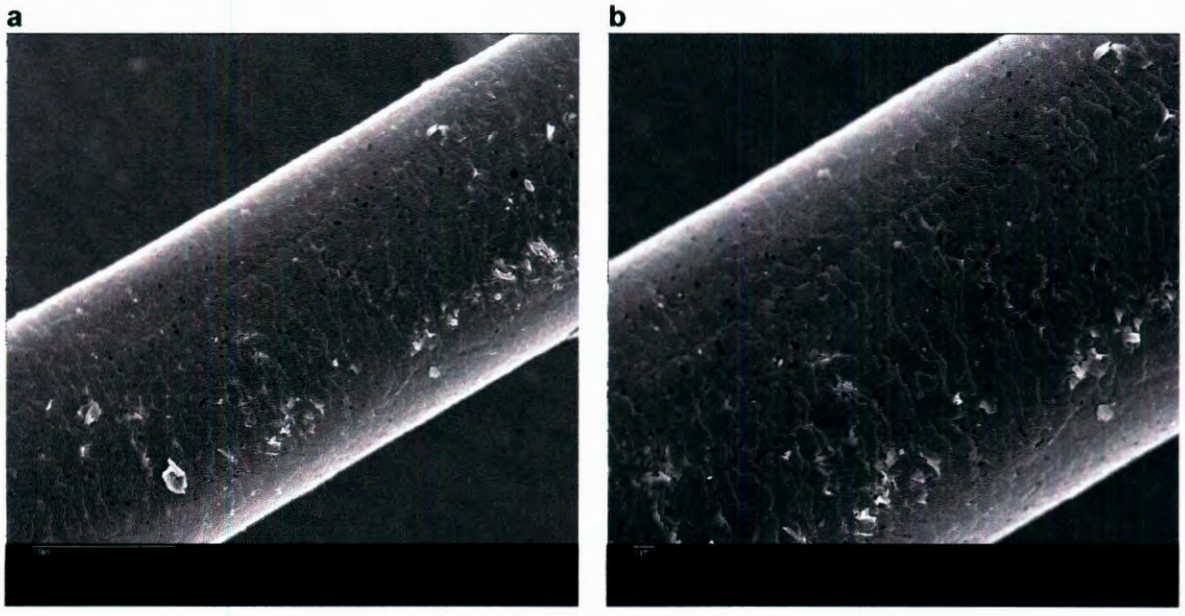


Figure 5.4 Electron microscopic photographs of the cuticular scale pattern of the hair of the gemsbok (a = 650x, b = 1 100x).

5.1.3 Waterbuck (*Kobus ellipsiprymnus*)

A light microscopic photograph of a cross-section of the hair of the waterbuck is presented in Figure 5.5. *Cross-section*: Hairs appear oval. The medium-sized medulla appear dark, owing to frequent air spaces. The spongy cortex appear dark orange brown to light brown.

Electron microscopic photographs of the cuticular scale pattern of the hair of the waterbuck are presented in Figure 5.6. *Cuticular scale pattern*: An irregular waved mosaic pattern is visible in the mid-shaft region of the hair. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Almost touching.

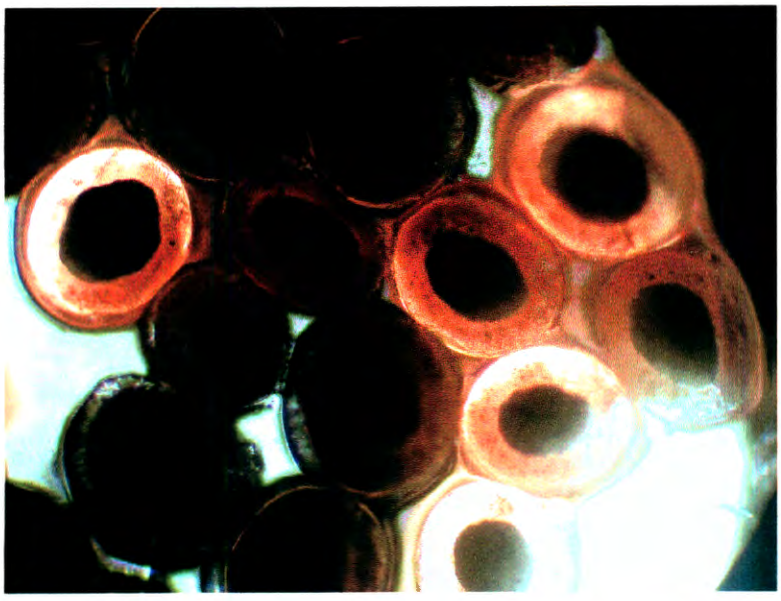


Figure 5.5 Light microscopic photograph of a cross-section of the hair of the waterbuck (100x).

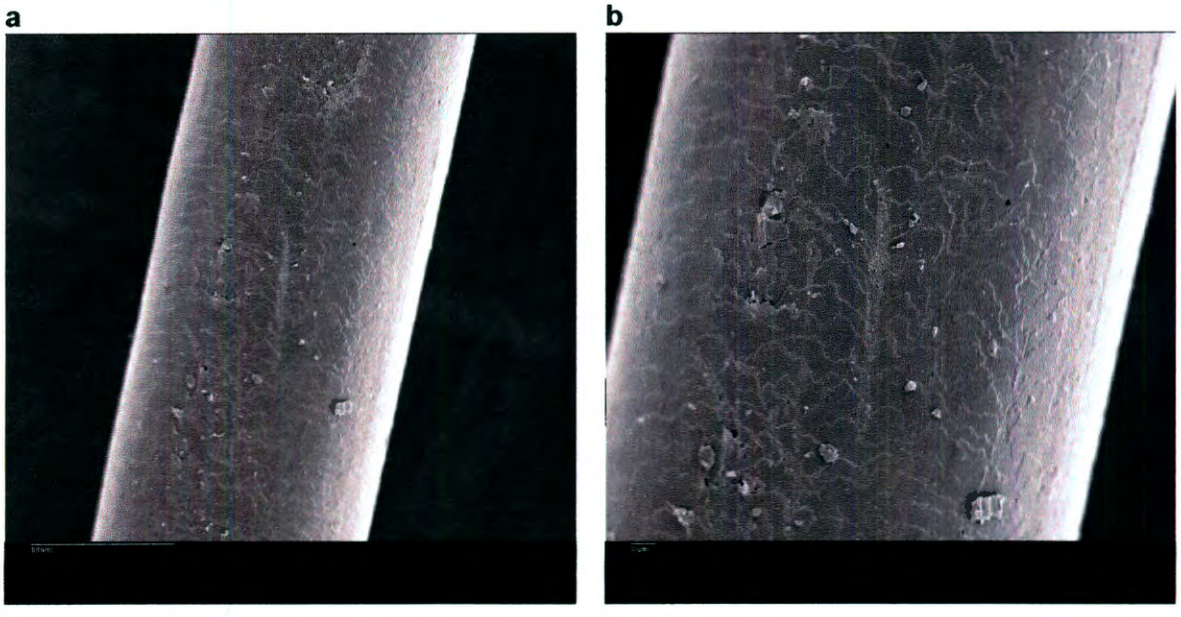


Figure 5.6 Electron microscopic photographs of the cuticular scale pattern of the hair of the waterbuck (a = 300x, b = 550x).

5.1.4 Greater kudu (*Tragelaphus strepsiceros*)

A light microscopic photograph of a cross-section of the hair of the greater kudu is presented in Figure 5.7. *Cross-section*: Hairs appear oval with medium-sized medulla. The colours of the cortex appear pale yellowy orange, reddish or dark brown. White hairs are oval, with medium-sized medulla with a white cortex.

Electron microscopic photographs of the cuticular scale pattern of the hair of the greater kudu are presented in Figure 5.8. *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

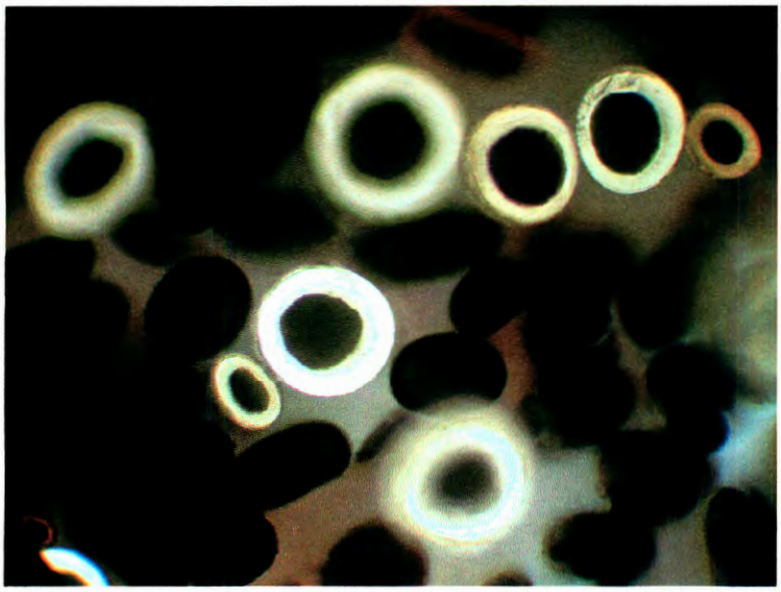


Figure 5.7 Light microscopic photograph of the cross-section of the hair of the greater kudu (100x).

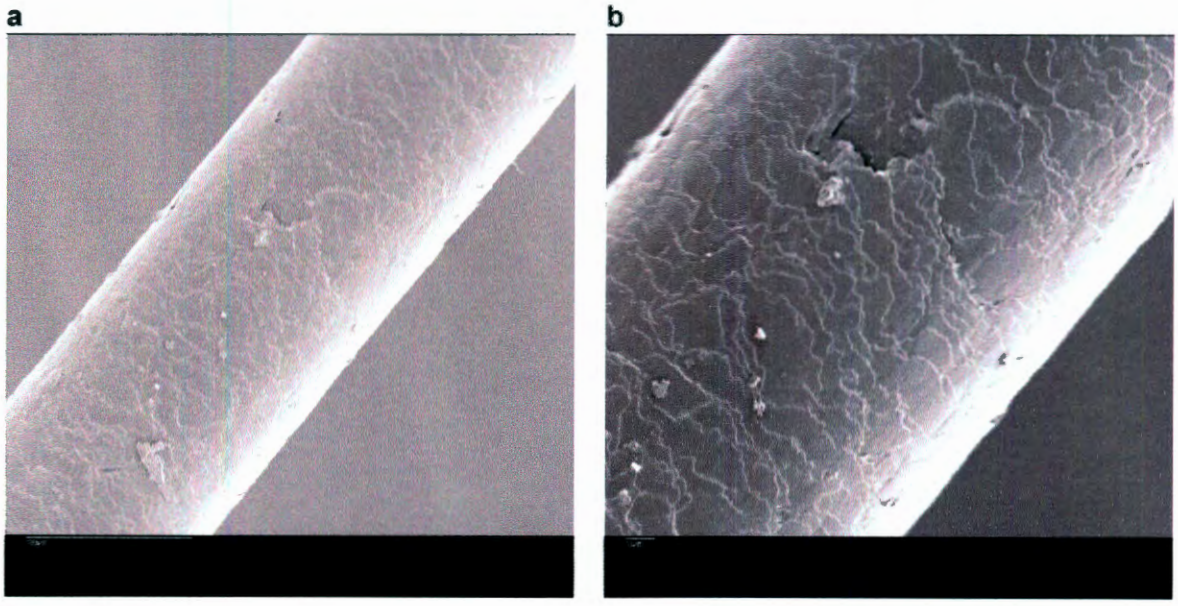


Figure 5.8 Electron microscopic photographs of the cuticular scale pattern of the hair of the greater kudu (a = 350x, b = 650x).

5.1.5 Nyala (*Tragelaphus angasii)*

A light microscopic photograph of a cross-section of the hair of the nyala is presented in Figure 5.9. *Cross-section*: Hairs appear oval to oblong with medium-sized medulla, while the cortex appear reddish. The medulla appear black, but are dark brown in white hairs. The medulla of under fur hairs are small with a reddish cortex. White hairs are similar, but with a white cortex.

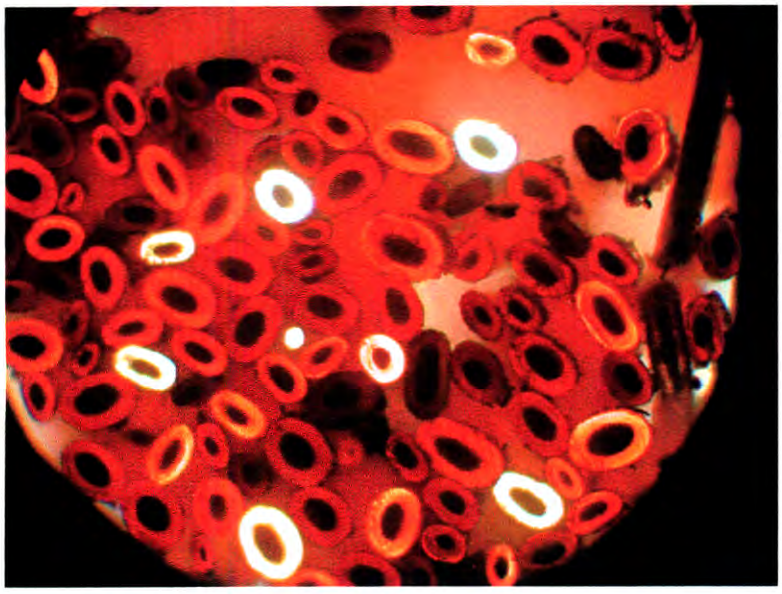


Figure 5.9 Light microscopic photograph of a cross-section of the hair of the nyala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the nyala are presented in Figure 5.10. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible with three to four scales across the width. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

5.1.6 Bushbuck (*Tragelaphus scriptus)*

A light microscopic photograph of a cross-section of the hair of the bushbuck is presented in Figure 5.11. *Cross-section:* Hairs appear oblong to oval and are fairly uniform in appearance. The cortex appear reddish in colour. The medium-sized medulla appear uniformly dark, while white hairs appear oblong with medium-sized medulla and white cortex.

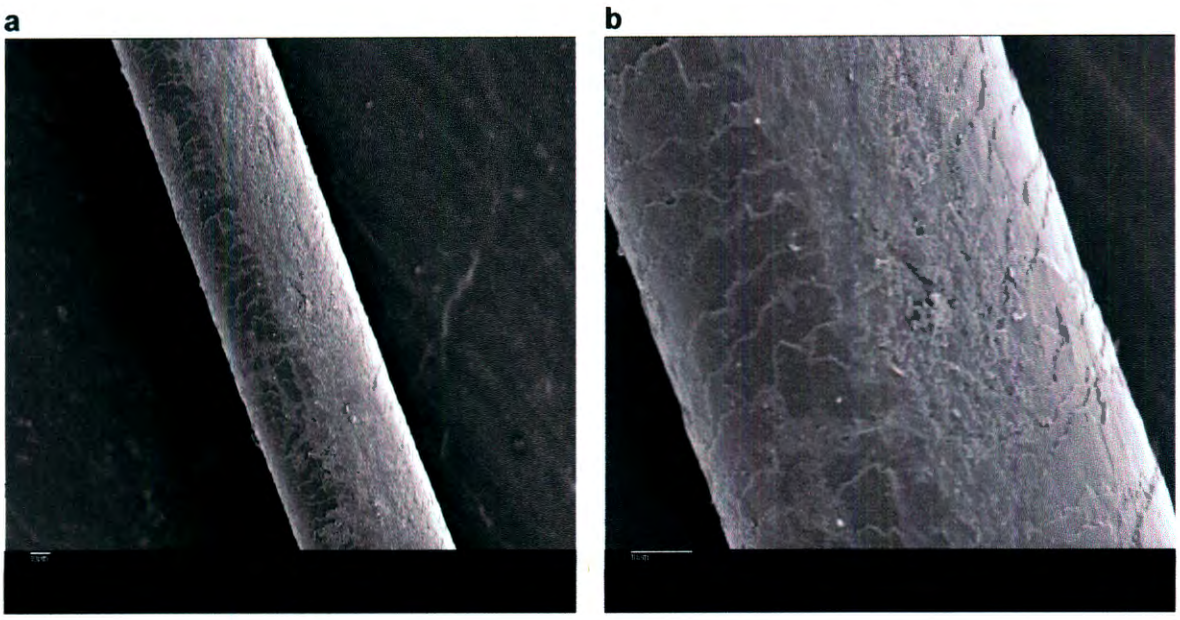


Figure 5.10 Electron microscopic photographs of the cuticular scale pattern of the hair of the nyala (a = 400x, b = 1 300x).

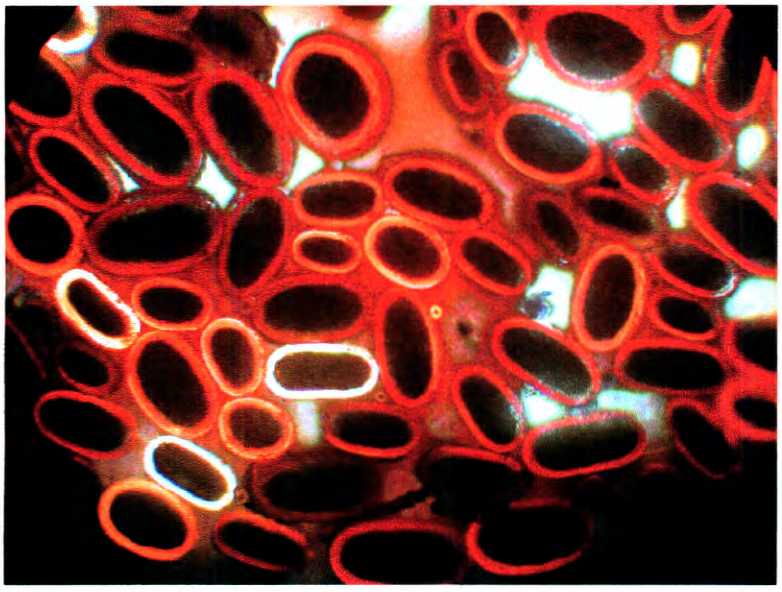


Figure 5.11 Light microscopic photograph of a cross-section of the hair of the bushbuck (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the bushbuck are presented in Figure 5.12. *Cuticular scale pattern*: A regular mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Widely spaced.

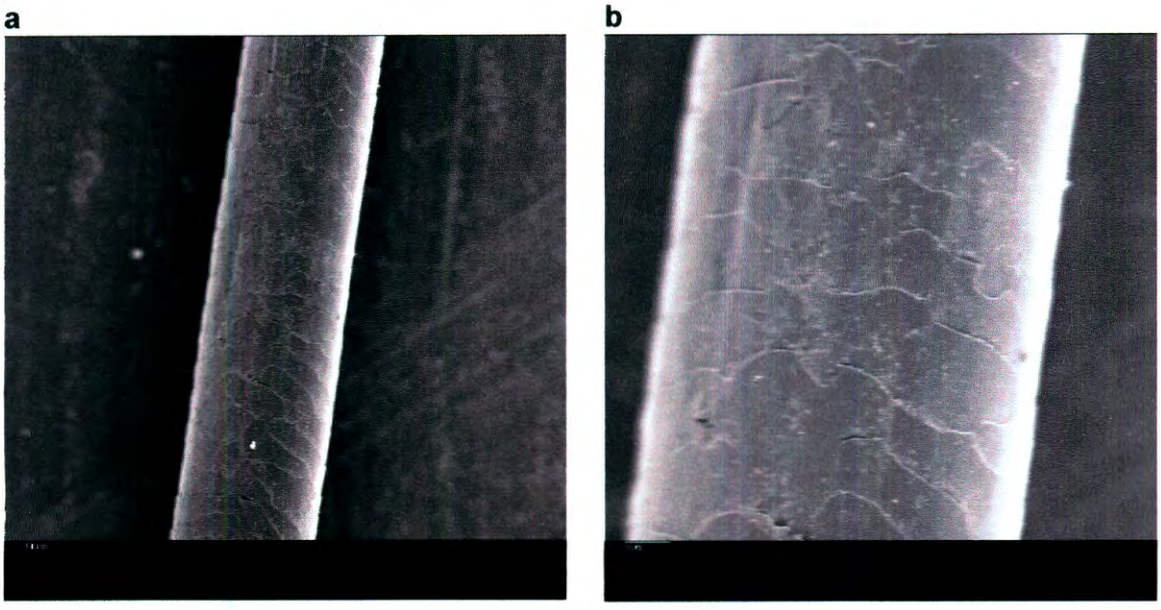


Figure 5.12 Electron microscopic photographs of the cuticular scale pattern of the hair of the bushbuck (a = 350x, b = 1 000x).

5.1.7 Southern reedbuck (*Redunca arundinum*)

A light microscopic photograph of a cross-section of the hair of the southern reedbuck is presented in Figure 5.13. *Cross-section*: The medulla are medium-sized with an oval, oblong to dumb-bell shape. The cortex appear reddish. In the case of dark coloured hair the cortex are difficult to distinguish due to heavy pigmentation. Under fur hairs have small, oblong medulla with reddish cortex.

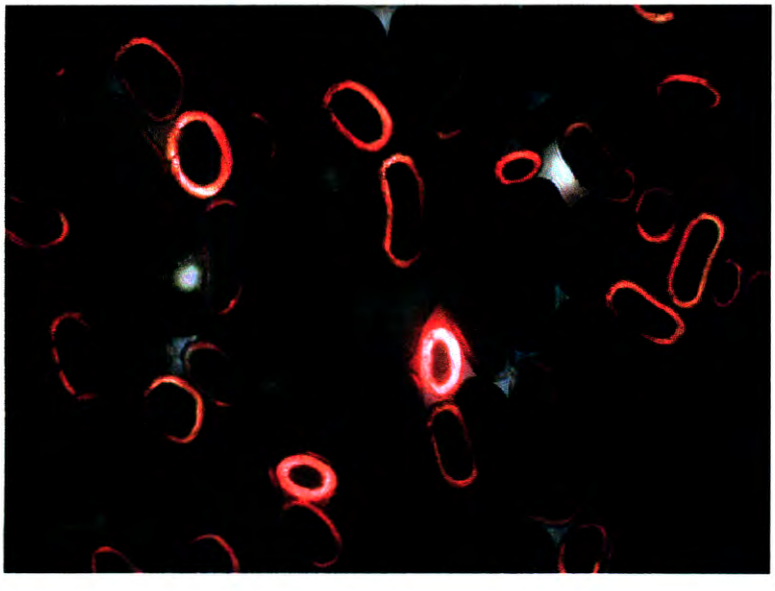


Figure 5.13 Light microscopic photograph of a cross-section of the hair of the southern reedbuck (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the southern reedbuck are presented in Figure 5.14. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

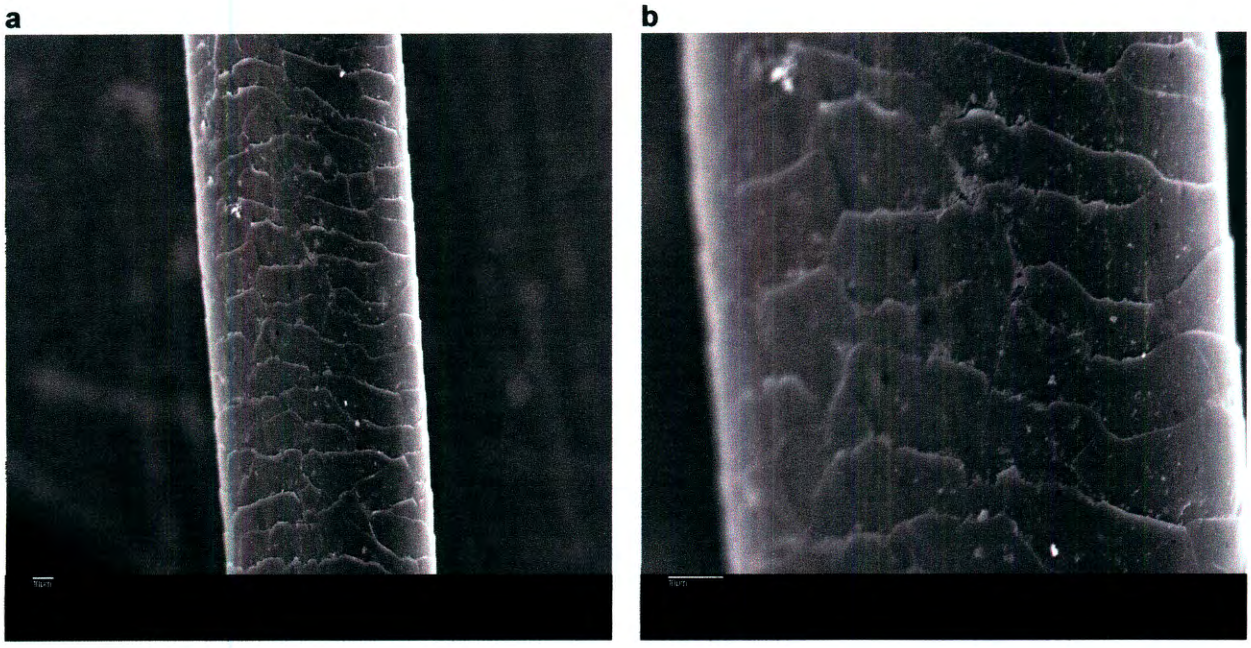


Figure 5.14 Electron microscopic photographs of the cuticular scale pattern of the hair of the southern reedbuck (a = 400x, b = 900x).

5.1.8 Klipspringer (*Oreotragus oreotragus*)

A light microscopic photograph of a cross-section of the hair of the klipspringer is presented in Figure 5.15. *Cross-section*: The hollow hair are easily distorted when sections are cut. The medulla are large and appear spongy, while the cortex appear narrow and soft. The cortex show yellowish brown pigmentation. The hair are concavo-convex, some with distorted circles.

Electron microscopic photographs of the cuticular scale pattern of the hair of the klipspringer are presented in Figure 5.16. *Cuticular scale pattern*: A regular mosaic pattern in the mid-shaft region is visible with seven to eight scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

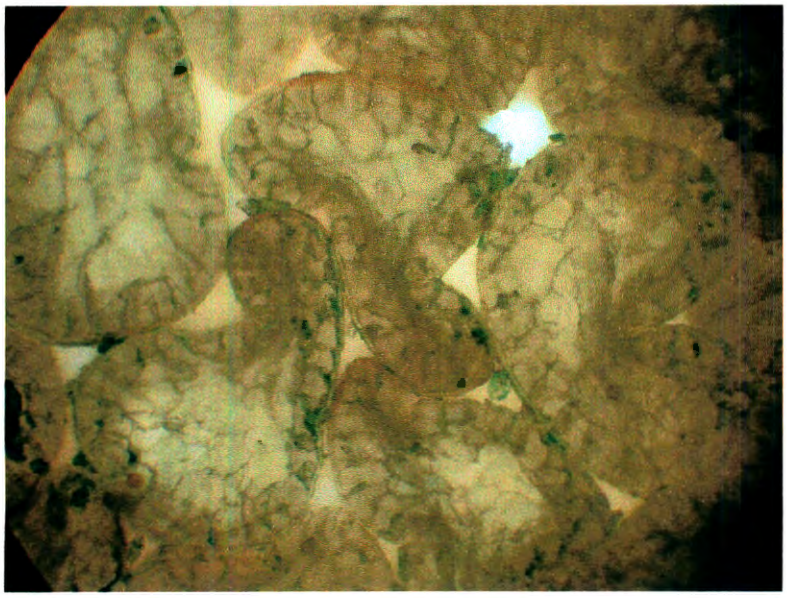


Figure 5.15 Light microscopic photograph of a cross-section of the hair of the klipspringer (100x).

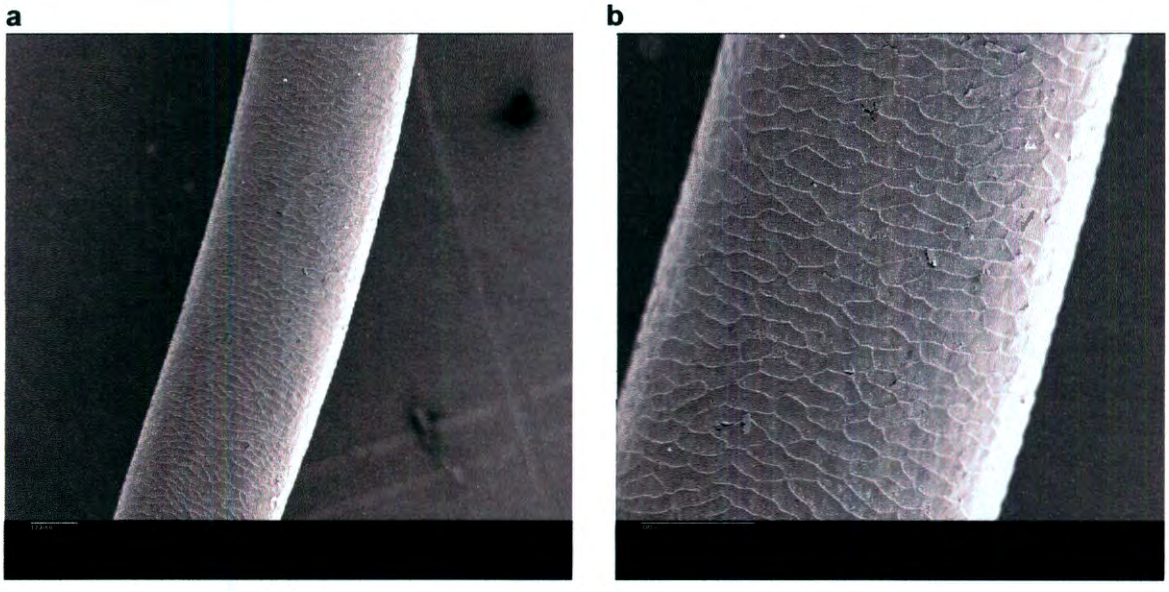


Figure 5.16 Electron microscopic photographs of the cuticular scale pattern of the hair of the klipspringer (a = 250x, b = 250x).

5.1.9 Common duiker (*Sylvicapra grimmia)*

A light microscopic photograph of a cross-section of the hair of the common duiker is presented in Figure 5.17. *Cross-section*: The medium-sized medulla are oval to oblong, with a reddish cortex. Under fur hairs have small, circular medulla. White hairs are oval to oblong with a white cortex.

Figure 5.17 Light microscopic photograph of a cross-section of the hair of the common duiker (100x).

Electron microscopic photographs of a cuticular scale pattern of the hair of the common duiker are presented in Figure 5.18. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible with three scales across the width. *Scale margins*: Smooth to rippled in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

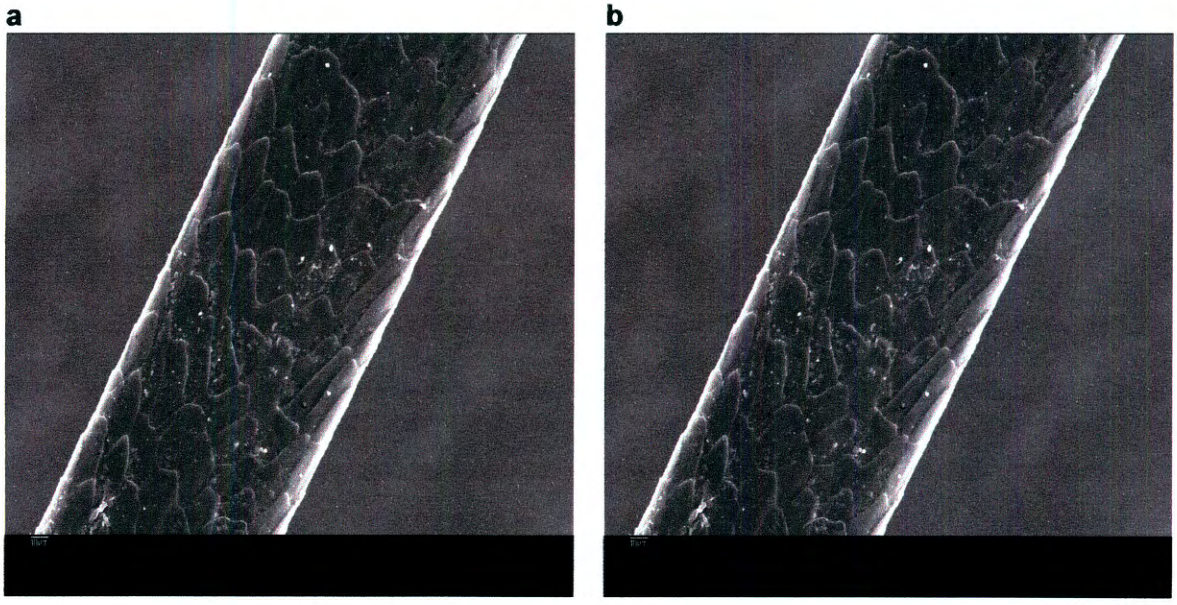


Figure 5.18 Electron microscopic photographs of the cuticular scale pattern of the hair of the common duiker (a = 400x, b = 1 200x).

5.1.10 Steenbok (*Raphicerus campestris)*

A light microscopic photograph of a cross-section of the hair of the steenbok is presented in Figure 5.19. *Cross-section*: The hair appear oval to slightly circular. The cortex are dark and difficult to see in black hairs, owing to heavy pigmentation. White hairs are oval with medium-sized medulla and white cortex.

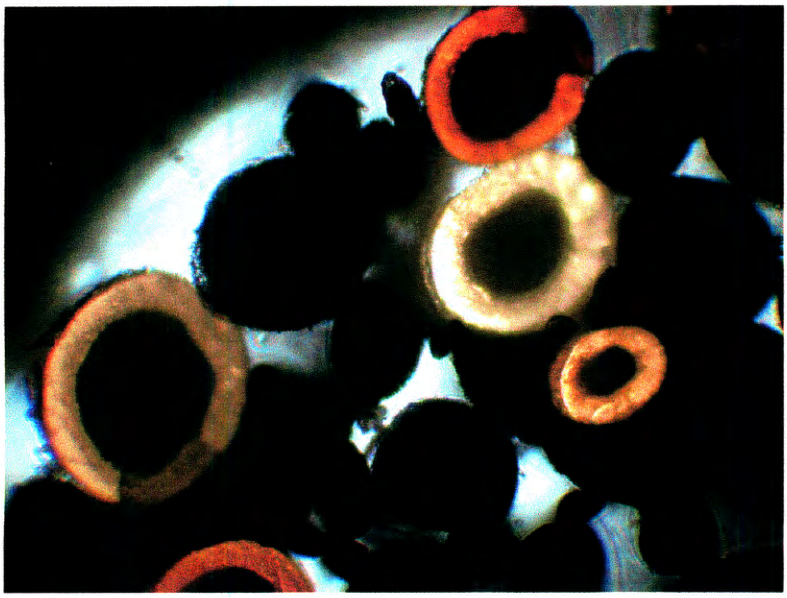


Figure 5.19 Light microscopic photograph of a cross-section of the hair of the steenbok (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the steenbok are presented in Figure 5.20. *Cuticular scale pattern*: A regular mosaic pattern in the mid-shaft region is visible, with two to four scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

5.1.11 Sharpe's grysbok (*Raphicerus sharpei)*

A light microscopic photographs of a cross-section of the hair of the Sharpe's grysbok are presented in Figure 5.21. *Cross-section*: The concavo-convex medulla are large and appear very dark, while the cortex appear reddish. White hairs are concavo-convex with medium-sized medulla and white cortex. Under fur hairs have small medulla with reddish cortex.

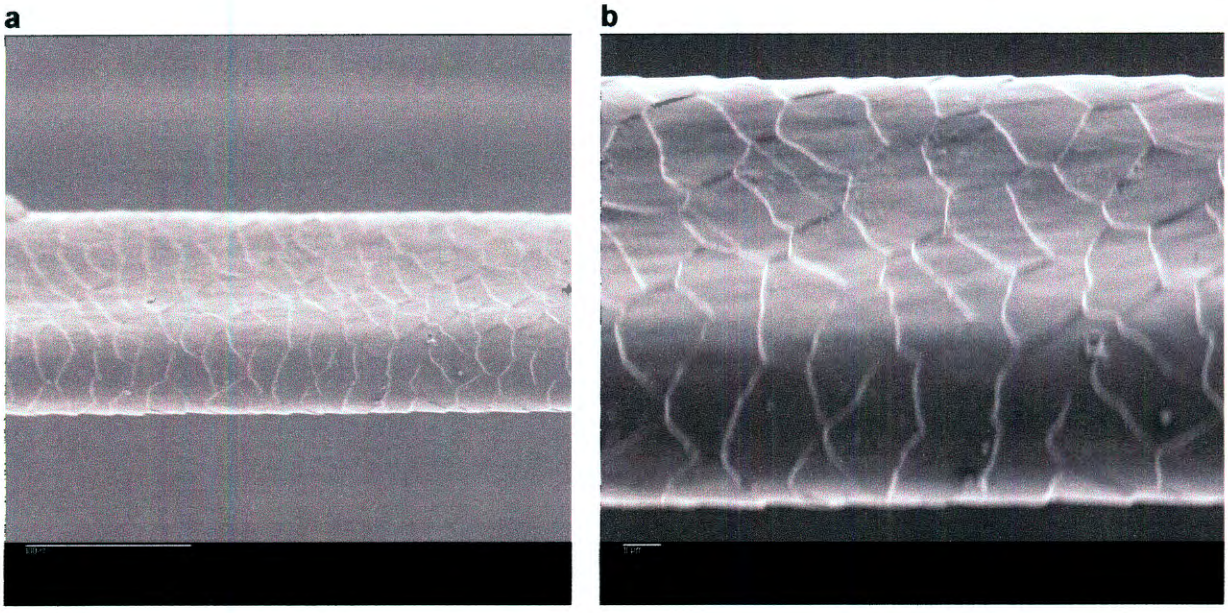


Figure 5.20 Electron microscopic photographs of the cuticular scale pattern of the hair of the steenbok (a = 350x, b = 750x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the Sharpe's grysbok are presented in Figure 5.22. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible, with two scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

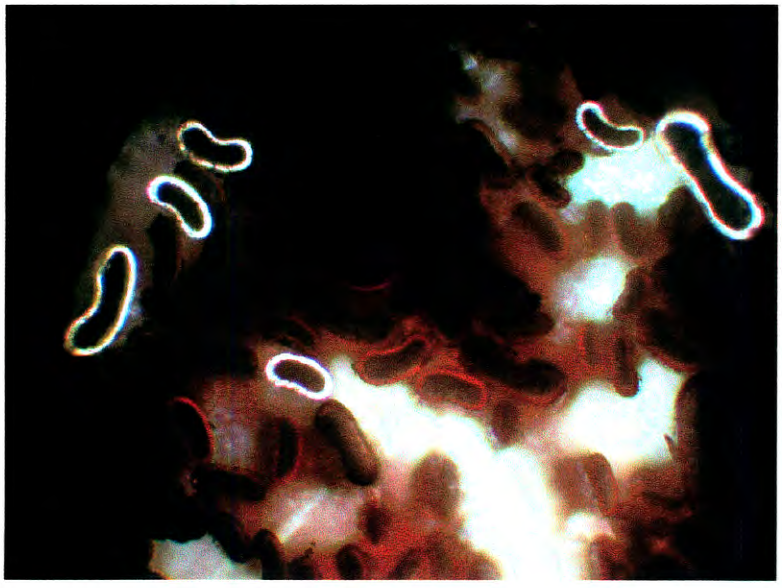


Figure 5.21 Light microscopic photograph of a cross-section of the hair of the Sharpe's grysbok (100x).

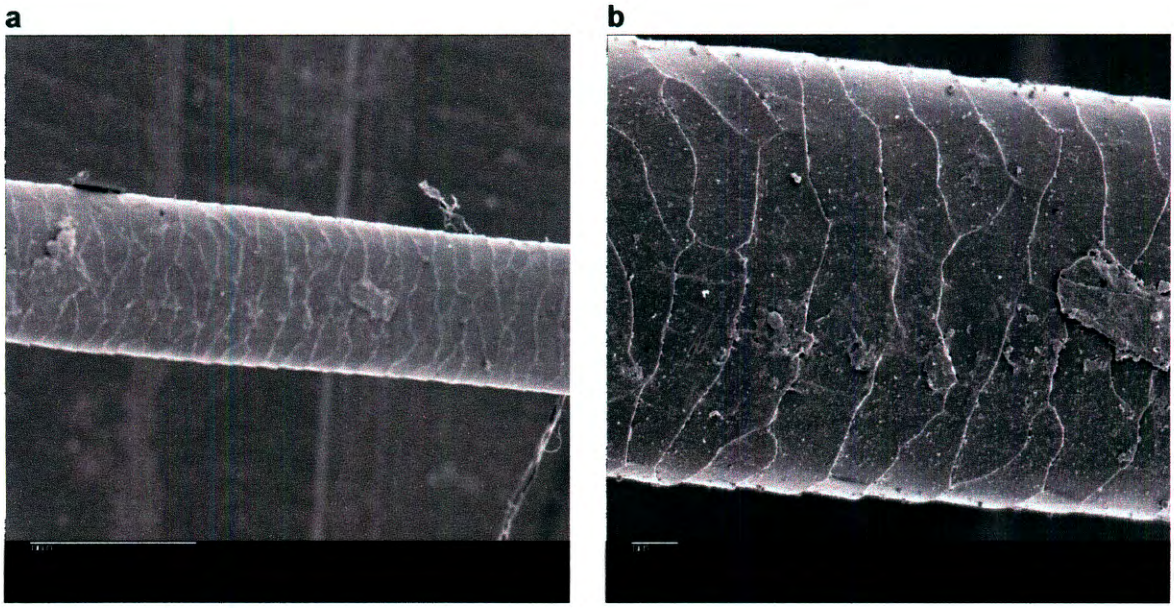


Figure 5.22 Electron microscopic photographs of the cuticular scale pattern of the hair of the Sharpe's grysbok (a = 350x, b = 1 000x).

5.1.12 Red duiker (*Cephalophus natalensis)*

A light microscopic photograph of a cross-section of the hair of the red duiker is presented in Figure 5.23. *Cross-section*: Hairs appear oval to oblong with medium-sized medulla. The cortex are mostly reddish, some yellow and a few white. Under fur hairs are oblong with smaller medulla with a white cortex. White hairs vary from oval to oblong with medium sized medulla and white cortex.

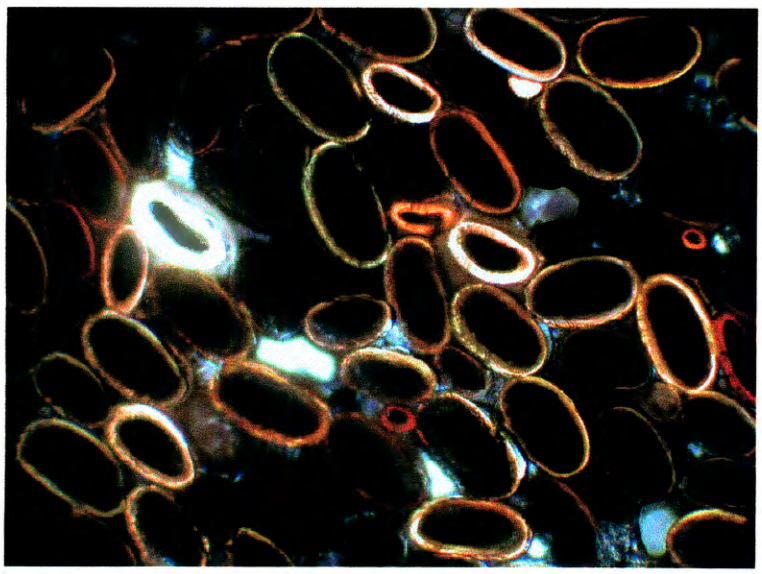


Figure 5.23 Light microscopic photograph of a cross-section of the hair of the red duiker (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the red duiker are presented in Figure 5.24. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

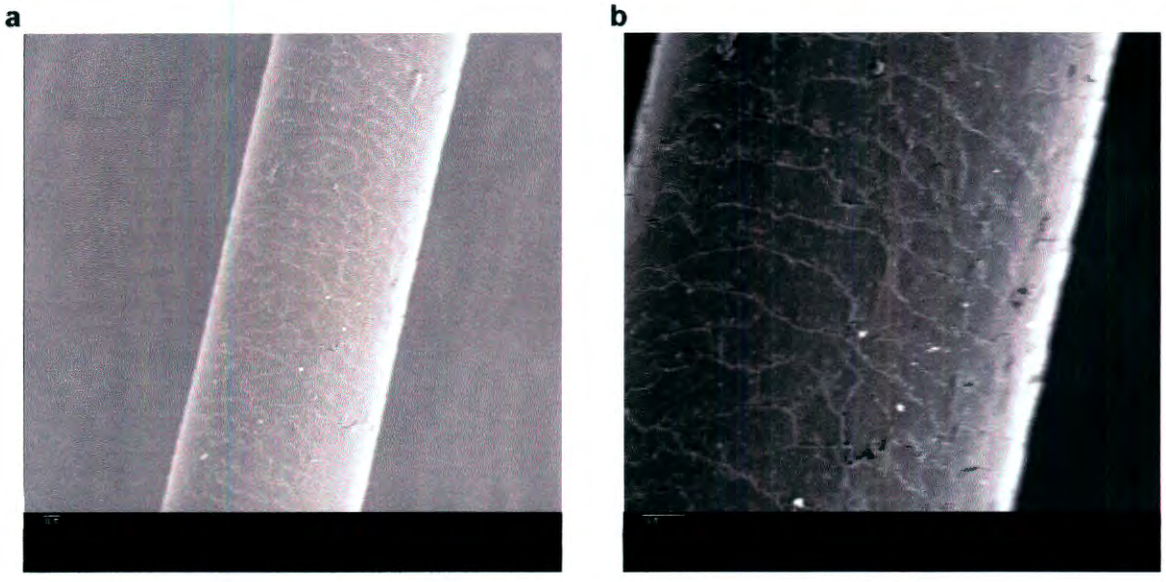


Figure 5.24 Electron microscopic photographs of the cuticular scale pattern of the hair of the red duiker (a = 400x, b = 950x).

5.1.13 Blue duiker (*Philantomba monticola*)

A light microscopic photograph of a cross-section of the hair of the blue duiker is presented in Figure 5.25. *Cross-section*: The hairs are concavo-convex, some oval with large medulla. The cortex appear light brown to reddish. Some darker hairs are heavily pigmented, which makes it very difficult to differentiate between the cortex and medulla.

Electron microscopic photographs of the cuticular scale pattern of the hair of the blue duiker are presented in Figure 5.26 *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft region is visible with two to five scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

Figure 5.25 Light microscopic photograph of a cross-section of the hair of the blue duiker (100x).

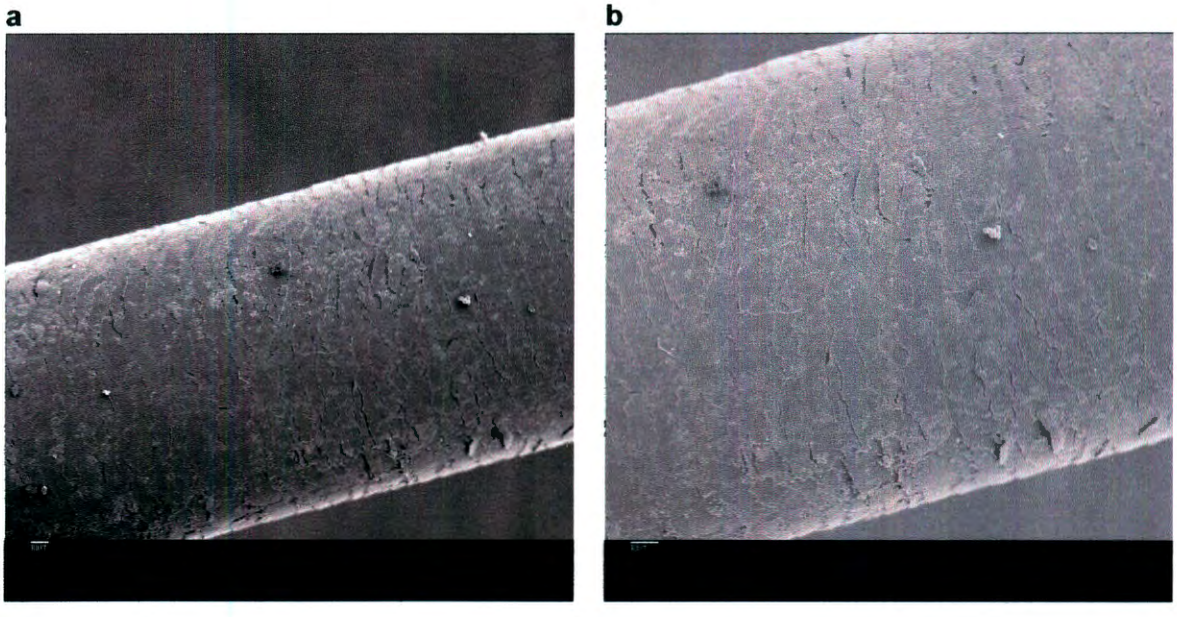


Figure 5.26 Electron microscopic photographs of the cuticular scale pattern of the hair of the blue duiker (a = 400x, b = 600x).

5.1.14 Suni (*Neotragus moschatus*)

A light microscopic photograph of a cross-section of the hair of the suni are presented in Figure 5.27. *Cross-section*: Hairs appear oblong to oval with medium to large medulla, the latter being black or dark-brown in colour. The cortex appear yellow orange. Under fur hairs are oval with small sized medulla and their cortex are yellowish orange. White

hairs have medium to large medulla with the cortex that are white.

Electron microscopic photographs of the cuticular scale pattern of the hair of the suni are presented in Figure 5.28. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible with one to two scales across the width. *Scale margins*: smooth in the mid-shaft region of the hairs. *Distance between the scales*: Closely spaced.

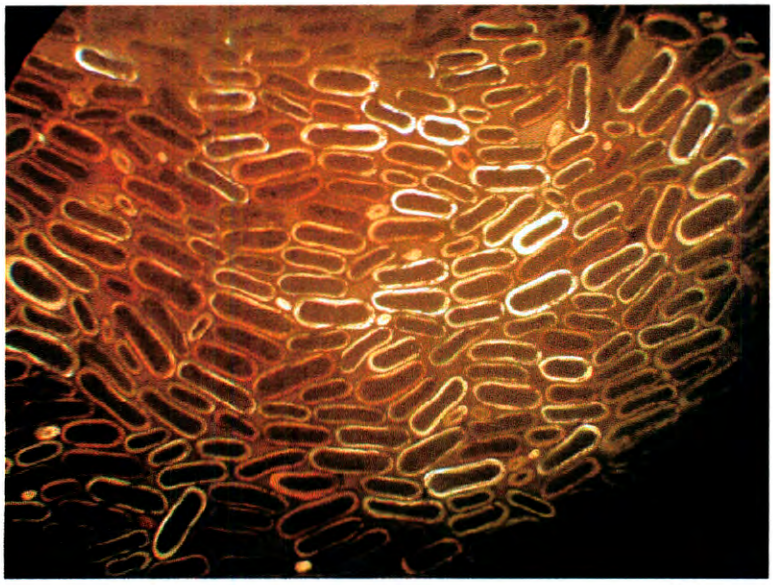


Figure 5.27 Light microscopic photograph of a cross-section of the hair of the suni (100x).

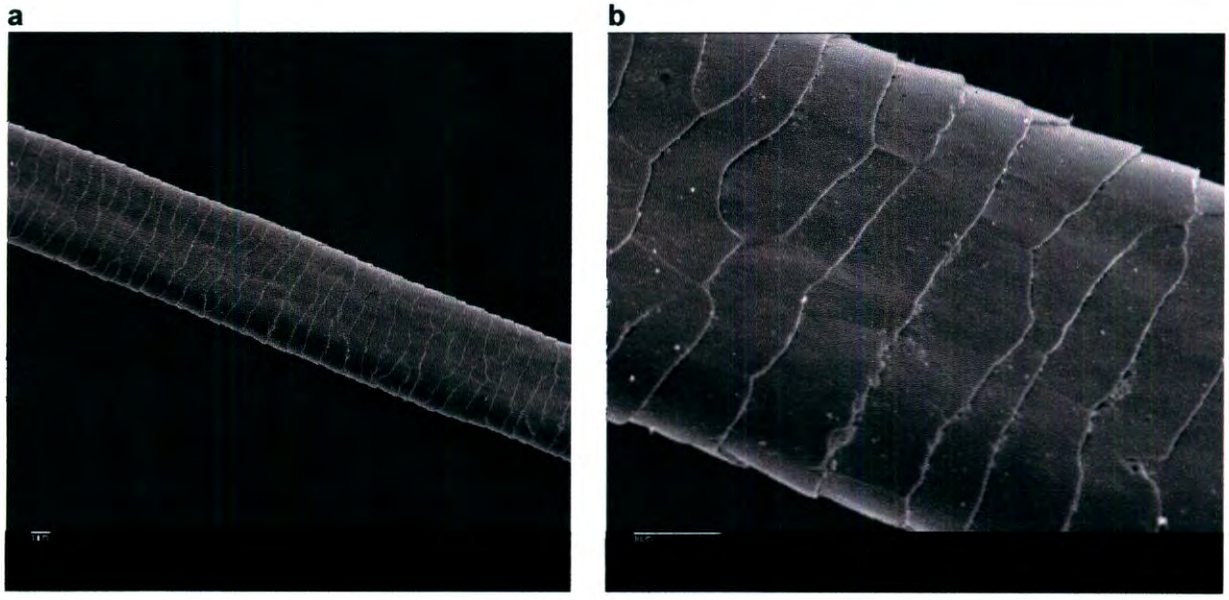


Figure 5.28 Electron microscopic photographs of the cuticular scale pattern of the hair of the suni (a = 650x, b = 1 700x).

5.1.15 Bushpig (*Potamochoerus larvantus)*

A light microscopic photographs of a cross-section of the hair of the bushpig are presented in Figure 5.29. *Cross-section*: Hairs appear round to oval with large medulla, which are dark in colour. The cortex is reddish brown to dark-brown. In some dark coloured hairs, it is difficult to distinguish the cortex and medulla. Owing to the thickness of the hair, ridges may be seen on the cortex as a result of uneven cutting.

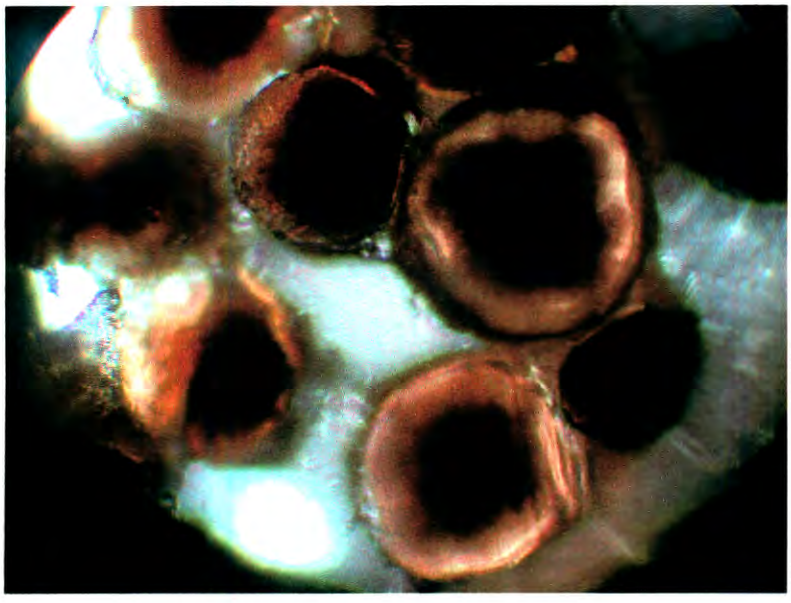


Figure 5.29 Light microscopic photograph of the cross-section of the hair of the bushpig (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the bushpig are presented in Figure 5.30. *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft region of the hair. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between the scales*: Almost touching

5.1.16 Common warthog (*Phacochoerus africanus)*

A light microscopic photograph of a cross-section of the hair of the common warthog is presented in Figure 5.31. *Cross-section:* Hairs appear round to oval with medium to large medulla, while the cortex appear yellowish and dark brown in some hairs.

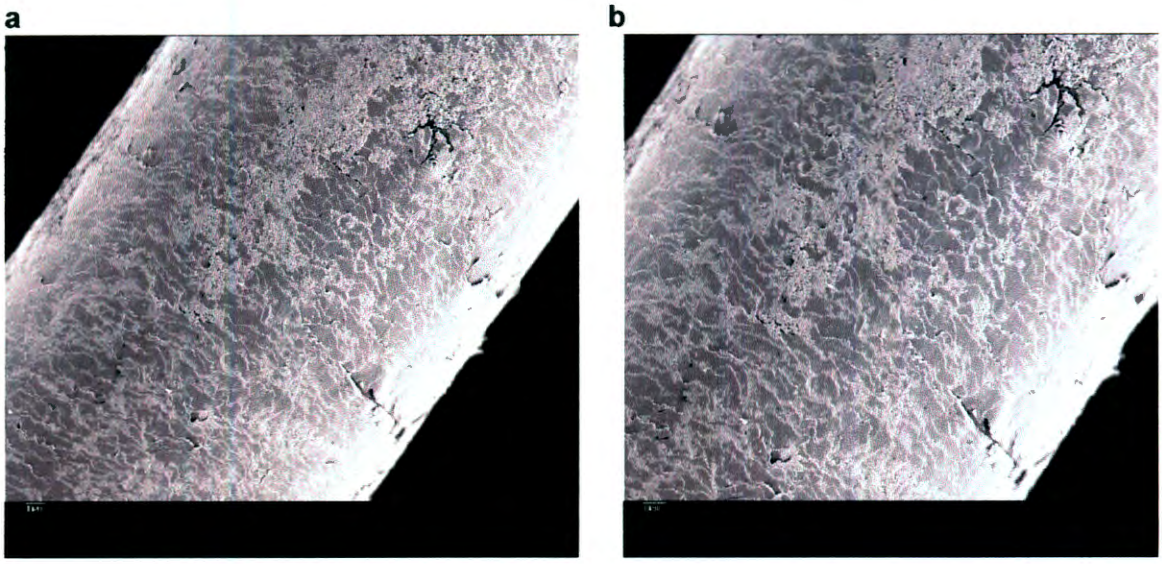


Figure 5.30 Electron microscopic photographs of the cuticular scale pattern of the hair of the bushpig (a = 430x, b = 550x).

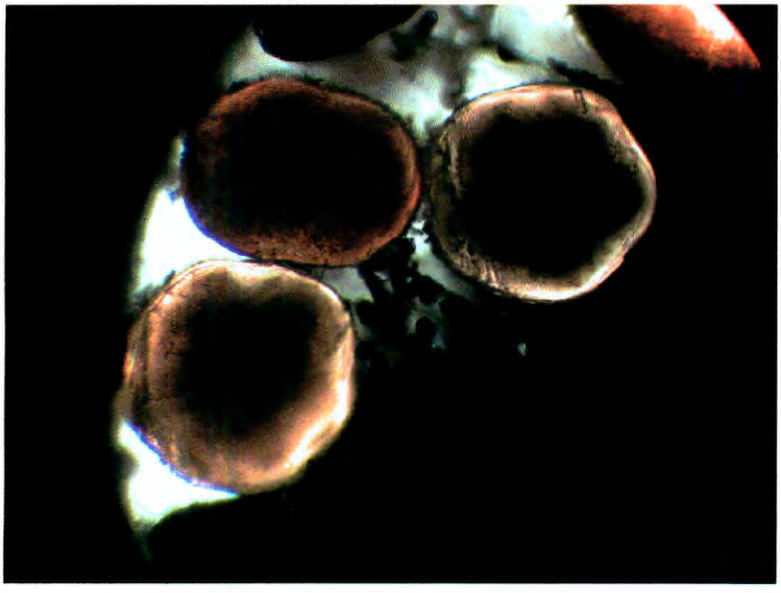


Figure 5.31 Light microscopic photograph of a cross-section of the hair of the common warthog (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the common warthog are presented in Figure 5.32. *Cuticular scale pattern*: Due to damage to the hair it was impossible to obtain proper scale imprints. However, the small scales show an irregular mosaic pattern.

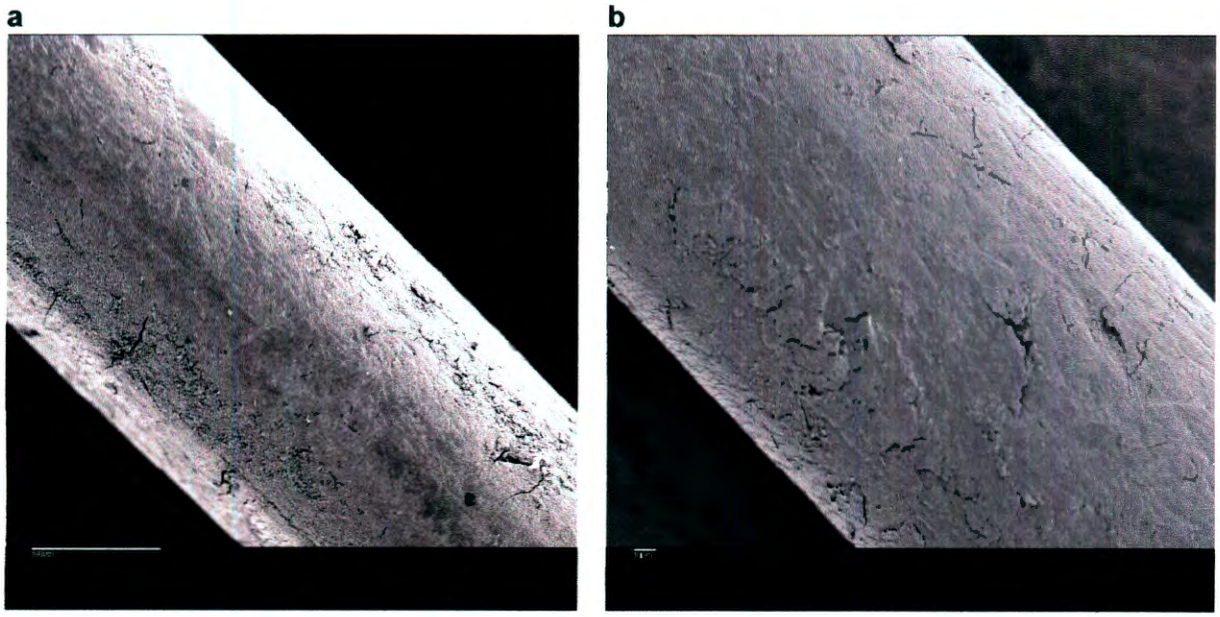


Figure 5.32 Electron microscopic photographs of the cuticular scale pattern of the hair of the common warthog (a = 270x, b = 430x).

5.1.17 Rock dormouse (*Graphiurus platyops*)

A light microscopic photograph of a cross-section of the hair of the rock dormouse is presented in Figure 5.33. *Cross-section*: Hairs appear oval with small medulla. The cortex appears reddish in colour. Under fur hairs are circular with small medulla.

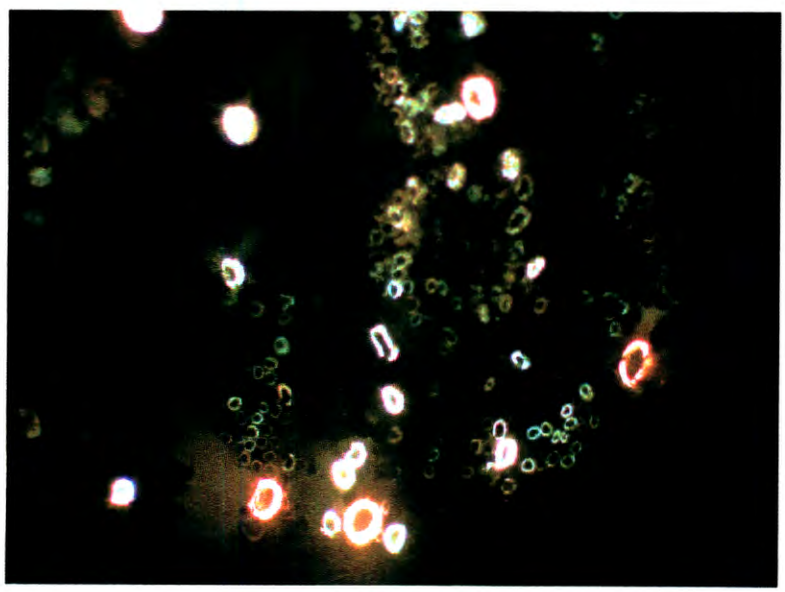


Figure 5.33 Light microscopic photograph of a cross-section of the hair of the rock dormouse (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the rock dormouse are presented in Figure 5.34. *Cuticular scale pattern*: Petal patterns in the mid-shaft region are visible with two to four scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

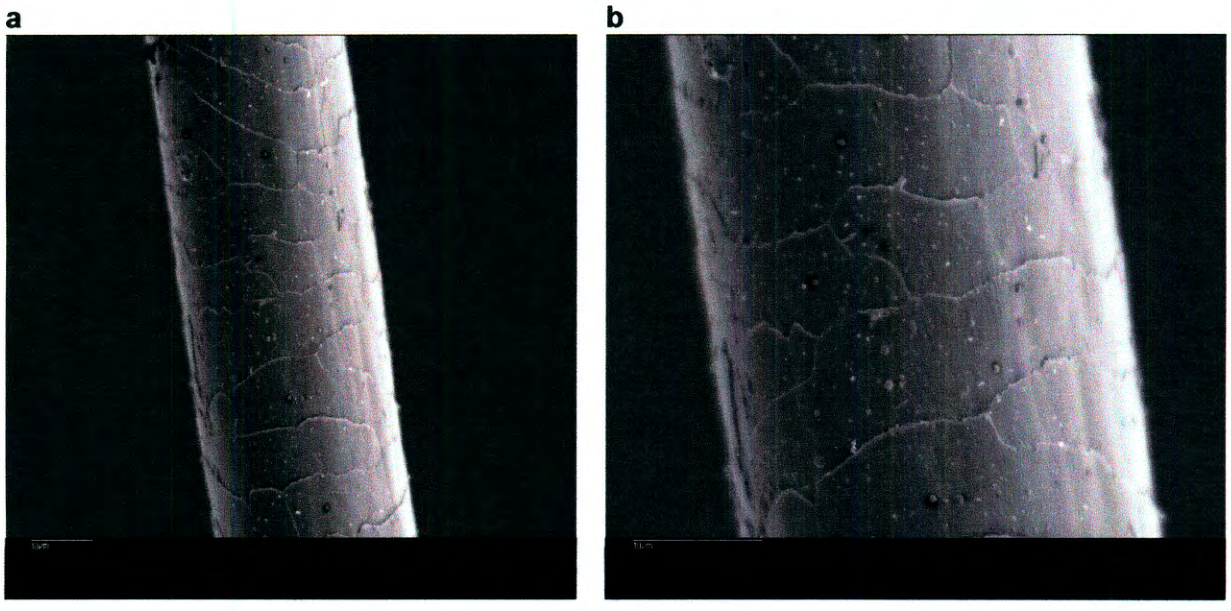


Figure 5.34 Electron microscopic photographs of the cuticular scale pattern of the hair of the rock dormouse (a = 1 300x, b = 2 500x).

5.1.18 Rock hyrax (*Procavia capensis*)

A light microscopic photograph of a cross-section of the hair of the rock hyrax is presented in Figure 5.35. *Cross-section*: The hairs appear oval with medium-sized medulla and the cortex light brown. Under fur hairs have a unique tripartite shape and very small medulla with big cortex that appear white to reddish.

Electron microscopic photographs of the cuticular scale pattern of the hair of the rock hyrax are presented in Figure 5.36. *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

Figure 5.35 Light microscopic photograph of the cross-section of the hair of the rock hyrax (100x).

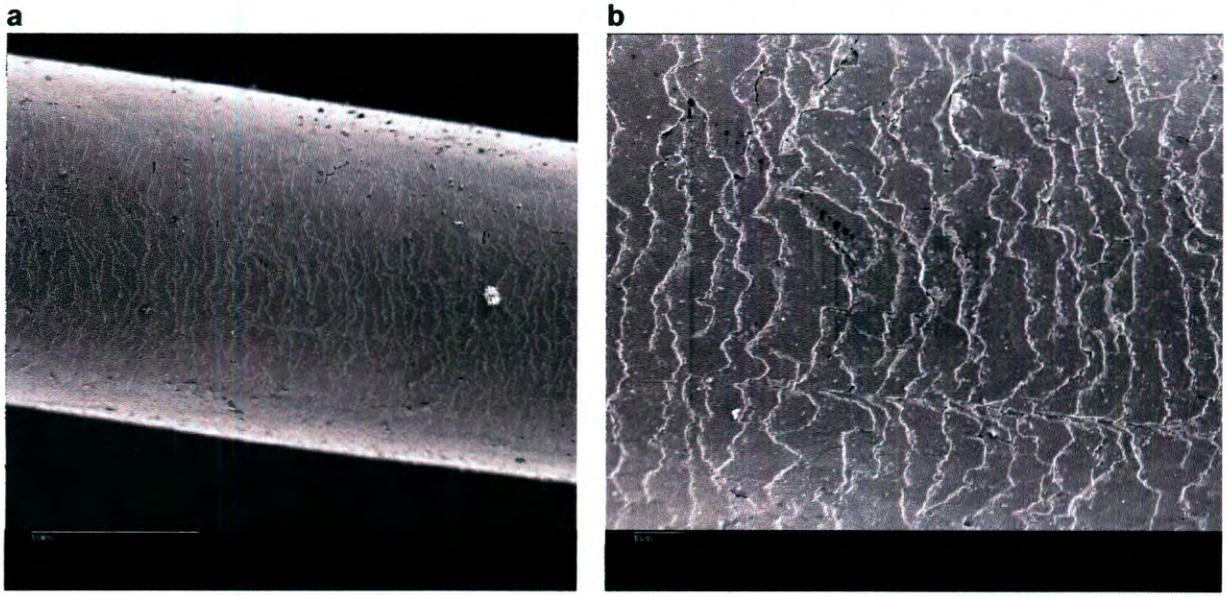


Figure 5.36 Electron microscopic photographs of the cuticular scale pattern of the hair of the rock hyrax (a = 350x, b = 1 000x).

5.1.19 Springhare *(Pedetes capensis)*

A light microscopic photograph of a cross-section of the hair of the springhare is presented in Figure 5.37. *Cross-section*: Hairs appear round to oval with medium-sized medulla in both dark and light coloured hair. The cortex are reddish in darker hairs and pale yellowish in white hairs. The medulla of all hairs appear black

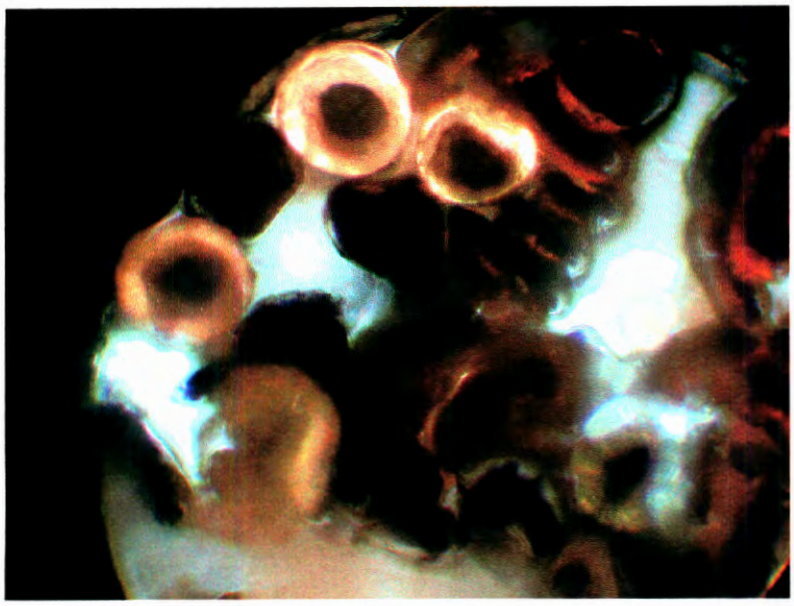


Figure 5.37 Light microscopic photograph of a cross-section of the hair of the springhare (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the springhare are presented in Figure 5.38. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Almost touching.

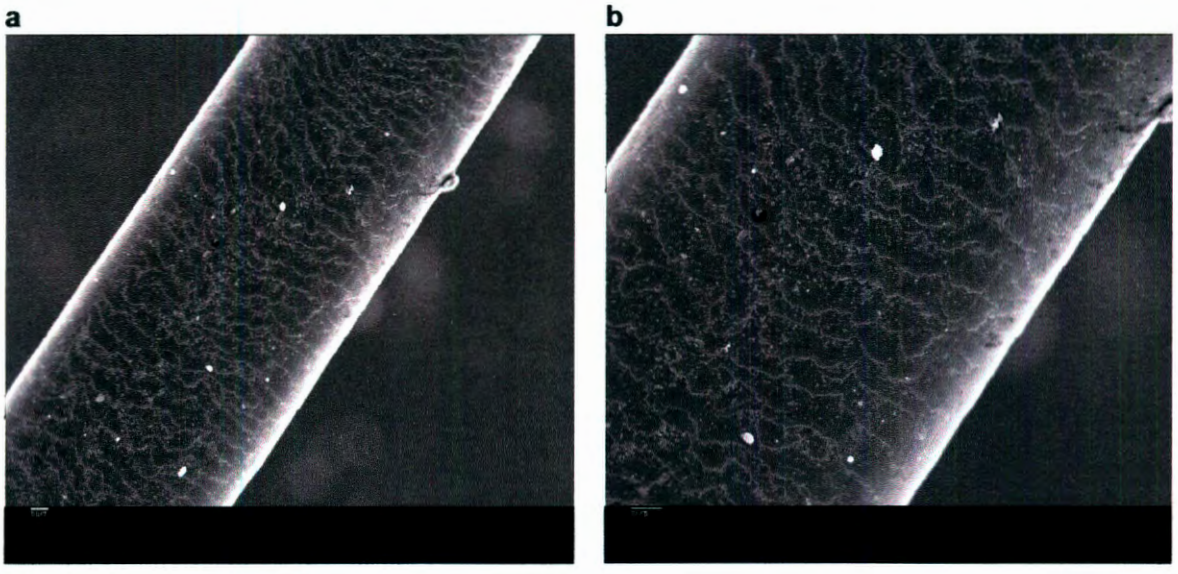


Figure 5.38 Electron microscopic photographs of the cuticular scale pattern of the hair of the springhare (a = 400x, b = 900x).

5.1.20 Scrub hare *(Lepus saxatilis)*

A light microscopic photograph of a cross-section of the hair of the scrub hare is presented in Figure 5.39. *Cross-section*: Hairs are oval with medium-sized medulla, which appear dark, while the cortex appear white. Under fur hairs have very small medulla with a yellowish cortex.

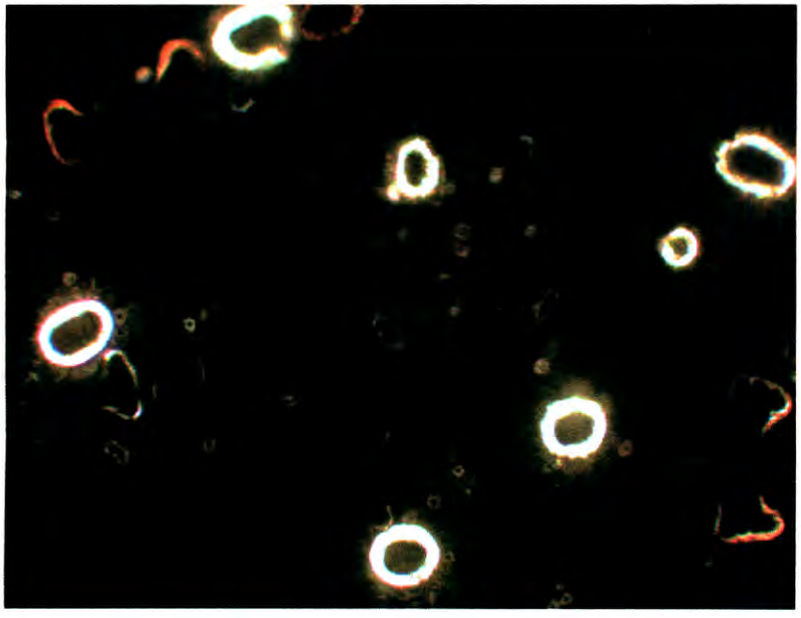


Figure 5.39 Light microscopic photograph of a cross-section of the hair of the scrub hare (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the scrub hare are presented in Figure 5.40. *Cuticular scale pattern*: A chevron-like, single pattern is visible in the mid-shaft region with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between scales:* Closely spaced.

5.1.21 South African ground squirrel (*Xerus inauris)*

A light microscopic photograph of a cross-section of the hair of the South African ground squirrel is presented in Figure 5.41. *Cross-section:* The large to medium-sized medulla are dumb-bell shaped and appear very dark, while the cortex appear pale yellowish.

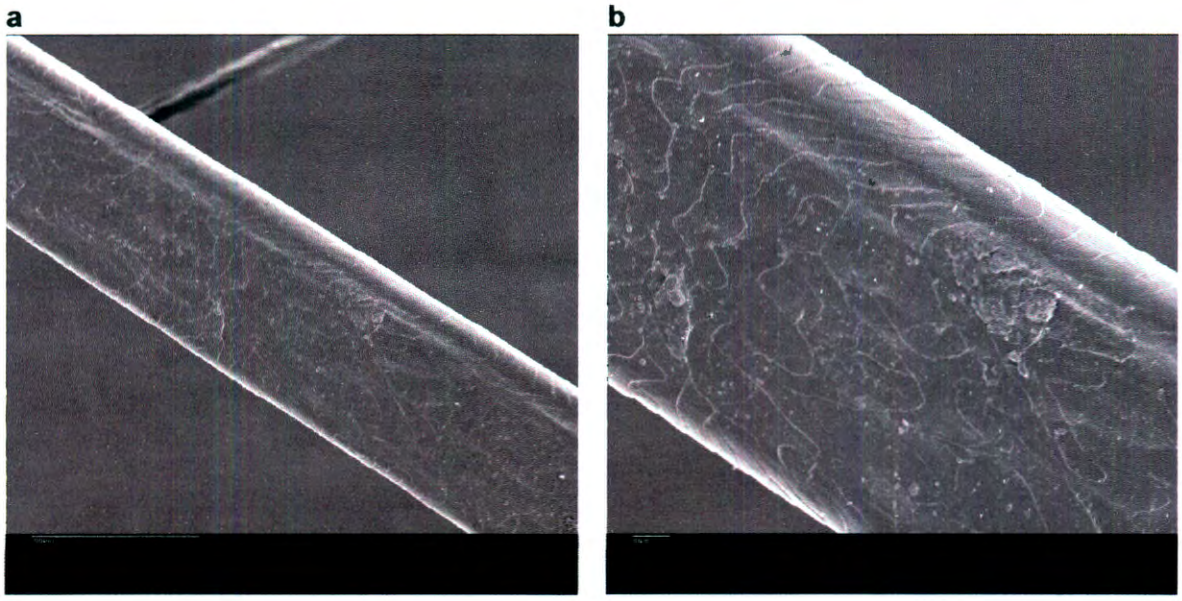


Figure 5.40 Electron microscopic photographs of the cuticular scale patterns of the hair of the scrub hare (a = 500x, b = 1 500x).

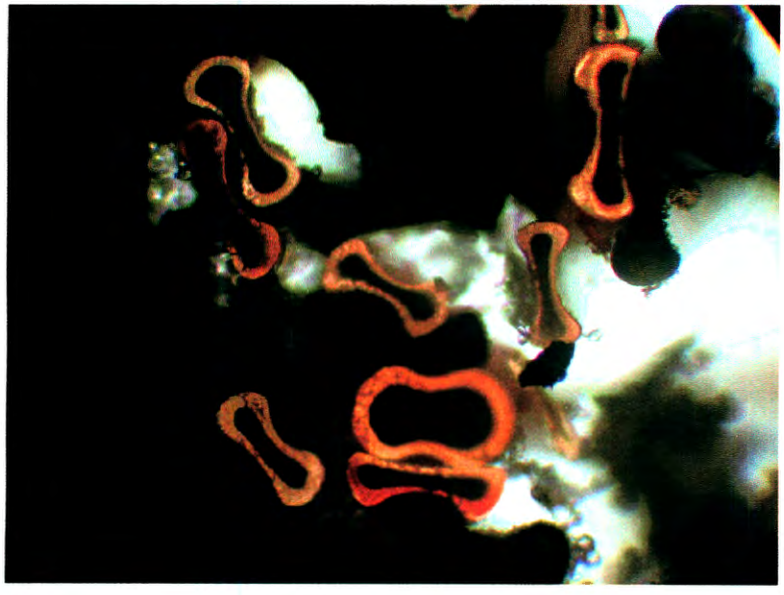


Figure 5.41 Light microscopic photograph of a cross-section of the hair of the South African ground squirrel (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the South African ground squirrel are presented in Figure 5.42. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

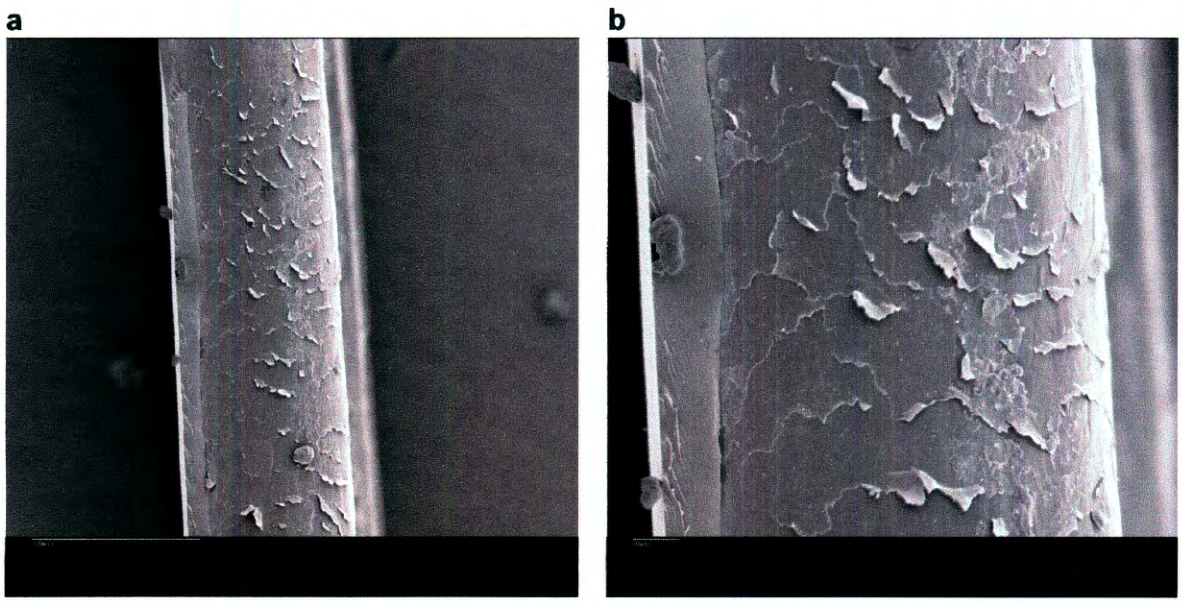


Figure 5.42 Electron microscopic photographs of the cuticular scale pattern of the hair of the South African ground squirrel (a = 100x, b = 230x).

5.1.22 Greater canerat (*Thryonomys swinderianus)*

A light microscopic photograph of a cross-section of the hair of the greater canerat is presented in Figure 5.43. *Cross-section*: Hairs appear oval with large, spongy medulla. They appear brownish to black in colour with a spongy, yellowish cortex.

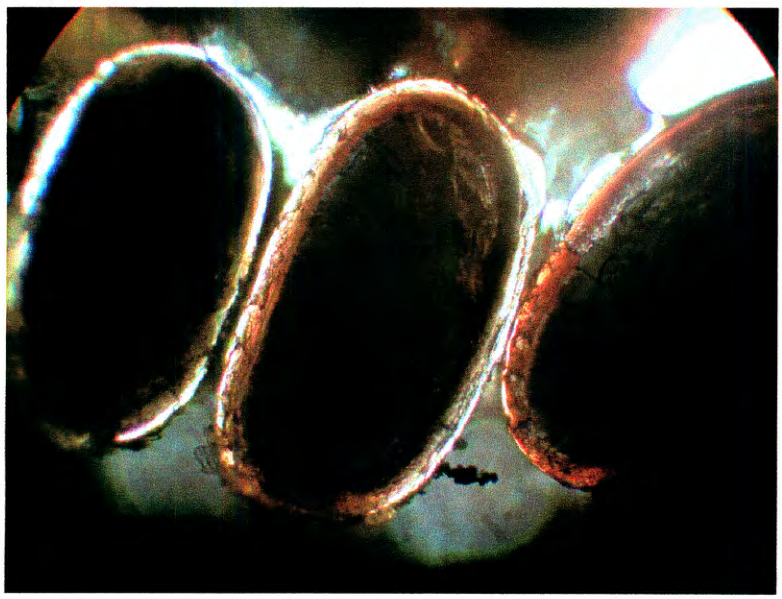


Figure 5.43 Light microscopic photograph of a cross-section of the hair of the greater canerat (100x).

Electron microscopic photograph of the cuticular scale patterns of the hair of the greater canerat are presented in Figure 5.44. *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft region is visible. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Almost touching.

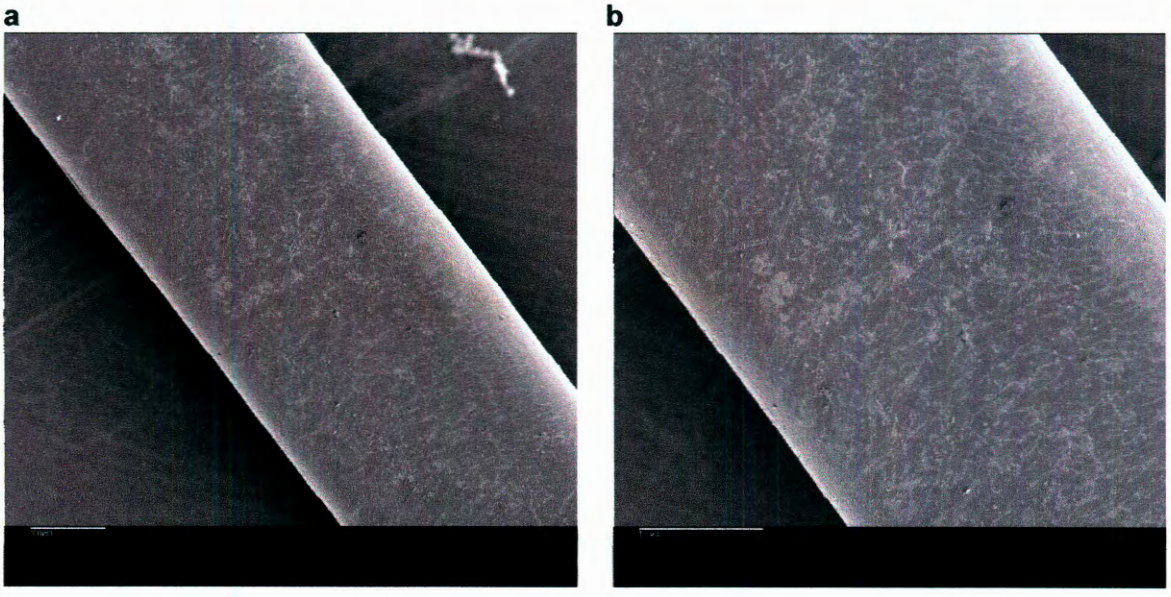


Figure 5.44 Electron microscopic photographs of the cuticular scale pattern of the hair of the greater canerat (a = 160x, b = 270x).

5.1.23 Gambian giant rat (*Cricetomys gambianus*)

A light microscopic photograph of a cross-section of the hair of the gambian giant rat is presented in Figure 5.45. *Cross-section*: Hairs appear oval, some oblong with medium–sized medulla and the cortex appear reddish in colour. White hairs are similar, but with a white cortex. Under fur hairs have small-sized medulla with a yellowish cortex.

Electron microscopic photographs of the cuticular scale pattern of the hair of the gambian giant rat is presented in Figure 5.46. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible with one to two scales across the width. *Scale margins*: Crenate (visible in figure 5.46b) in the mid-shaft region of the hair. *Distance between scales:* Closely spaced.

Figure 5.45 Light microscopic photograph of a cross-section of the hair of the Gambian giant rat (100x).

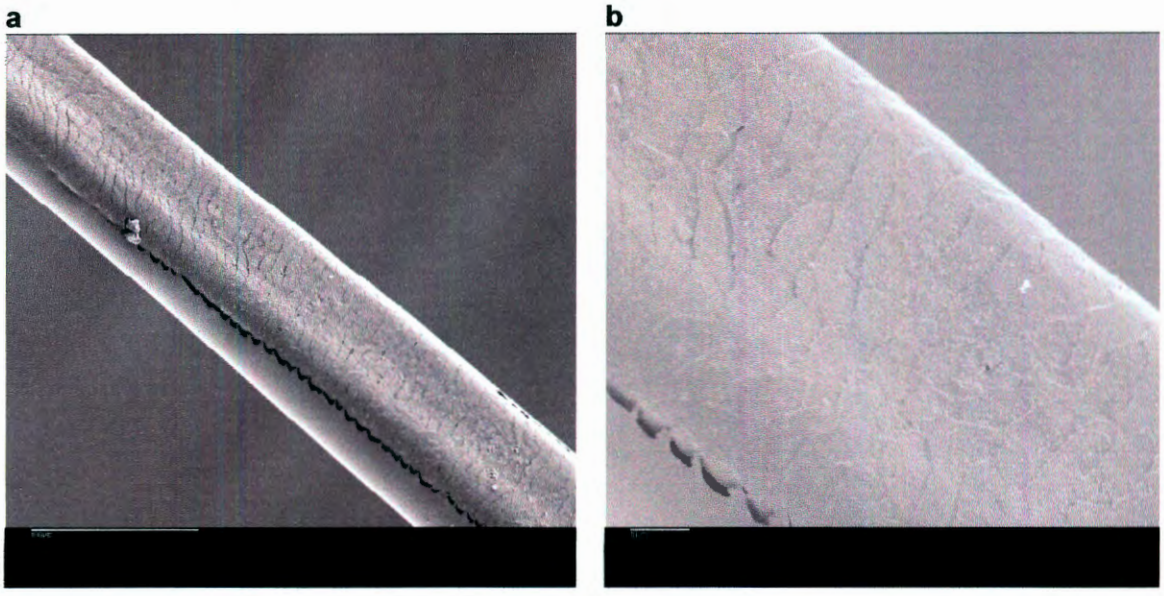


Figure 5.46 Electron microscopic photographs of the cuticular scale patterns of the hair of the Gambian giant rat (a = 350x, b =1 300x).

5.1.24 Red veld rat *(Aethomys chrysophilus)*

A light microscopic photograph of a cross-section of the hair of the red veld rat is presented in Figure 5.47. *Cross-section*: Hairs are concavo-convex shaped with pigments concentrated on edges. The medulla is large and the cortex appears reddish. White hairs have large medulla with a white cortex. Under fur hair have small medulla with a yellowish cortex.

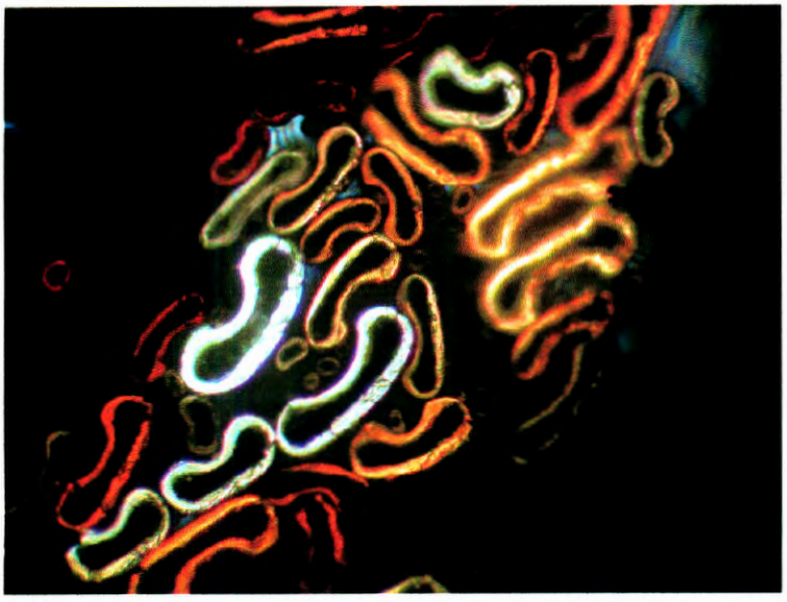


Figure 5.47 Light microscopic photograph of a cross-section of the hair of the red veld rat (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the red veld rat are presented in Figure 5.48. *Cuticular scale pattern*: A chevron shaped pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Widely spaced.

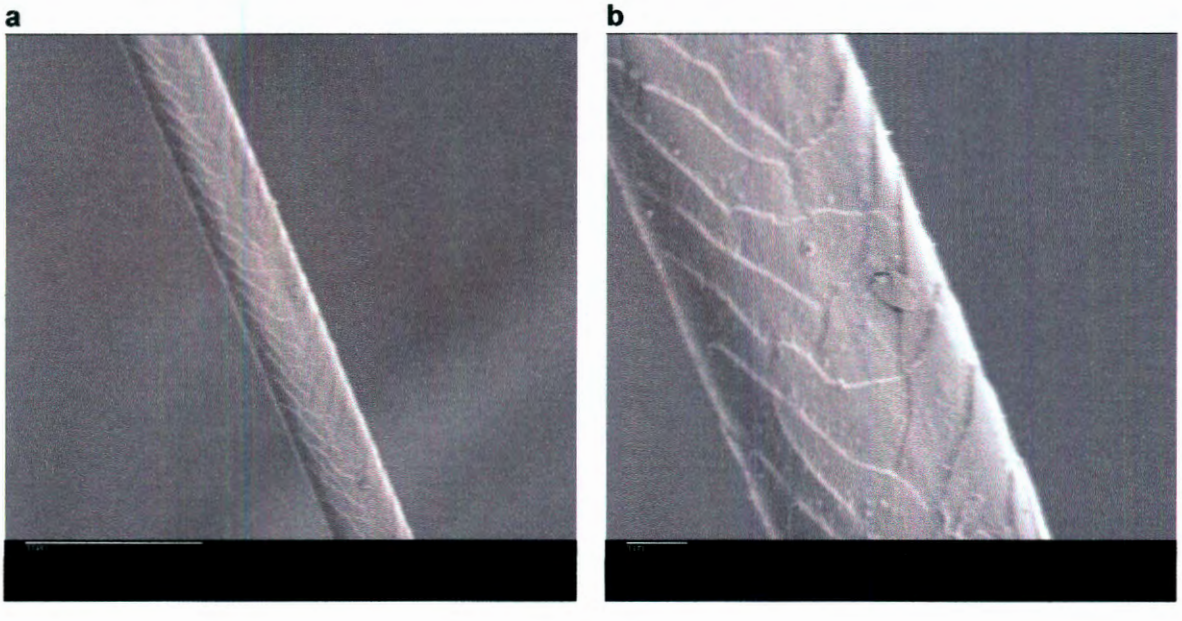


Figure 5.48 Electron microscopic photographs of the cuticular scale patterns of the hair of the red veld rat (a = 350x, b = 1 300x).

5.1.25 Bushveld gerbil (*Tatera leucogaster)*

A light microscopic photograph of a cross-section of the hair of the Bushveld gerbil is presented in Figure 5.49. *Cross-section*: Hairs are oblong with medium-sized medulla. The medulla are dark and the cortex appear reddish. White hairs have very small medulla and a large white cortex. Under fur hairs have small medulla and white cortex.

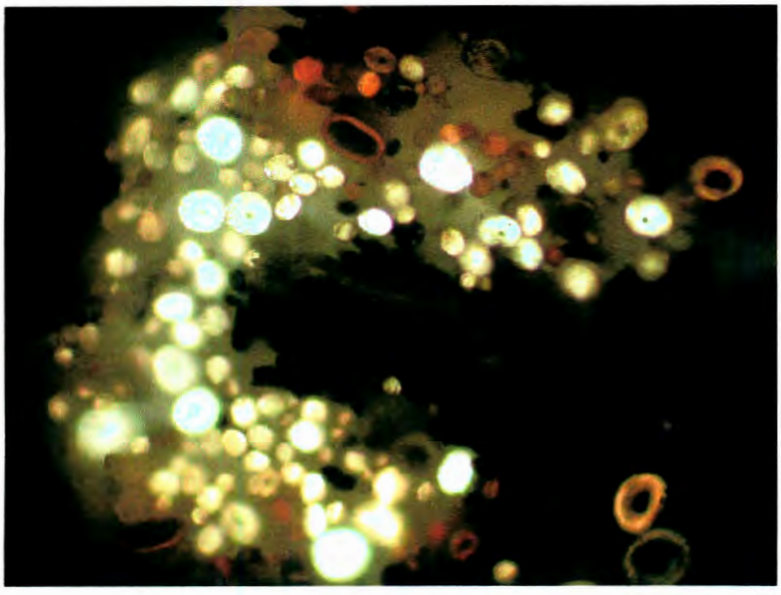


Figure 5.49 Light microscopic photograph of a cross-section of the hair of the bushveld gerbil (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the Bushveld gerbil is presented in Figure 5.50. *Cuticular scale pattern*: A regular, waved mosaic pattern in the mid-shaft region is visible, with two scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

5.1.26 Woodland thicket rat (*Grammomys murianus))*

A light microscopic photograph of a cross-section of the hair of the woodland thicket rat is presented in Figure 5.51. *Cross-section*: Hairs have a concavo-convex shape with large medulla, while the cortex appear pale yellowish. Under fur hairs have small circular medulla and the cortex are pale yellowish in colour. Lighter hairs can be either circular or concavo-convex shaped with a white cortex.

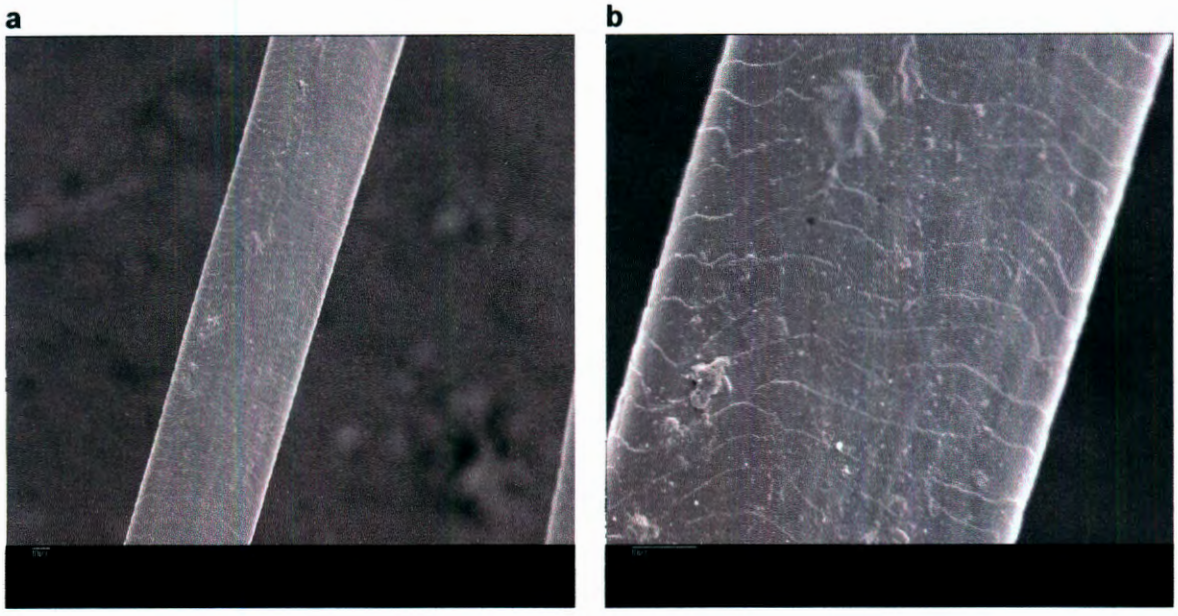


Figure 5.50 Electron microscopic photographs of the hair cuticular scale patterns of the hair of the bushveld gerbil (a = 400, b = 500x).

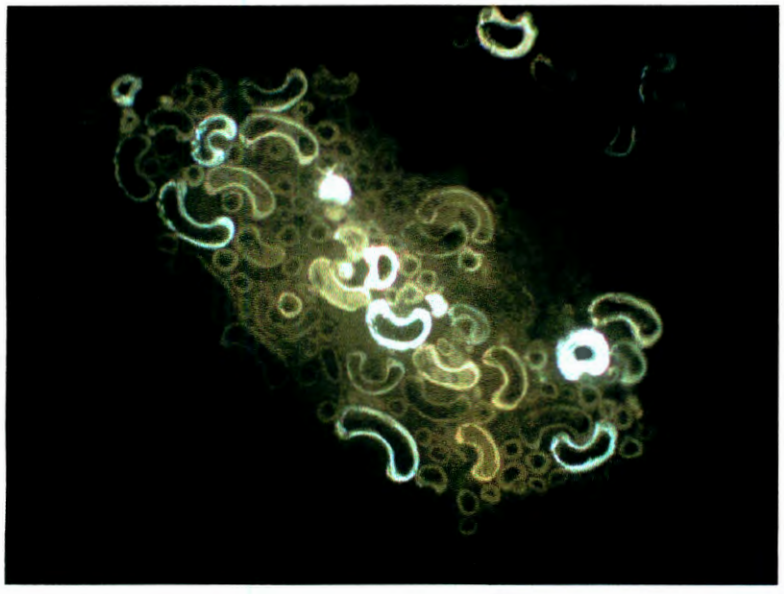


Figure 5.51 Light microscopic photograph of a cross-section of the hair of the woodland thicket rat (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the woodland thicket rat are presented in Figure 5.52. *Cuticular scale pattern*: A chevron shape pattern in the mid-shaft region is visible, with two scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Widely spaced.

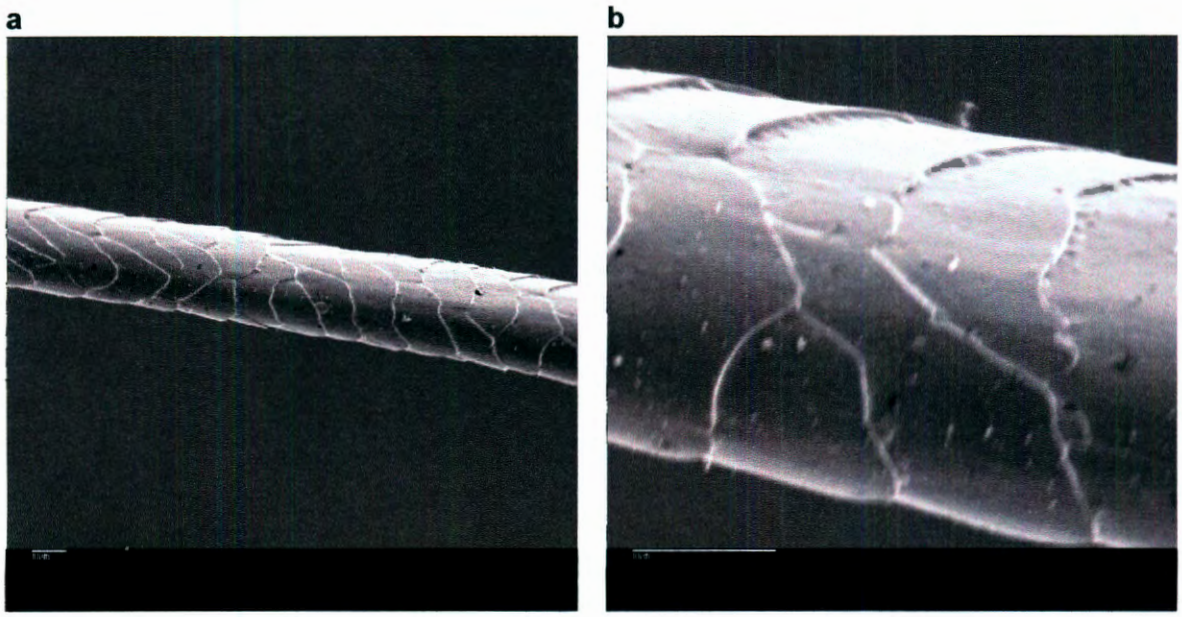


Figure 5.52 Electron microscopic photographs of the cuticular scale patterns of the hair of the woodland thicket rat (a = 750x, b = 3 000x).

5.1.27 Mozambique thicket rat (*Grammomys cometes*)

A light microscopic photograph of a cross-section of the hair of the Mozambique thicket rat is presented in Figure 5.53. *Cross-section*: Hairs are concavo-convex shaped, but some are oval with small medulla. The medulla appear dark in colour while the cortex appear yellowish. White hairs have smaller, circular medulla with a white cortex.

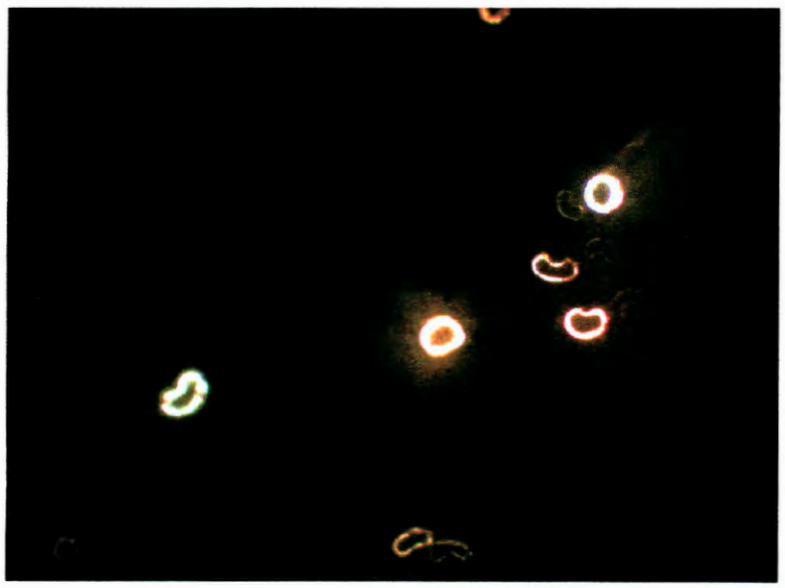


Figure 5.53 Light microscopic photograph of a cross-section of the hair of the Mozambique thicket rat (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the Mozambique thicket rat are presented in Figure 5.54. *Cuticular scale pattern*: Unique, pectinate pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Widely spaced.

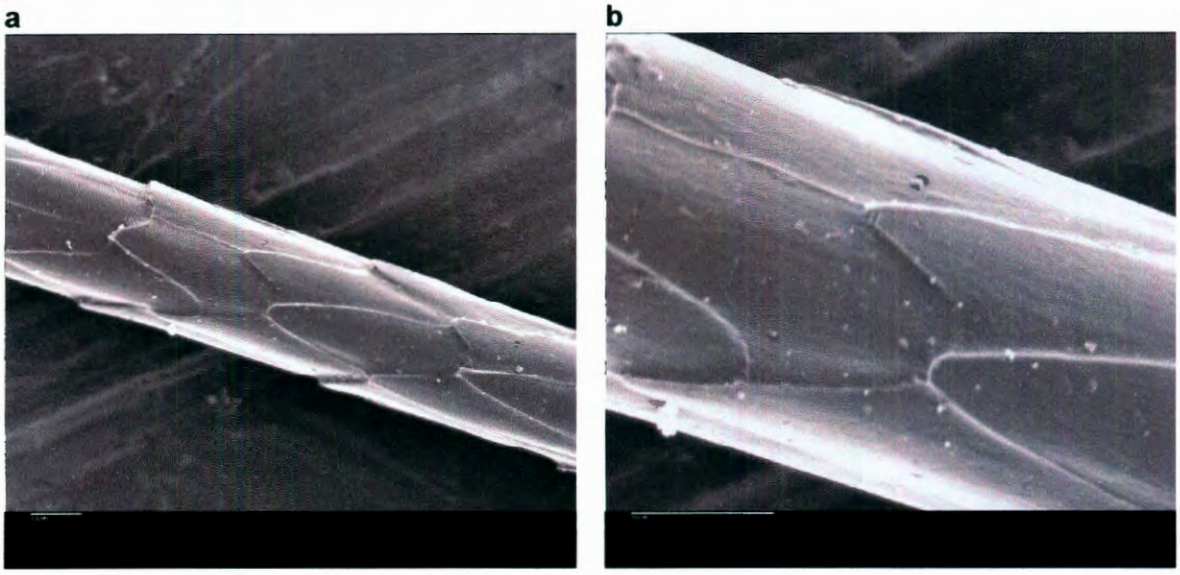


Figure 5.54 Electron microscopic photographs of the cuticular scale patterns of the hair of the Mozambique thicket rat (a = 1 100x, b = 3 000x).

5.1.28 Four-striped grass mouse (*Rhabdomys pumilio*)

A light microscopic photograph of a cross-section of the hair of the four striped grass mouse is presented in Figure 5.55. *Cross-section*: Hairs are oval, some oblong, with medium-sized medulla. The cortex are difficult to see in black hairs and appear uniformly black, owing to heavy pigmentation. White hairs have a white cortex, while under fur hairs are oval, circular, with smaller medulla and a reddish cortex.

Electron microscopic photographs of the cuticular scale pattern of the hair of the four striped grass mouse is presented in Figure 5.56. *Cuticular scale pattern*: An irregular mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Widely spaced.

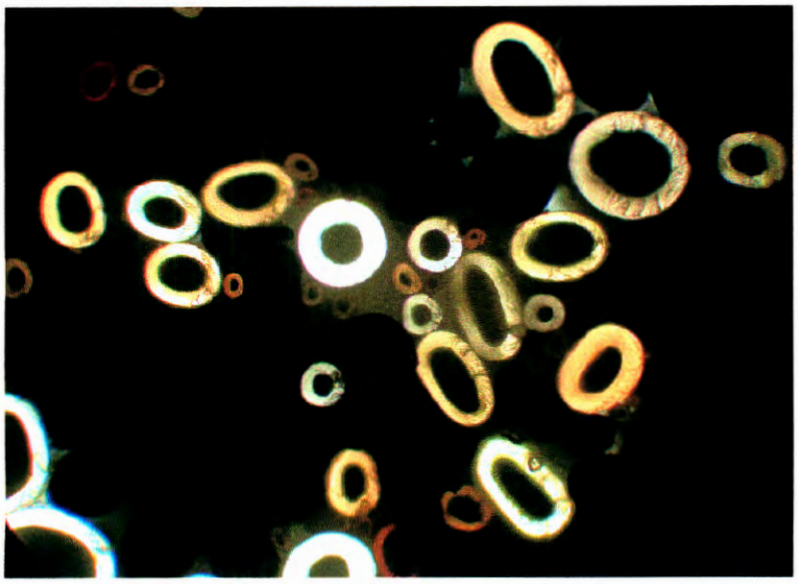


Figure 5.55 Light microscopic photograph of the cross-section of the hair of the four striped grass mouse (100x).

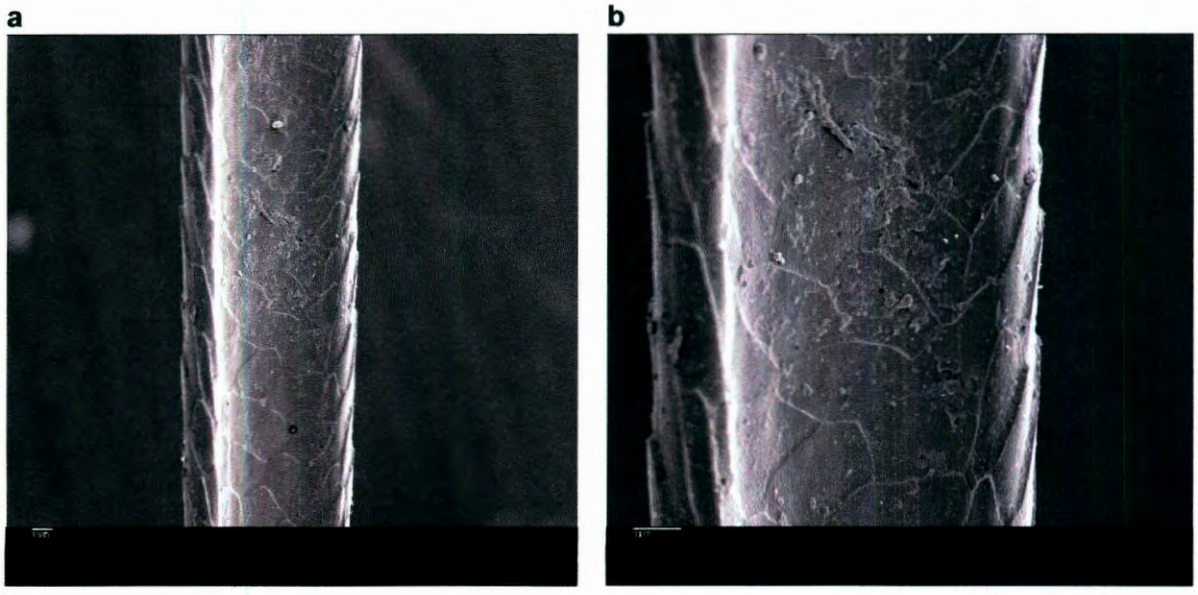


Figure 5.56 Electron microscopic photographs of the cuticular scale pattern of the hair of the four striped grass mouse (a = 450x, b =1 000x).

5.1.29 Sykes' monkey (*Cercopithecus albogularis)*

A light microscopic photograph of a cross-section of the hair of the Sykes' monkey is presented in Figure 5.75 *Cross-section*: Hairs appear oval, some oblong with medium-sized medulla. The cortex appear yellowish, while white hairs have very small medulla with a large white cortex. Under fur hairs have small medulla with a small white cortex.

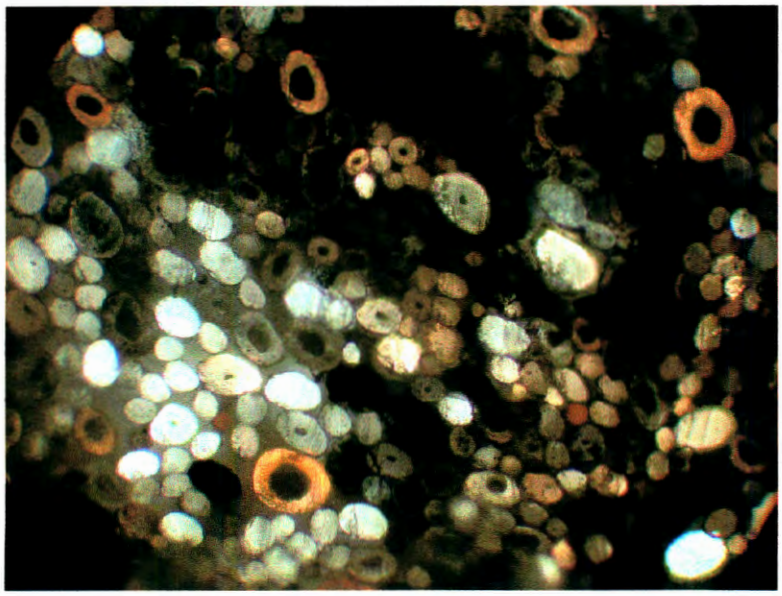


Figure 5.57 Light microscopic photograph of a cross-section of the hair of the Sykes' monkey (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the Sykes' monkey are presented in Figure 5.58. *Cuticular scale pattern*: A regular waved mosaic patterns in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

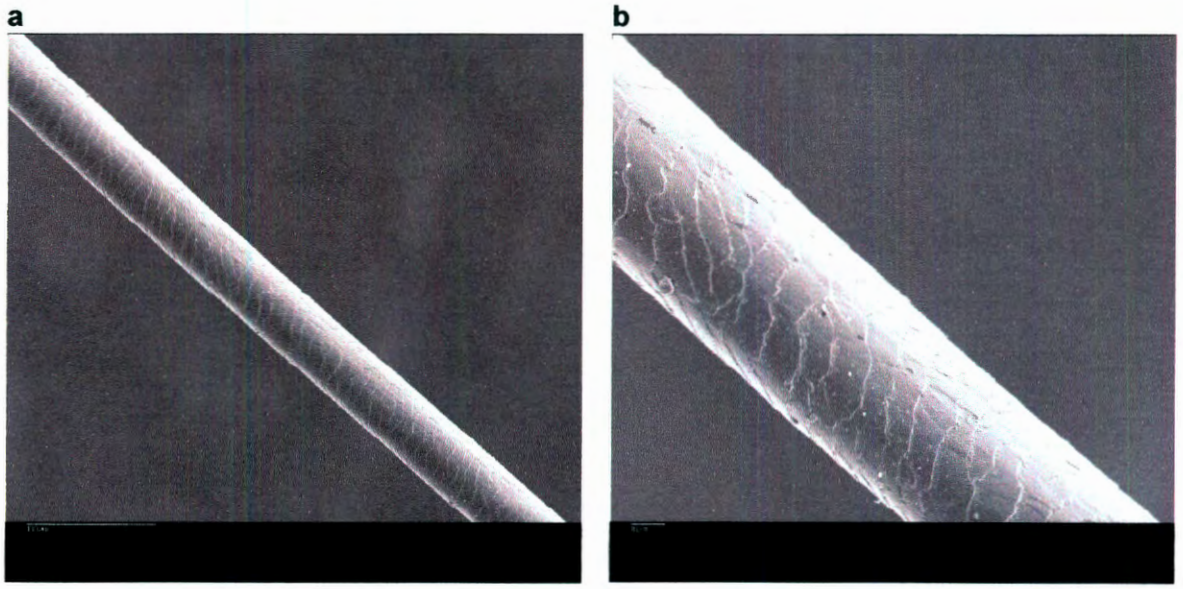


Figure 5.58 Electron microscopic photographs of the cuticular scale pattern of the hair of the Sykes' monkey (a = 270x, b = 750x).

5.1.30 South African large-spotted genet (*Genetta tigrina*)

A light microscopic photograph of a cross-section of the hair of the South African large spotted genet is presented in Figure 5.59. *Cross-section*: Hairs appear oval, with medium-sized medulla which appear dark in colour with a reddish cortex. White hairs have oval, medium-sized medulla and a white cortex, while under fur hairs have small, oval medulla and a yellowish cortex.

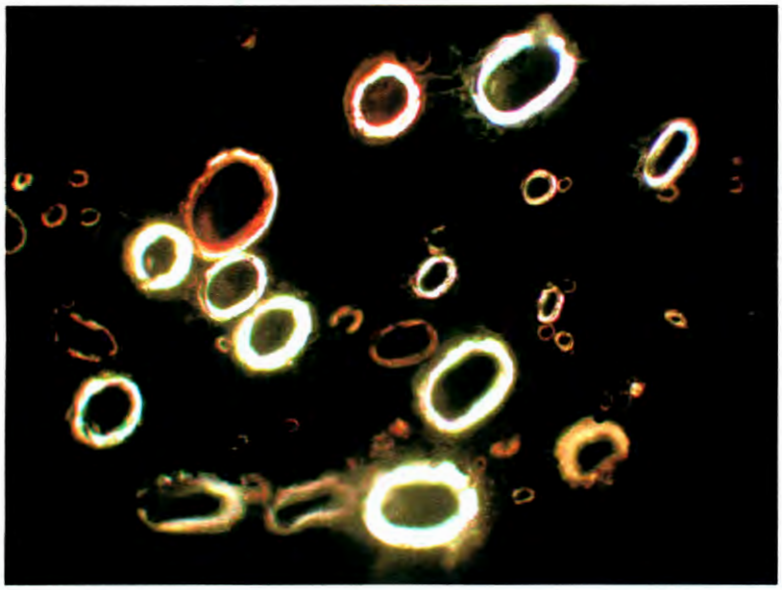


Figure 5.59 Light microscopic photograph of a cross-section of the hair of the South African large spotted genet (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the South African large spotted genet are presented in Figure 5.60. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance apart of scales*: Closely spaced.

5.1.31 Banded mongoose (*Mungos mungo*)

A light microscopic photograph of a cross-section of the hair of the banded mongoose is presented in Figure 5.61. *Cross-section*: Hairs are oblong with medium-sized medulla. The medulla appear dark in darker hairs and dark brown in lighter hairs, while the colour of the cortex is yellowish brown. White hairs have small medulla with a large white cortex.

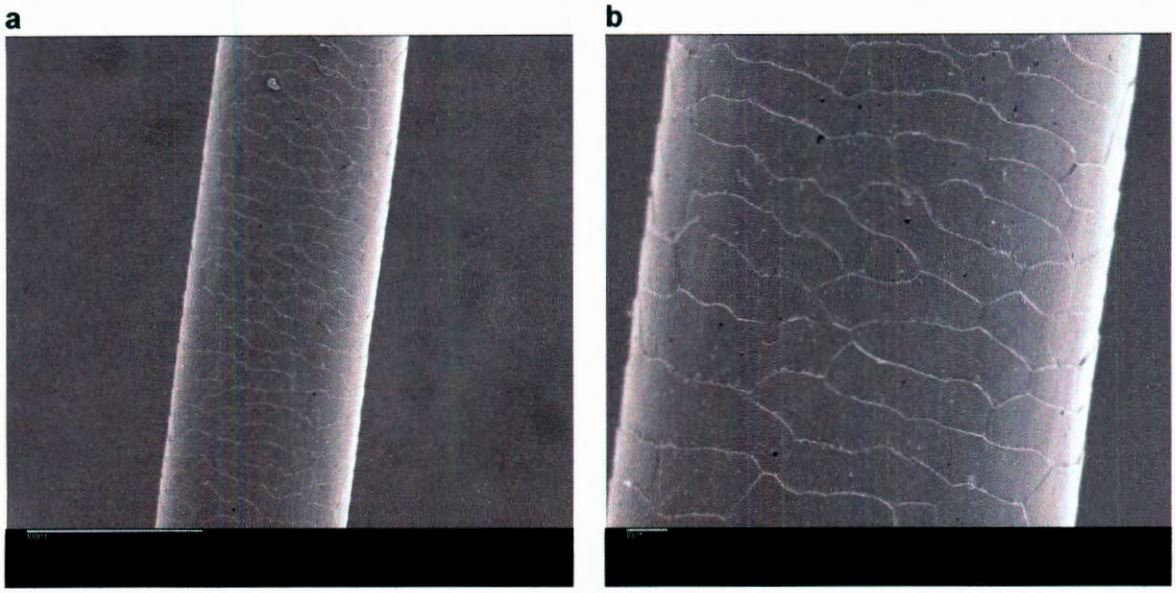


Figure 5.60 Electron microscopic photographs of the cuticular scale pattern of the hair of the South African large spotted genet (a = 800x, b = 1 000x).

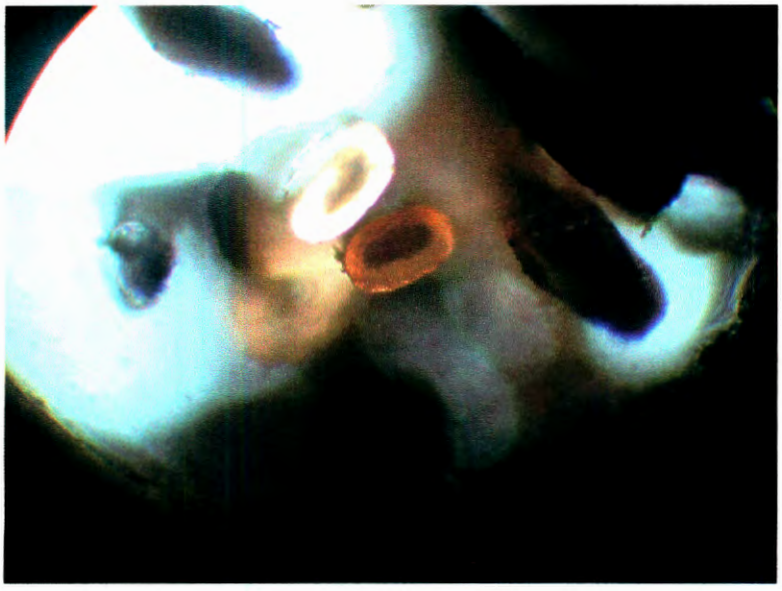


Figure 5.61 Light microscopic photograph of a cross-section of the hair of the banded mongoose (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the banded mongoose are presented in Figure 5.62. *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft shaft region is visible, with two to three scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

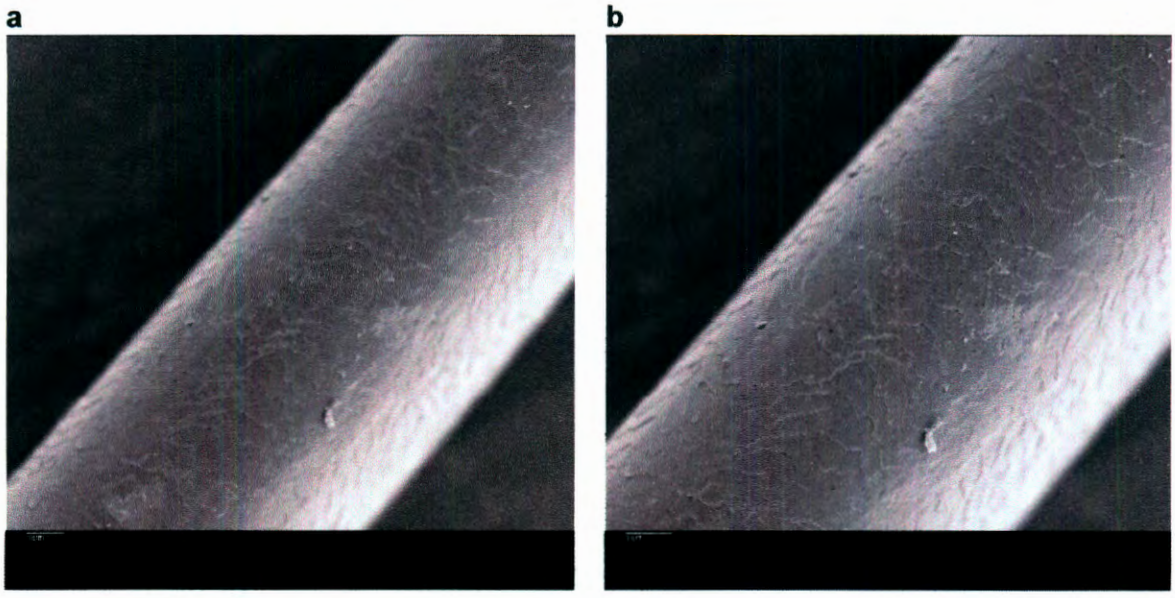


Figure 5.62 Electron microscopic photographs of the cuticular scale pattern of the hair of the banded mongoose (a = 800x, b = 1 000x).

5.1.32 Dwarf mongoose *(Helogale parvula)*

A light microscopic photograph of a cross-section of the hair of the dwarf mongoose is presented in Figure 5.63. *Cross-section*: Hairs appear oblong, with small to medium-sized medulla. The medulla appear dark and the cortex reddish. Under fur hairs have small medulla with a reddish cortex.

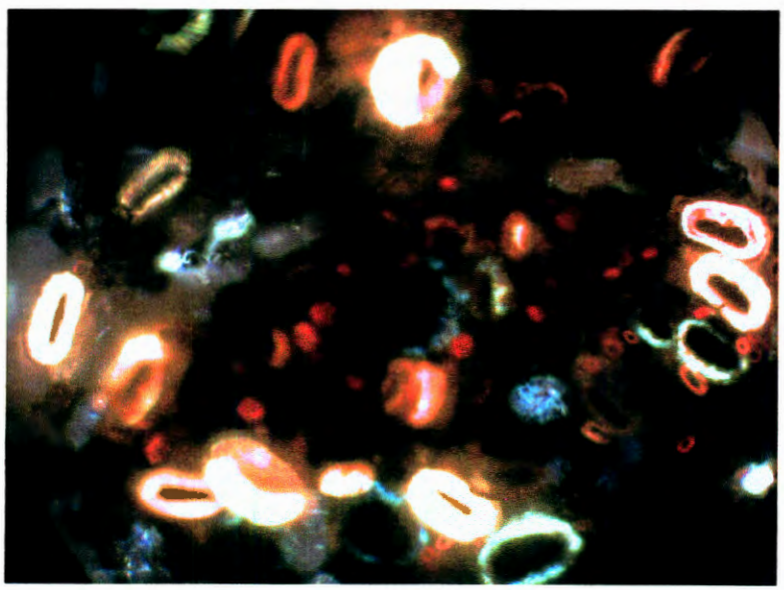


Figure 5.63 Light microscopic photograph of a cross-section of the hair of the dwarf mongoose (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the dwarf mongoose are presented in Figure 5.64. *Cuticular scale pattern*: An irregular waved mosaic pattern in the mid-shaft region of the hair. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Almost touching.

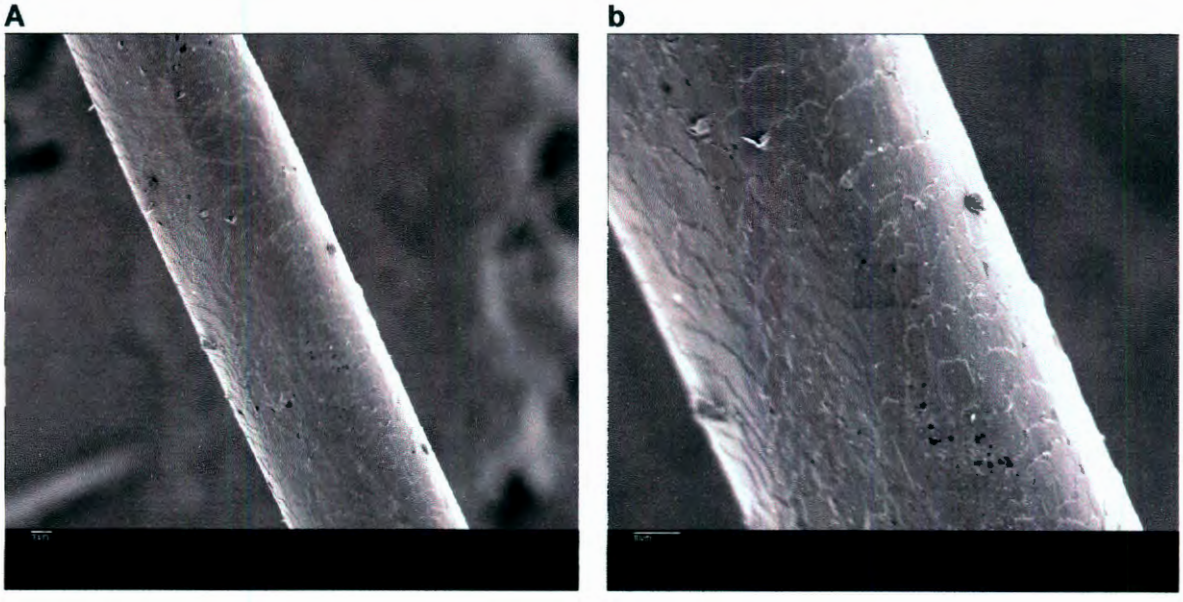


Figure 5.64 Electron microscopic photographs of the cuticular scale pattern of the hair of the dwarf mongoose (a = 450x, b = 1 000x).

5.1.33 Striped polecat (*Ictonyx striatus*)

A light microscopic photograph of a cross-section of the hair of the striped polecat is presented in Figure 5.65. *Cross-section*: Hairs appear oblong to oval with medium-sized medulla, while the cortex appear reddish. Under fur hairs have circular, small-sized medulla and the cortex are yellowish in colour. White hairs are oblong to oval shaped, with medium-sized medulla and a white cortex.

Electron microscopic photographs of the cuticular scale pattern of the hair of the striped polecat are presented in Figure 5.66. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible, with two to four scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between scales*: Closely spaced.

Figure 5.65 Light microscopic photograph cross-section of the hair of the striped polecat (100x).

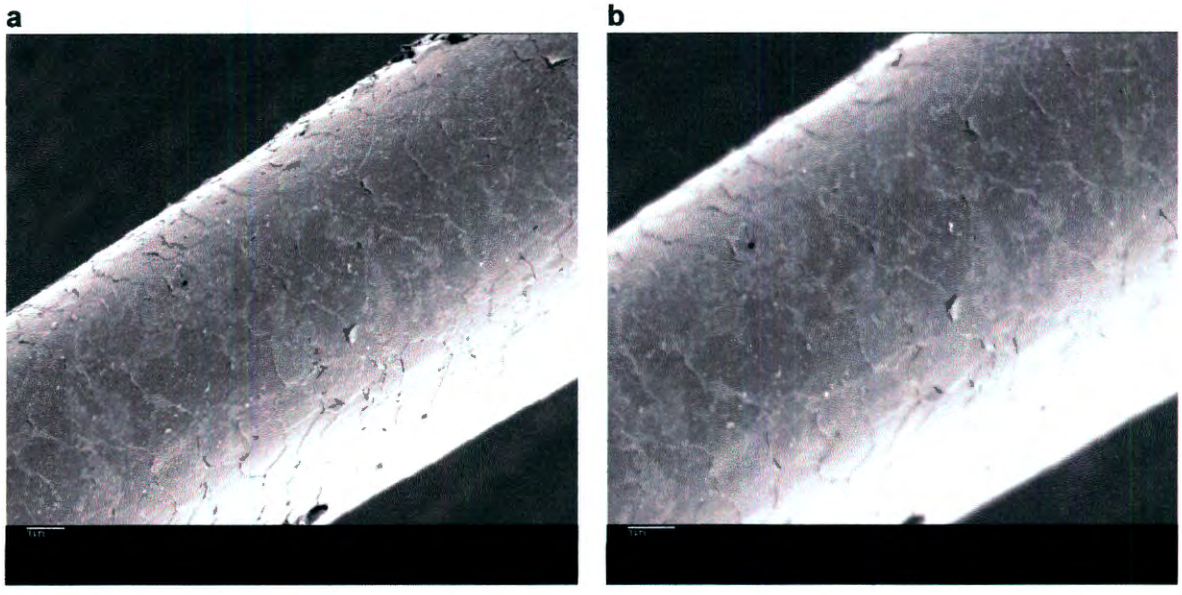


Figure 5.66 Electron microscopic photographs of the cuticular scale pattern of the hair of the stripe polecat (a = 800x, b = 1 000x).

5.1.34 African striped weasel (*Poecilogale albinucha)*

A light microscopic photograph of a cross-section of the hair of the African striped weasel is presented in Figure 5.67. *Cross-section*: Hairs appear oval to oblong with medium-sized medulla that shows a very dark colour. The cortex appear yellowish to reddish in colour. White hairs are similar, but with a white cortex. Under fur hair have small medulla

and a yellowish cortex.

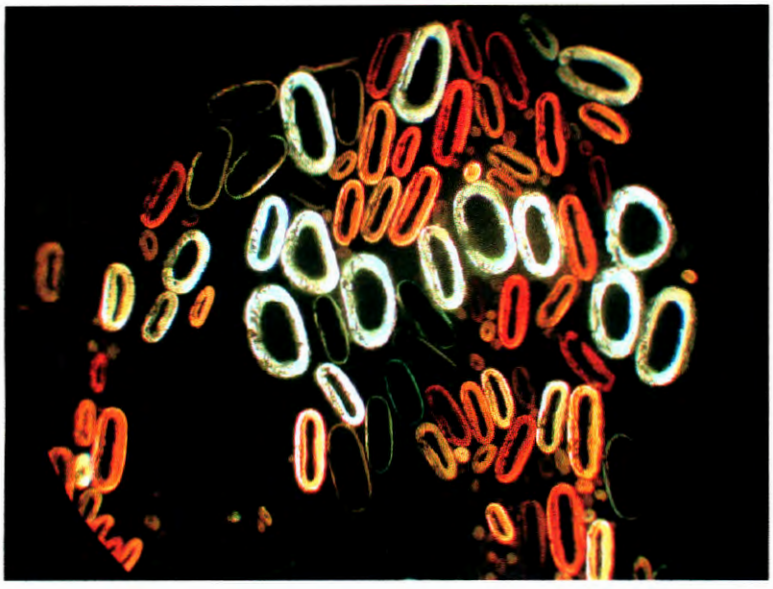


Figure 5.67 Light microscopic photograph of a cross-section of the hair of the African striped weasel (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the African striped weasel are presented in Figure 5.68. *Cuticular scale pattern*: An irregular waved mosaic pattern is visible in the mid-shaft region of the hair. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

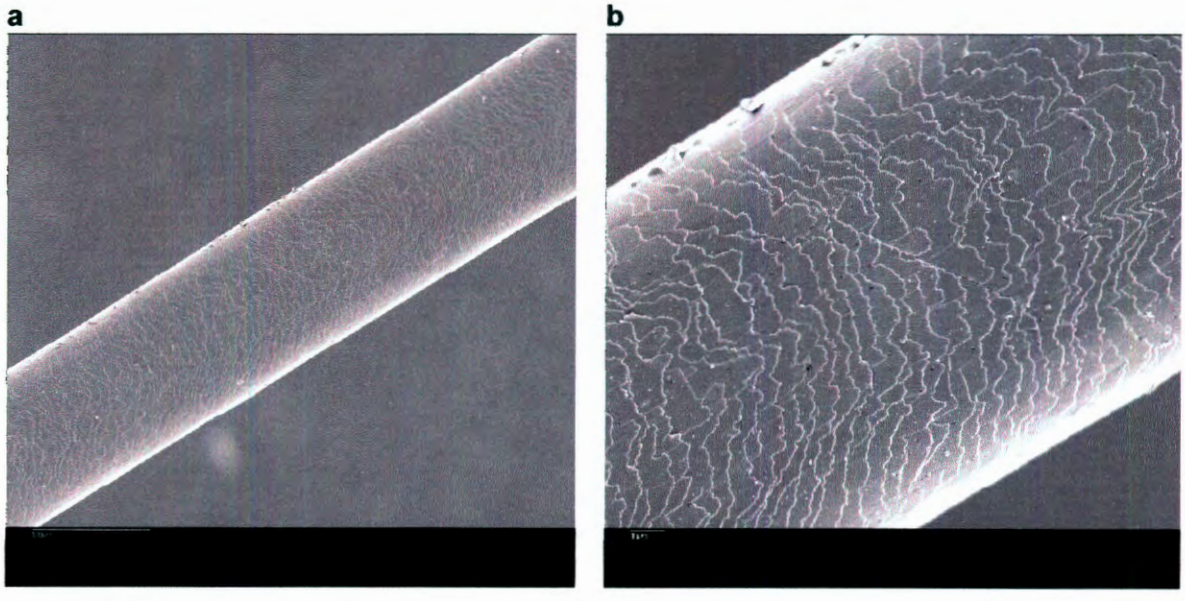


Figure 5.68 Electron microscopic photographs of the cuticular scale pattern of the hair of the African striped weasel (a = 250x, b = 750x).

5.1.35 Caracal *(Caracal caracal)*

A light microscopic photograph of a cross-section of the hair of the caracal is presented in Figure 5.69. *Cross-section*: Hairs appear oval with medium-sized medulla with reddish cortex. Under fur hairs are circular with small-sized medulla and the cortex are yellowish in colour. White hairs have small-sized medulla and a white cortex.

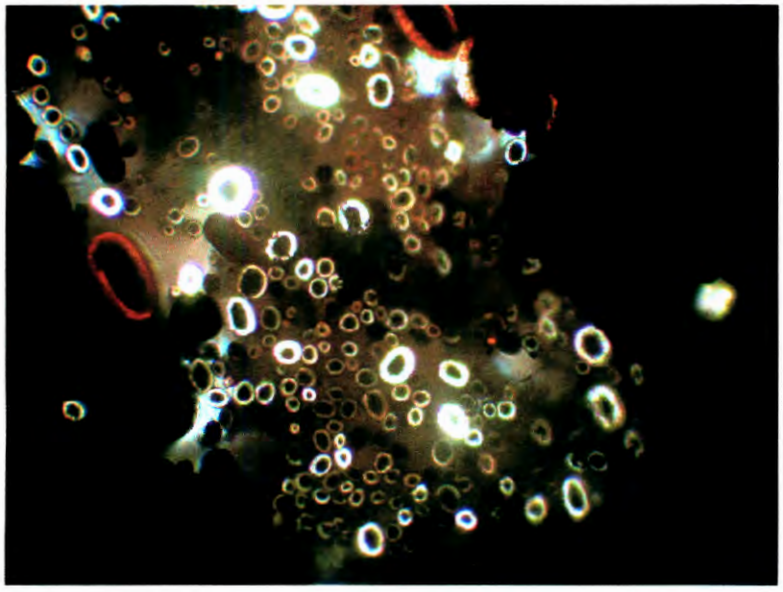


Figure 5.69 Light microscopic photograph of a cross-section of the hair of the caracal (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the caracal are presented in Figure 5.70. *Cuticular scale pattern*: An irregular waved mosaic pattern is visible in the mid-shaft region of the hair. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between the scales*: almost touching.

5.1.36 Serval (*Reptailurus serval)*

A light microscopic photograph of a cross-section of the hair of the serval is presented in Figure 5.71. *Cross-section*: Some hairs appear oval, others oblong, with large to medium-sized medulla. The medulla appears black, while the cortex appear reddish. White hairs are similar, but with the cortex that are white. Under fur hairs have small medulla with white cortex.

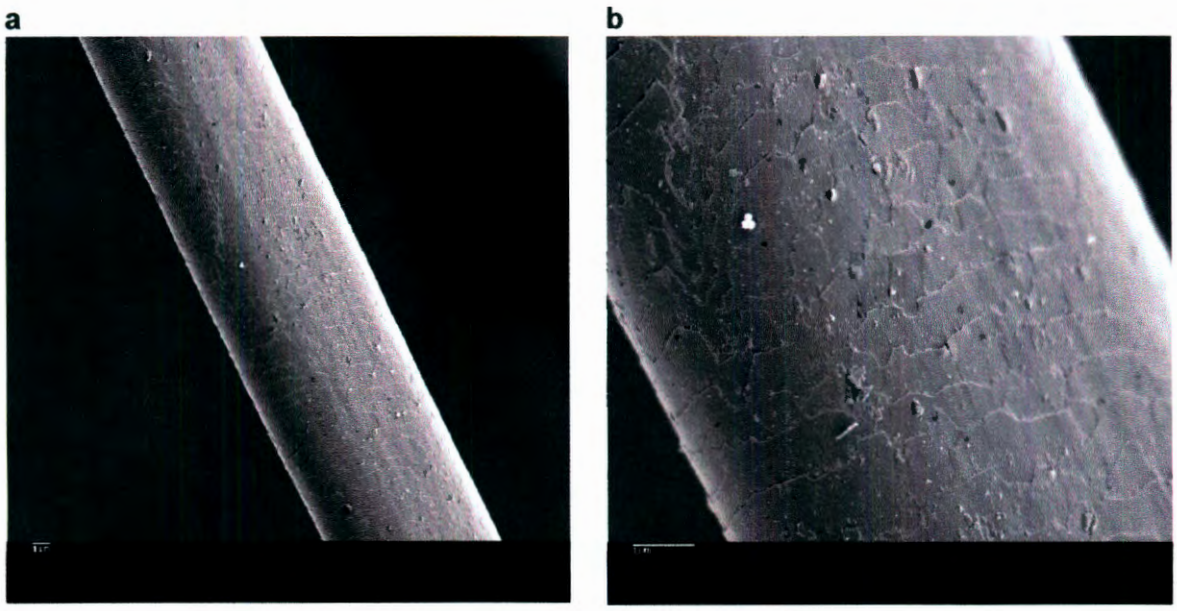


Figure 5.70 Electron microscopic photographs of the cuticular scale pattern of the hair of the caracal (a = 400x, b = 1 300x).

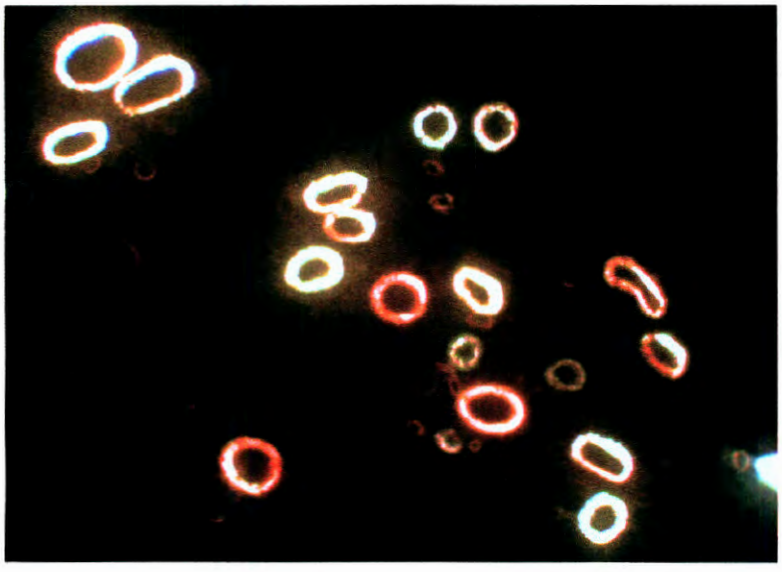


Figure 5.71 Light microscopic photograph of a cross-section of the hair of the serval (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the serval are presented in Figure 5.72.. *Cuticular scale pattern*: A regular mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Widely spaced.

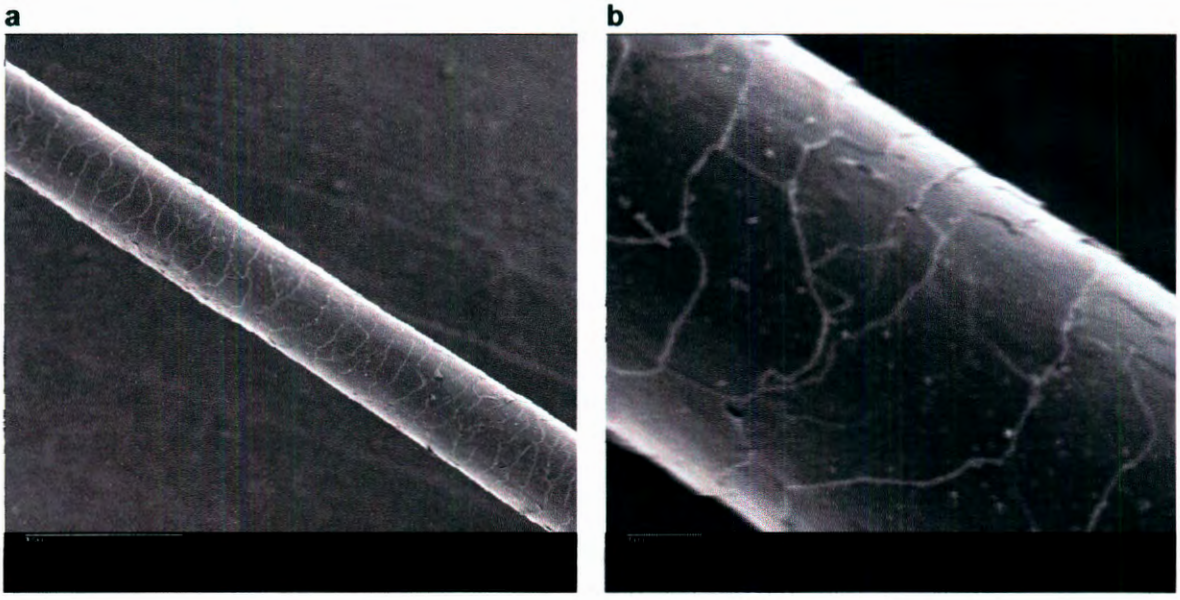


Figure 5.72 Electron microscopic photographs of the cuticular scale pattern of the hair of the serval (a =330x, b = 1 600x).

5.1.37 African wild cat (*Felis silvestris)*

A light microscopic photograph of a cross-section of the hair of the African wild cat is presented in Figure 5.73. *Cross-section*: Hairs appear round to oval with medium-sized, dark coloured medulla and a white cortex. Under fur hairs have small medulla with the cortex that are reddish.

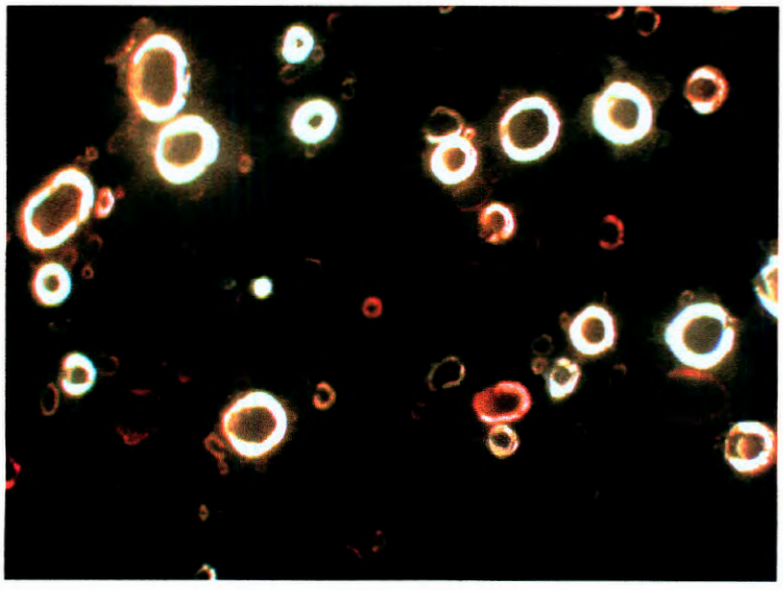


Figure 5.73 Light microscopic photograph of a cross-section of the hair of the African wild cat (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair of the african wild cat are presented in Figure 5.74. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible, with two scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance apart of scales*: Widely spaced.

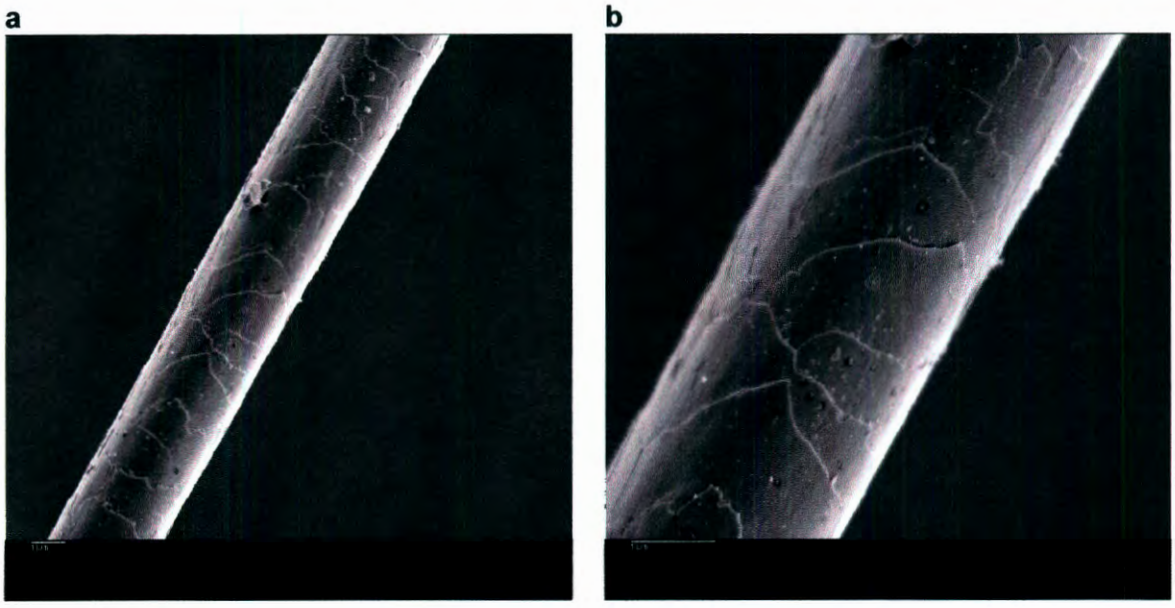


Figure 5.74 Electron microscopic photographs of the cuticular scale pattern of the hair of the African wild cat (a = 750x, b = 1 800x).

5.1.38 Aardvark (*Orycteropus afer*)

A light microscopic photograph of a cross-section of the hair of the aardvark is presented in Figure 5.75. *Cross-section*: Hairs appear oval with medium-sized medulla. It is difficult to differentiate between the medulla and cortex of darker hairs. In lighter hairs the medulla appear as very small spots with a big creamy cortex.

Electron microscopic photographs of the cuticular scale pattern of the hair of the aardvark is presented in Figure 5.76. *Cuticular scale pattern*: A regular waved mosaic pattern in the mid-shaft region is visible, with three to six scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance apart of scales*: Almost touching.

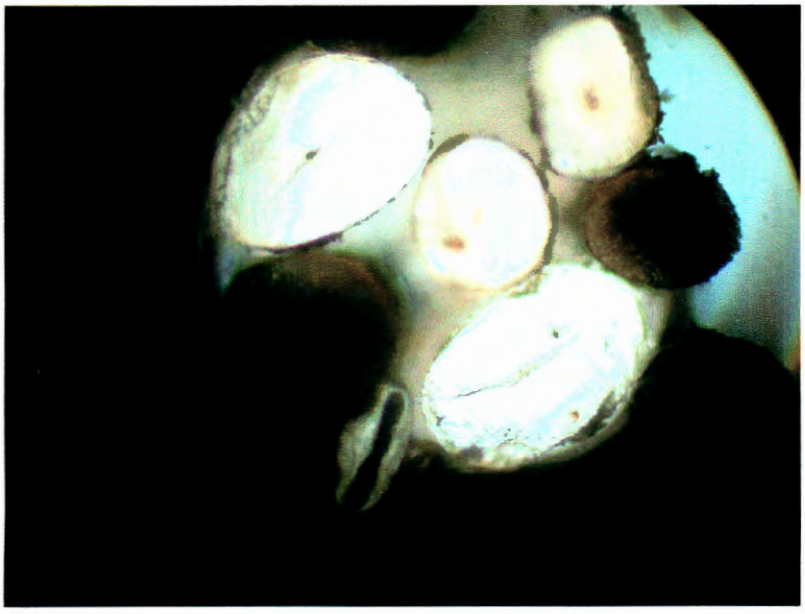


Figure 5.75 Light microscopic photograph of a cross-section of the hair of the aardvark (100x).

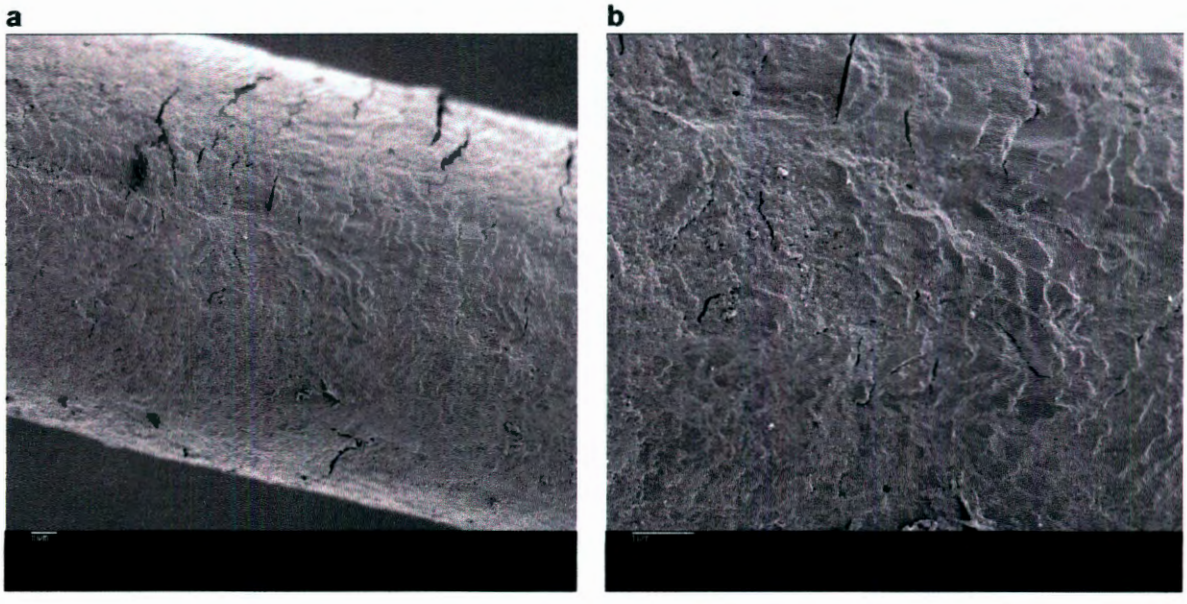


Figure 5.76 Electron microscopic photographs of the cuticular scale pattern of the hair of the aardvark (a = 550x, b = 1 300x).

CHAPTER 6

VARIATION IN THE MICROSCOPIC CHARACTERS OF HAIR FROM DIFFERENT BODY PARTS OF THE SAME MAMMAL SPECIES

6.1 INTRODUCTION

Hair samples are often obtained from the feaces of predators with the objective of identifying the particular mammal prey species from microscopic characters of the hair. It is often difficult, if not impossible, to determine the origin of the hair with regard to the particular body part of the particular mammal species. The question then arises whether hair of any part of the body of a particular species can be used to identify the species or whether the microscopic characters of hair from different body parts of the same species differ. A study was subsequently conducted where the microscopic characters of hair from distinctly different body parts of an impala were compared with the objective of establishing whether such differences exist. The impala was selected for this study in view of its importance as a preferred prey species of the leopard in the northern savanna of South Africa.

6.2 PROCEDURE

6.2.1 Collection of hair samples

The hair samples from the different body parts were obtained from an impala that was hunted during the winter of 2003 in the Bloemfontein area. Hair samples of the following eleven body parts were removed from the fresh skin with the aid of a forceps: neck, tail, shoulder, belly, ears, fore-leg, thighs, face, throat, back and brisket. These parts were considered to be representatives of the main variation within any hair sample from the feaces of a predator.

6.2.2 Preparation and microscopic analyses of hair samples

The collected hair samples were washed and microscopically analyzed according to the procedures as described in Chapter 4. All the cross-sections of the hairs were

photographed under a light microscope, except those from the back and shoulders of the impala. Due to poor visibility under the light microscope, these cross-sections were photographed under the electron microscope.

The light microscopic photographs were taken at a specific, known magnification, which enabled the measurement of hair diameters from the photographs according to a pre-determined scale (100 µm = 10 mm).

6.3 RESULTS

6.3.1 Taxonomic description of hair from different body parts

6.3.1.1 Face

A light microscopic photograph of a cross-section of the hair from the face of the impala is presented in Figure 6.1. *Cross-section*: The hairs have a papillo-convex shape and the convex shape is almost flattened to almost linear. The medulla are small-sized with a reddish to pale yellowish cortex.

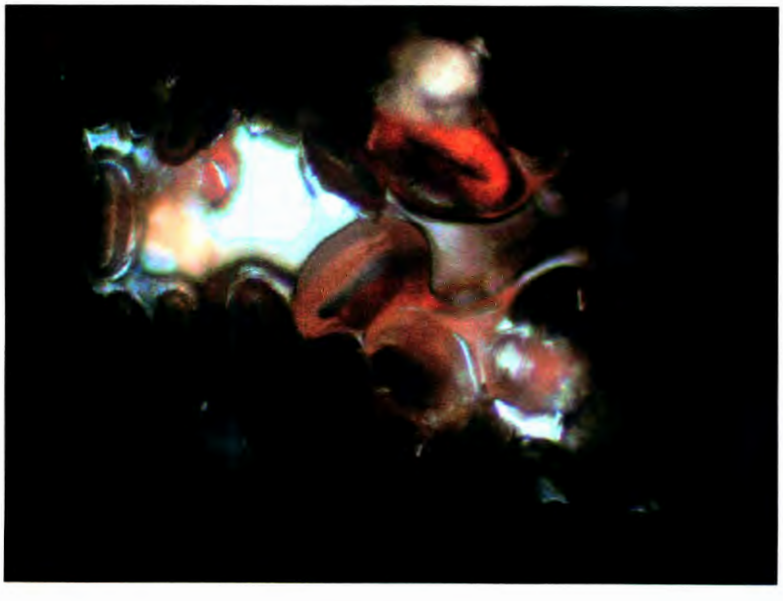


Figure 6.1 Light microscopic photograph of the cross-section of the hair from the face of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the face of the impala are presented in Figure 6.2. *Cuticular scale pattern:* A regular mosaic

pattern in the mid-shaft region is visible, with one to two scales across the width. *Scale margins*: Smooth to rippled in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

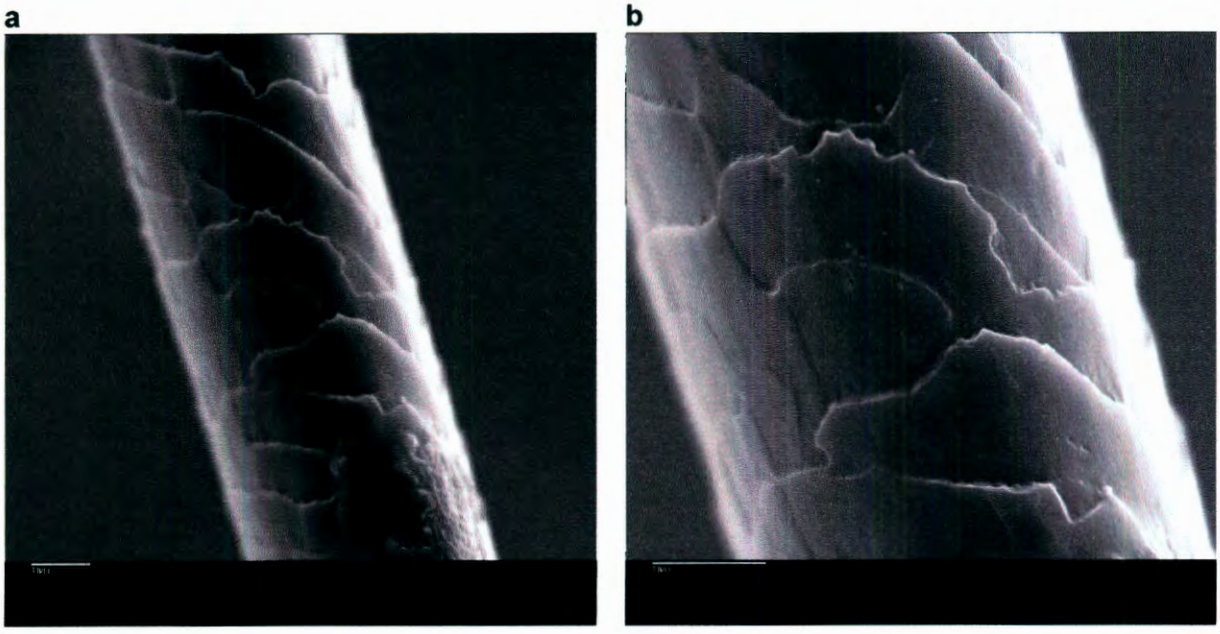


Figure 6.2 Electron microscopic photographs of the cuticular scale pattern of the hair from the face of the impala (a = 1 200x, b = 2 500x).

6.3.1.2 Back

A electron microscopic photograph of the cross-section of the hair from the back of the impala is presented in Figure 6.3. *Cross-section*: The shape of the hairs vary from convex, papillo-convex to triangular and in the case of the the convex shape, it is almost flattened or almost linear. The medium-sized medulla have a reddish or pale yellow orange cortex under a light microscope (not visible in Figure 6.3).

Electron microscopic photographs of the cuticular scale pattern of the hair from the back of the impala are presented in Figure 6.4. *Cuticular scale pattern:* Regular waved mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between the scales*: Closely spaced.

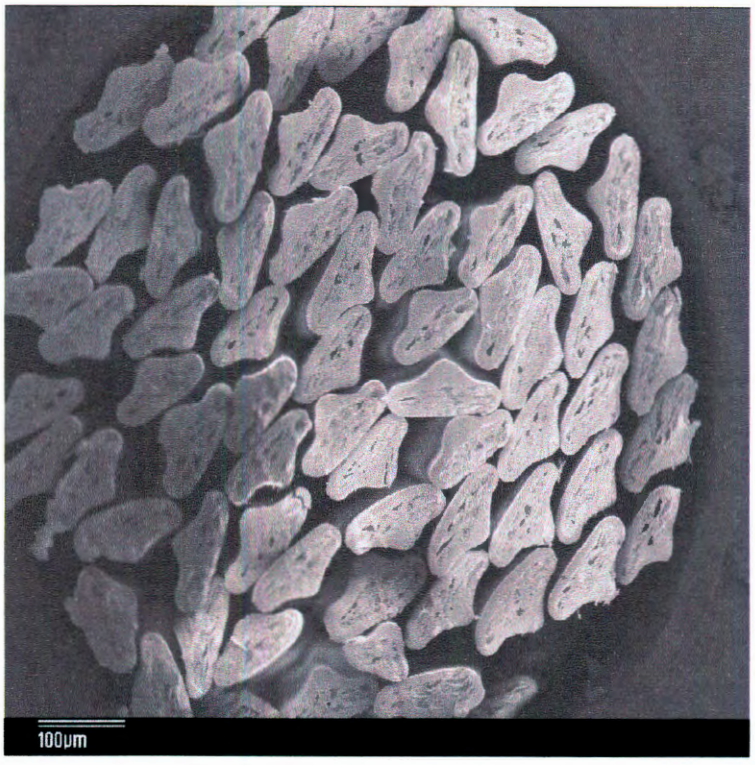
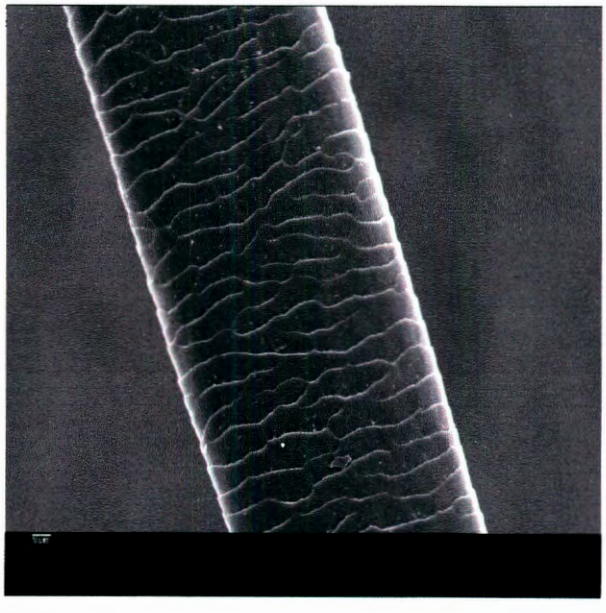


Figure 6.3 Electron microscopic photograph of the cross-section of the hair from the back of the impala (100x).

a



b

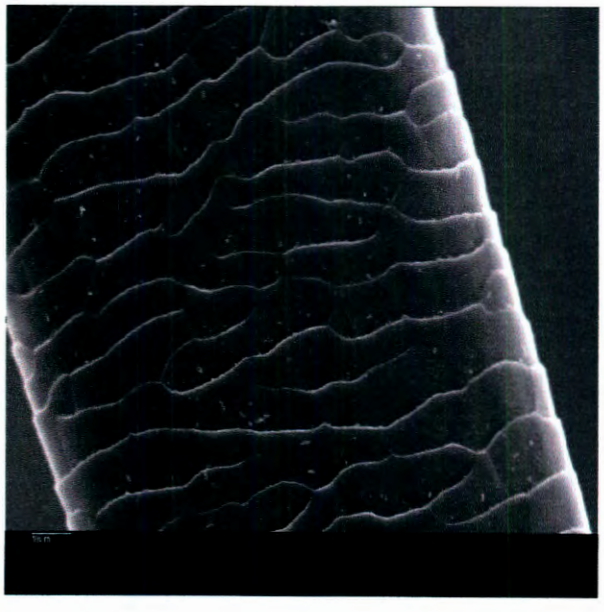


Figure 6.4 Electron microscopic photographs of the cuticular scale pattern of the hair from the back of the impala (a = 270x, b = 450x).

6.3.1.3 Tail

A light microscopic photograph of a cross-section of the hair from the tail of the impala is presented in Figure 6.5. *Cross-section*: The hairs have an oval shape with medium-sized medulla. The cortex are reddish or pale yellow-orange, but in light coloured hair they are white.

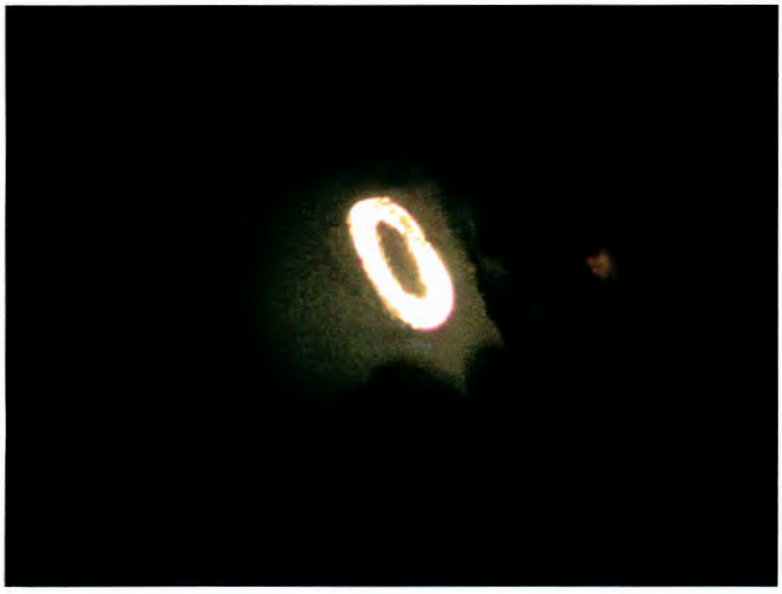


Figure 6.5 Light microscopic photograph of the cross-section of the hair from the tail of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the tail of the impala are presented in Figure 6.6. *Cuticular scale pattern:* A regular waved mosaic pattern is visible in the mid-shaft region of the hair, with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between scales*: Closely spaced.

6.3.1.4 Neck

A light microscopic photograph of a cross-section of the hair from the neck of the impala is presented in Figure 6.7. *Cross-section*: The hairs have a papillo-convex shape and the convex shape is almost flattened to almost linear. The medulla are medium sized with a reddish to pale yellow orange cortex, while the cortex appear white in light coloured hairs.

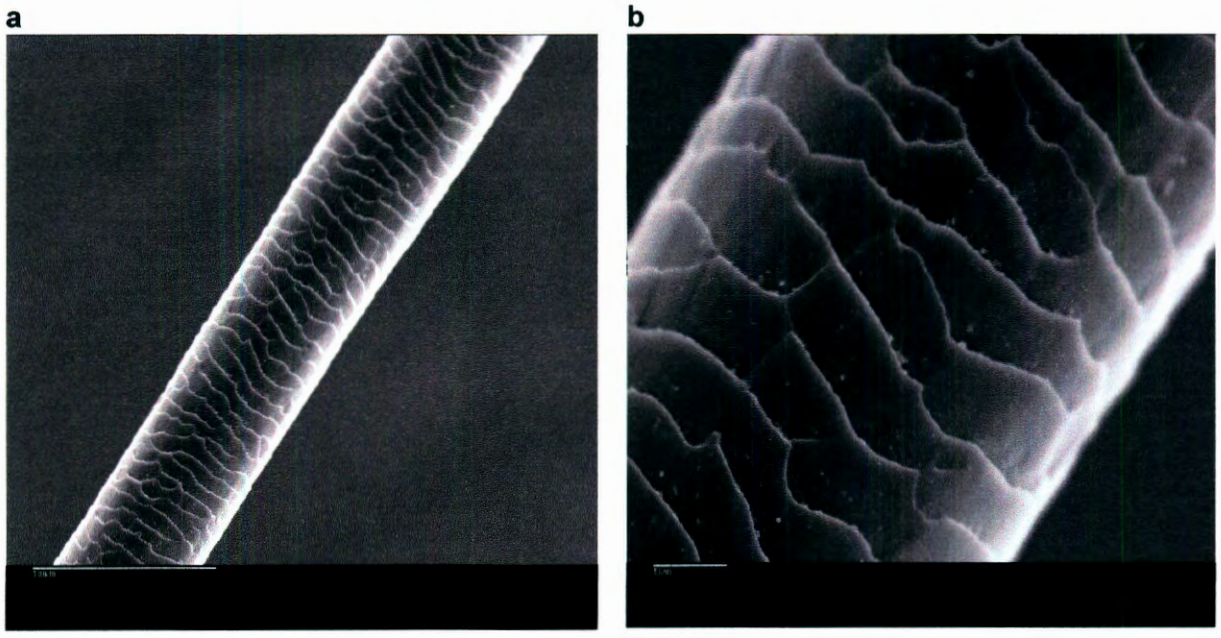


Figure 6.6 Electron microscopic photographs of the cuticular scale pattern of the hair from the tail of the impala (a = 1 370x, b = 1 500x).

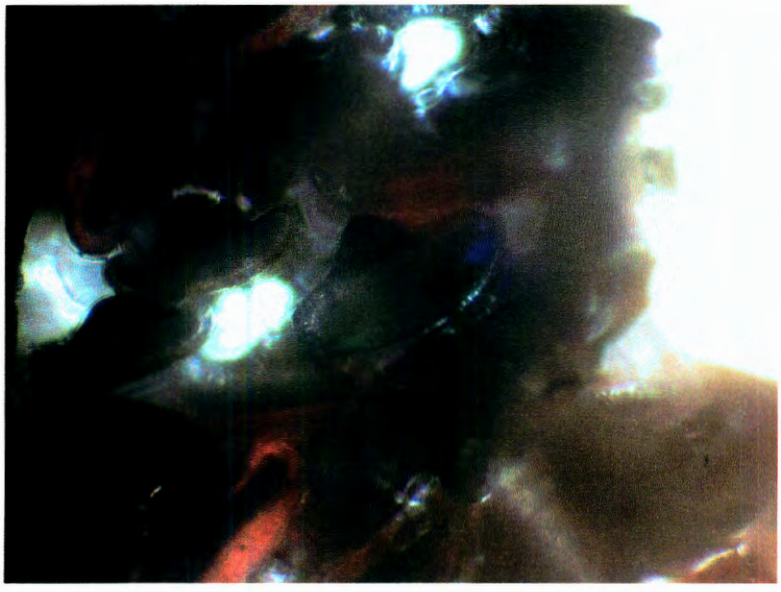


Figure 6.7 Light microscopic photograph of the cross-section of the hair from the neck of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the neck of the impala are presented in Figure 6.8. *Cuticular scale pattern:* A regular waved mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Smooth in the mid-shaft region of the hair. *Distance between scales*: Closely spaced.

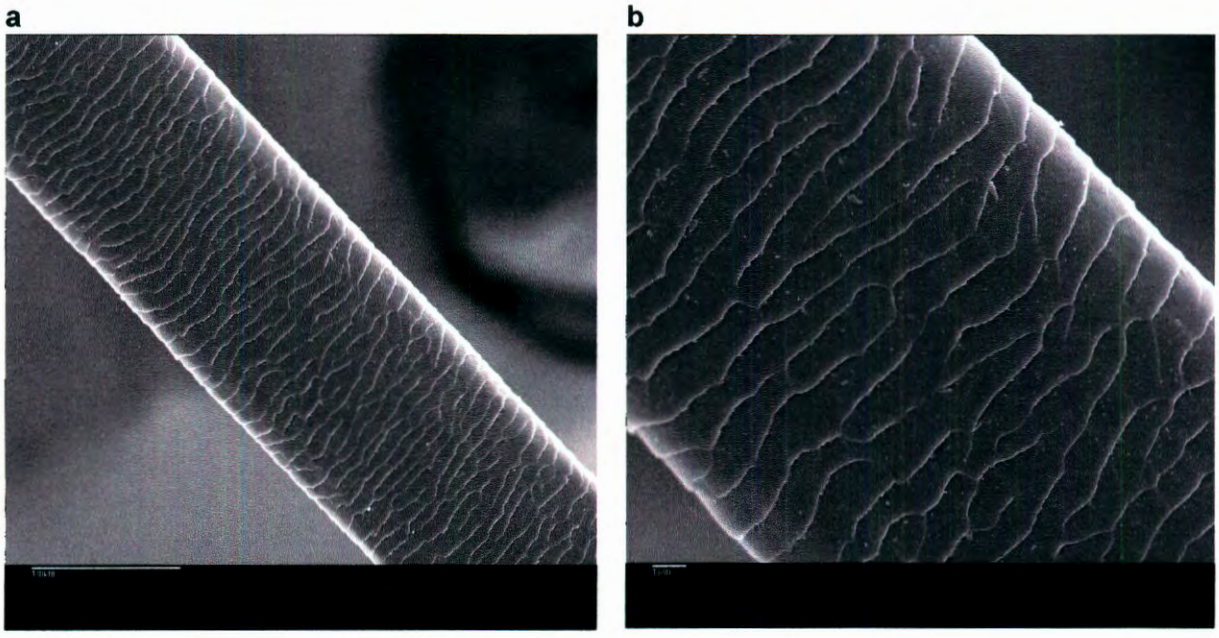


Figure 6.8 Electron microscopic photographs of the cuticular scale pattern of the hair from the neck of the impala (a = 700x, b = 1 300x).

6.3.1.5 Shoulder

An electron microscopic photograph of a cross-section of the hair from the shoulder of the impala is presented in Figure 6.9. *Cross-section*: The hairs have a papillo-convex shape and the convex shape is almost flattened to almost linear. Some hairs appear as triangles with blunted corners. The medulla are medium-sized and under a light microscope the cortex appear reddish to pale yellow orange (not shown in Figure 6.9).

Electron microscopic photographs of the cuticular scale pattern of the hair from the shoulder of the impala are presented in Figure 6.10. *Cuticular scale pattern:* A regular waved mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between scales*: Almost touching.

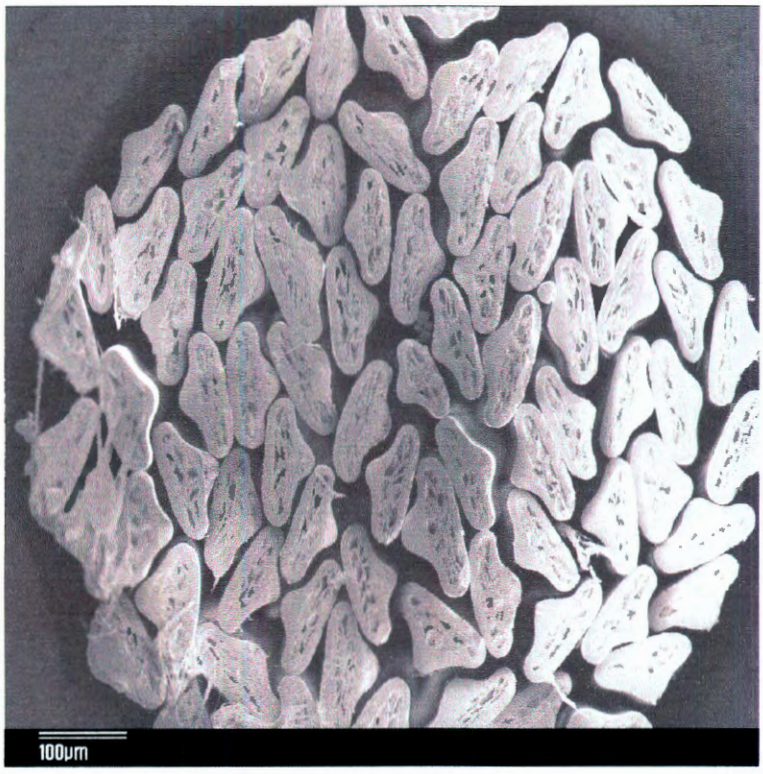


Figure 6.9 Electron microscopic photograph of the cross-section of the hair from the shoulder of the impala (100x).

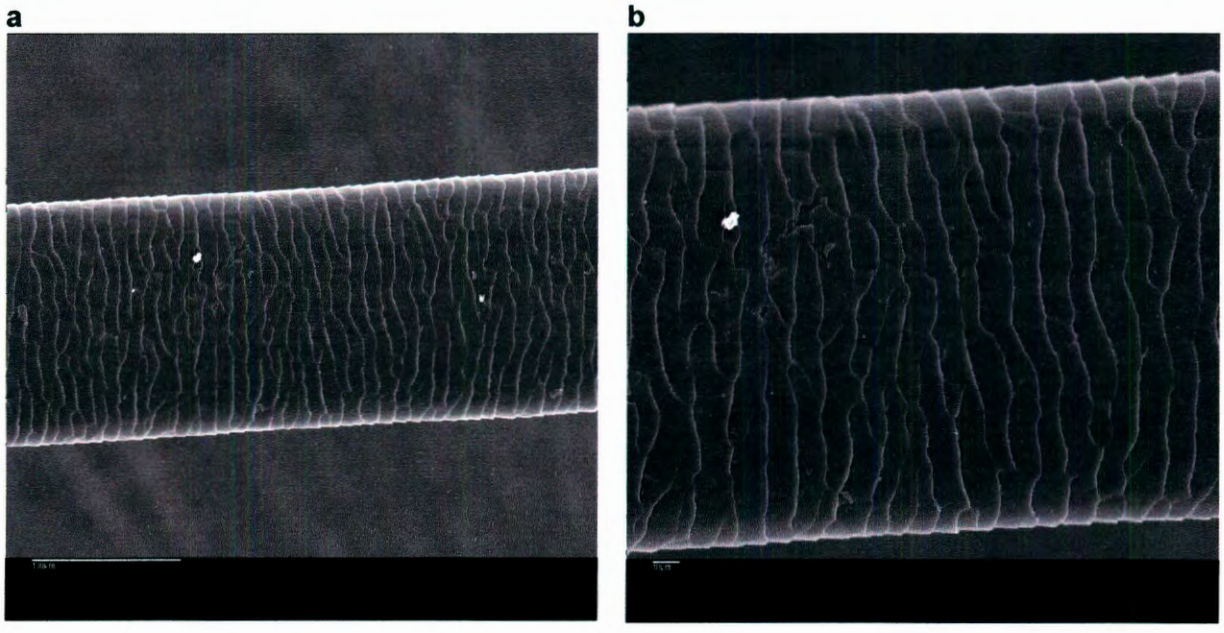


Figure 6.10 Electron microscopic photographs of the cuticular scale pattern of the hair from the shoulder of the impala (a = 300x, b = 550x).

6.3.1.6 Thigh

A light microscopic photograph of a cross-section of the hair from the thigh of the impala is presented in Figure 6.11. *Cross-section*: The hairs have a papillo-convex shape and the convex shape is almost flattened to almost linear. Some hairs are more oval shaped with rounded corners. The medulla are medium to large in size with the cortex pale white to yellowish in colour.

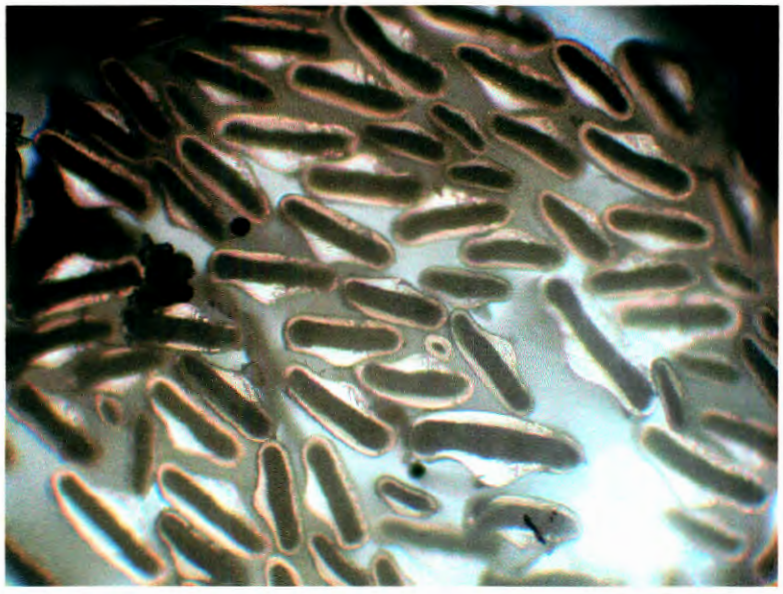


Figure 6.11 Light microscopic photograph of the cross-section of the hair from the thigh of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the thigh of the impala are presented in Figure 6.12. *Cuticular scale pattern:* A regular waved mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between scales*: Almost touching.

6.3.1.7 Throat

A light microscopic photograph of the cross-section of the hair from the throat of the impala is presented in Figure 6.13. *Cross-section*: The hairs have a papillo-convex shape and the convex shape is almost flattened to almost linear. The medulla are medium-sized and the cortex reddish to pale yellowish in colour.

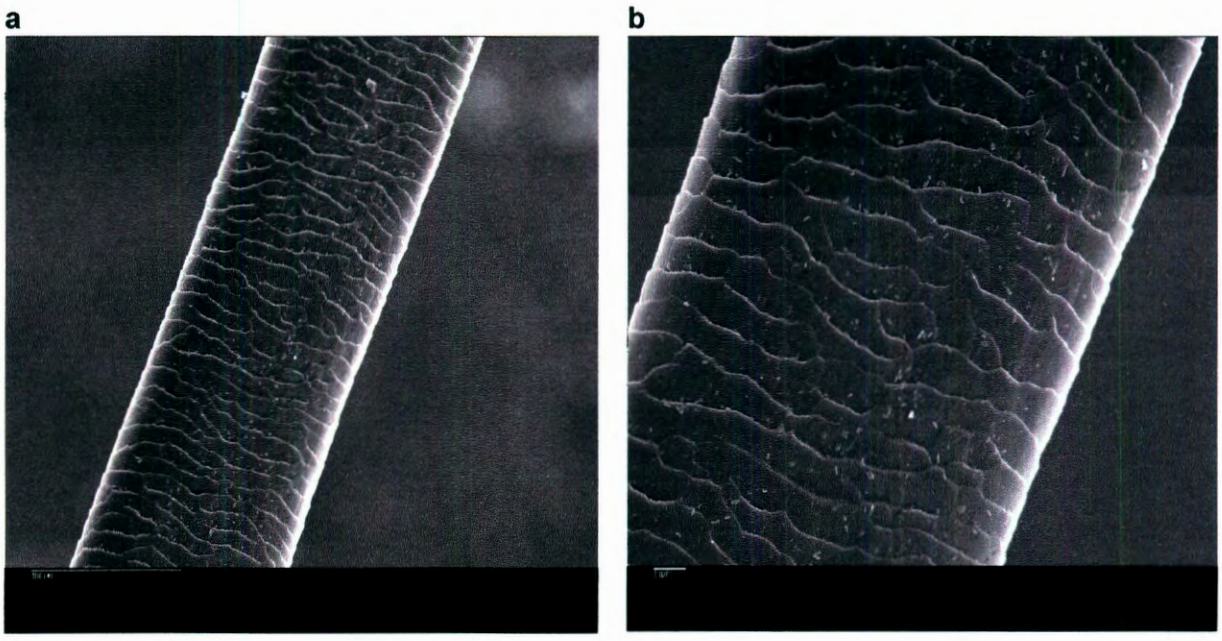


Figure 6.12 Electron microscopic photographs of the cuticular scale pattern of the hair from the thigh of impala (a = 300x, b = 650x).

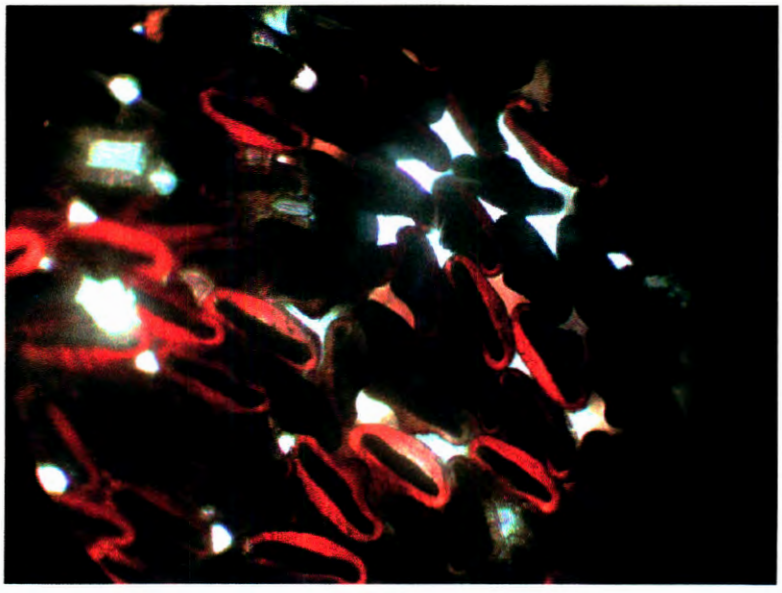


Figure 6.13 Light microscopic photograph of the cross-section of the hair from the throat of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the throat of the impala are presented in Figure 6.14. *Cuticular scale pattern:* A regular waved mosaic pattern in the mid-shaft region is visible, with four to six scales across the width. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between scales*: Almost touching.

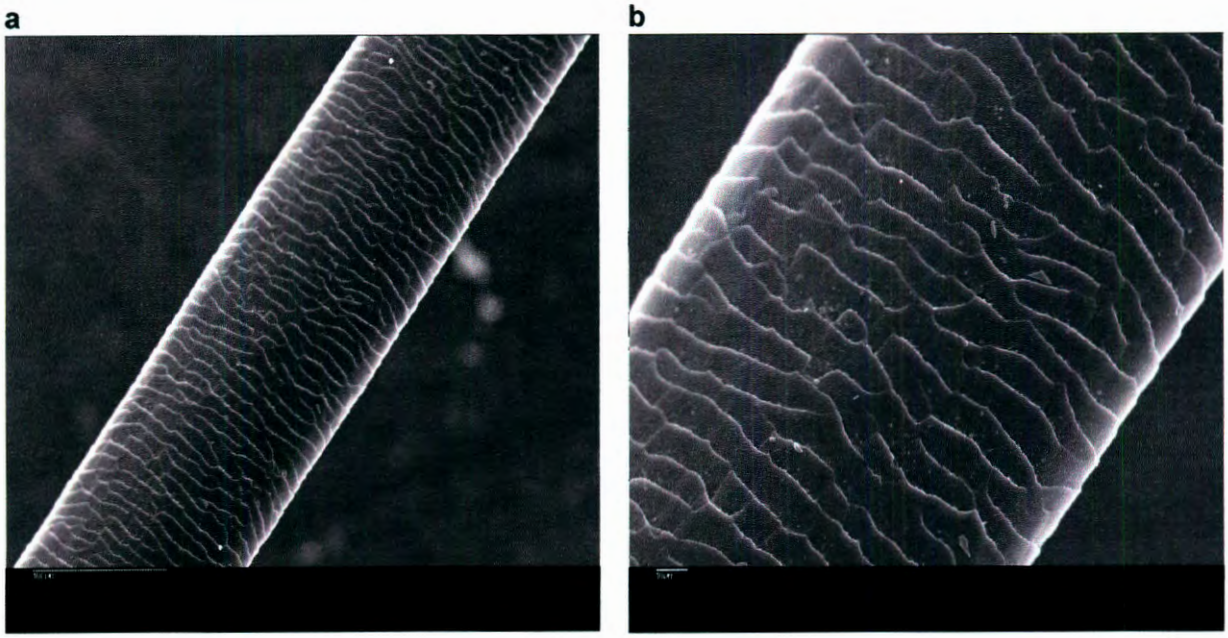


Figure 6.14 Electron microscopic photographs of the cuticular scale pattern of the hair from the throat of the impala (a = 270x, b = 450x).

6.3.1.8 Abdomen

A light microscopic photograph of a cross-section of the hair from the abdomen of the impala is presented in Figure 6.15. *Cross-section*: The hairs have a papillo-convex shape and the convex shape is more flattened to almost linear. The medulla are medium to large in size and due to the white colour of the hair, the cortex have no pigmentation.

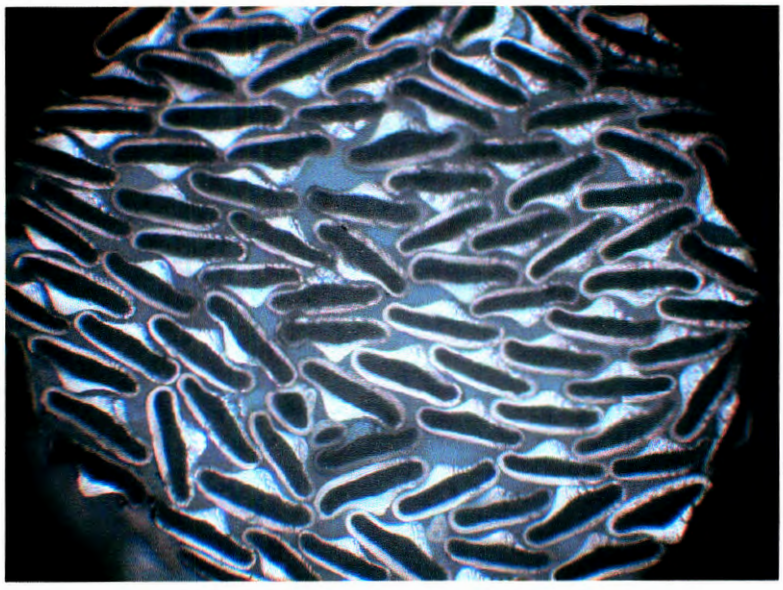


Figure 6.15 Light microscopic photograph of the cross-section of the hair from the abdomen of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the abdomen of the impala are presented in Figure 6.16. *Cuticular scale pattern:* A regular waved mosaic pattern in the mid-shaft region is visible with two to three scales across the width. *Scale margins*: Rippled in the mid-shaft region of the hair. *Distance between scales*: Almost touching.

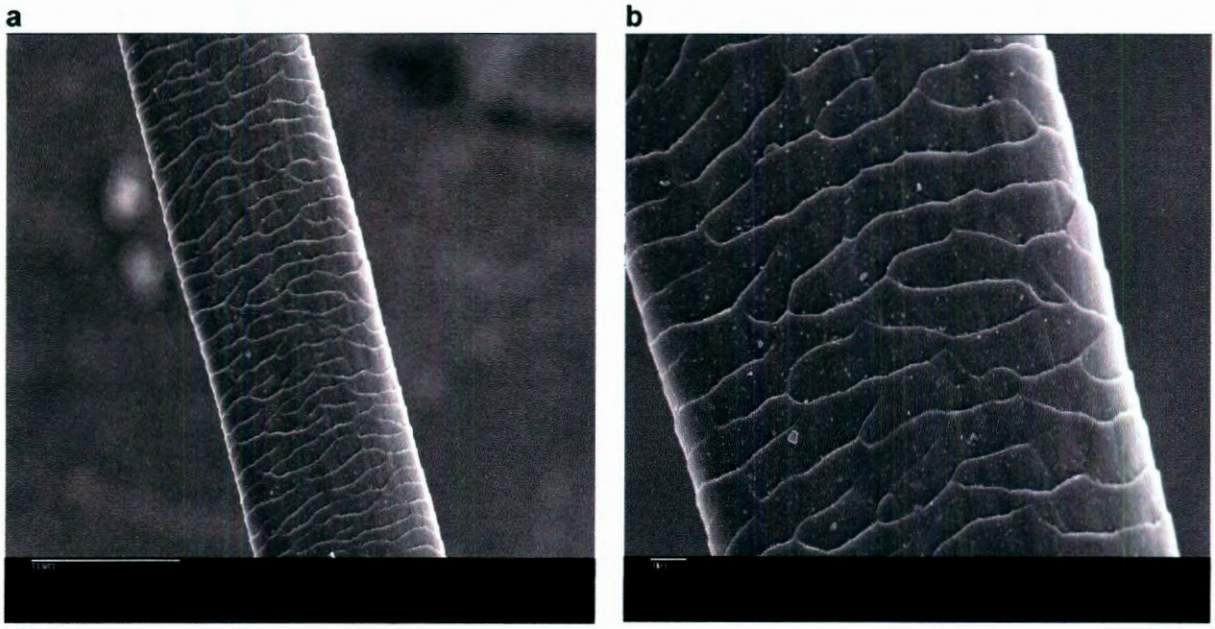


Figure 6.16 Electron microscopic photographs of the cuticular scale pattern of the hair from the abdomen of the impala (a = 300x, b = 750x).

6.3.1.9 Foreleg

A light microscopic photograph of a cross-section of the hair from the foreleg of the impala is presented in Figure 6.17. *Cross-section*: The shape of the hairs vary from papillo-convex to triangular with blunted corners, while others are rounded to almost circular. The medulla are medium-sized and the cortex are pale yellowish to reddish in colour. White hairs are circular with the cortex that are also white.

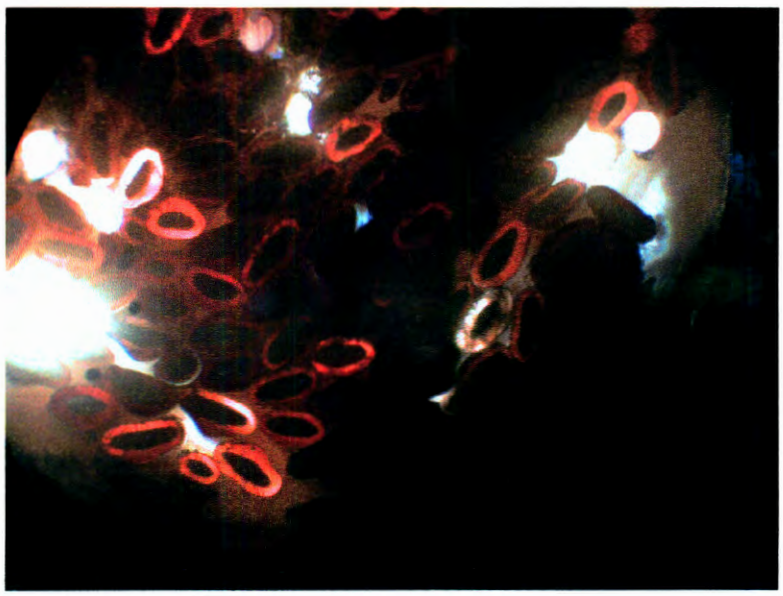


Figure 6.17 Light microscopic photograph of the cross-section of the hair from the foreleg of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the foreleg of the impala are presented in Figure 6.18. *Cuticular scale pattern:* An irregular waved mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between scales*: Closely spaced.

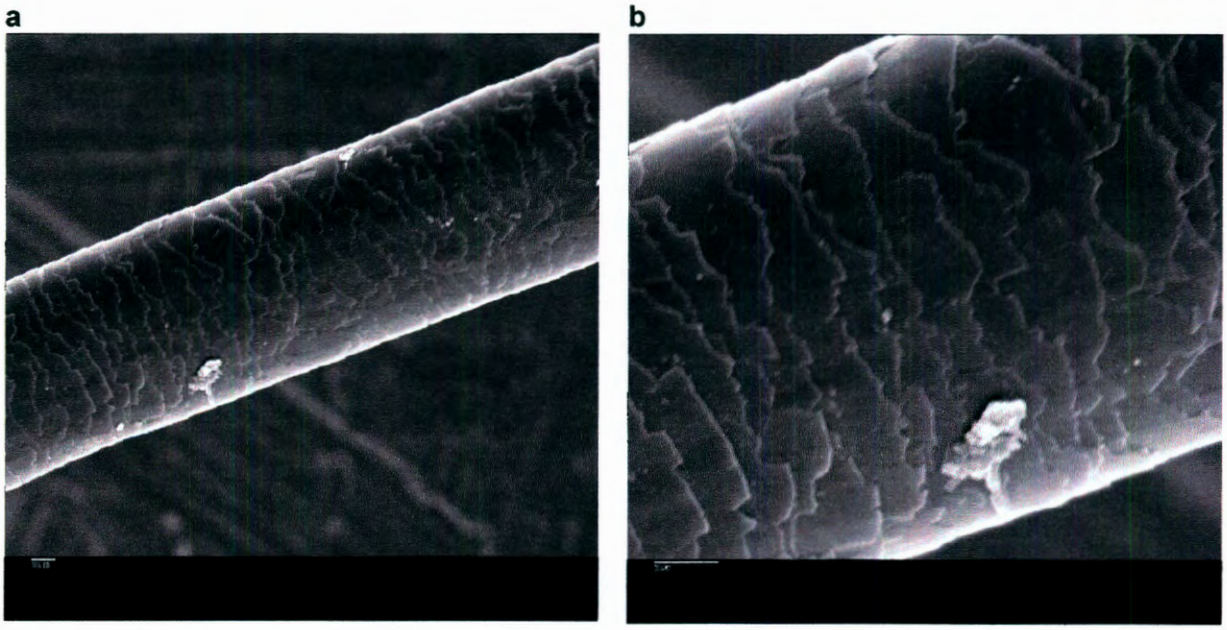


Figure 6.18 Electron microscopic photographs of the cuticular scale pattern of the hair from the foreleg of the impala (a = 500x, b = 1 300x).

6.3.1.10 Brisket

A light microscopic photograph of a cross-section of the hair from the brisket of the impala is presented in Figure 6.19. *Cross-section*: The hairs have a papillo-convex shape and the convex shape is almost flattened to almost linear. The medulla are medium to large in size and are visible. The cortex appear pale yellowish, but those of white hairs are also white.

Figure 6.19 Light microscopic photographs of the cross-section of the hair from the brisket of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the brisket of the impala are presented in Figure 6.20. *Cuticular scale pattern:* An irregular waved mosaic pattern in the mid-shaft region is visible, with three to four scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between scales*: Almost touching.

6.3.1.11 Ear

A light microscopic photograph of the cross-section of the hair from the ears of the impala is presented in Figure 6.21. *Cross-section*: The hairs have oval to oblong shapes with medium-sized medulla. The cortex are pale yellowish, but those of white hairs are also white.

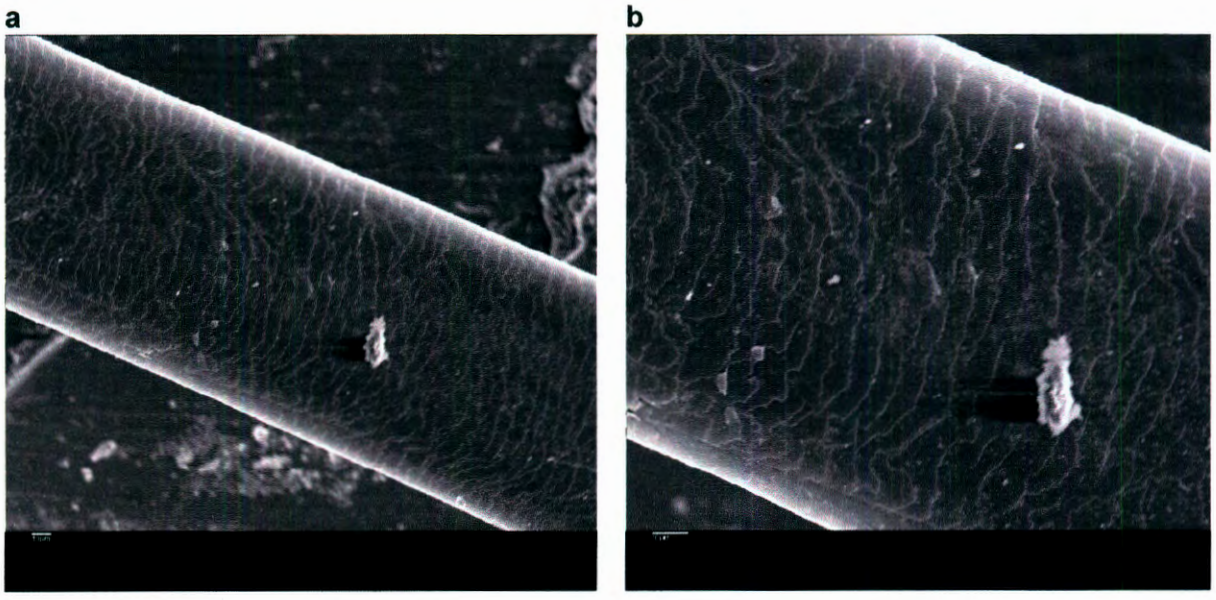


Figure 6.20 Electron microscopic photographs of the cuticular scale pattern of the hair from the brisket of the impala (a = 300x, b = 750x).

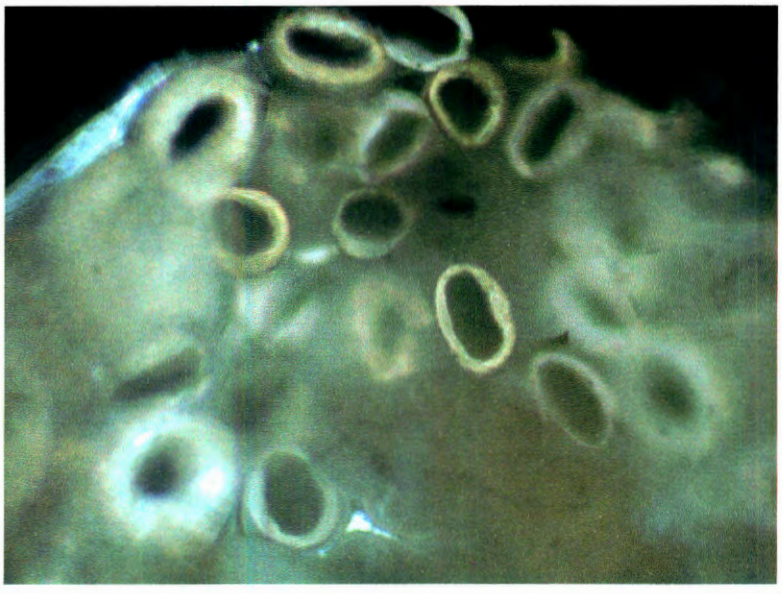


Figure 6.21 Light microscopic photograph of the cross-section of the hair from the ears of the impala (100x).

Electron microscopic photographs of the cuticular scale pattern of the hair from the ears of the impala are presented in Figure 6.22. *Cuticular scale pattern:* A regular waved mosaic pattern in the mid-shaft region is visible, with two to three scales across the width. *Scale margins*: Crenate in the mid-shaft region of the hair. *Distance between scales*: Almost touching.

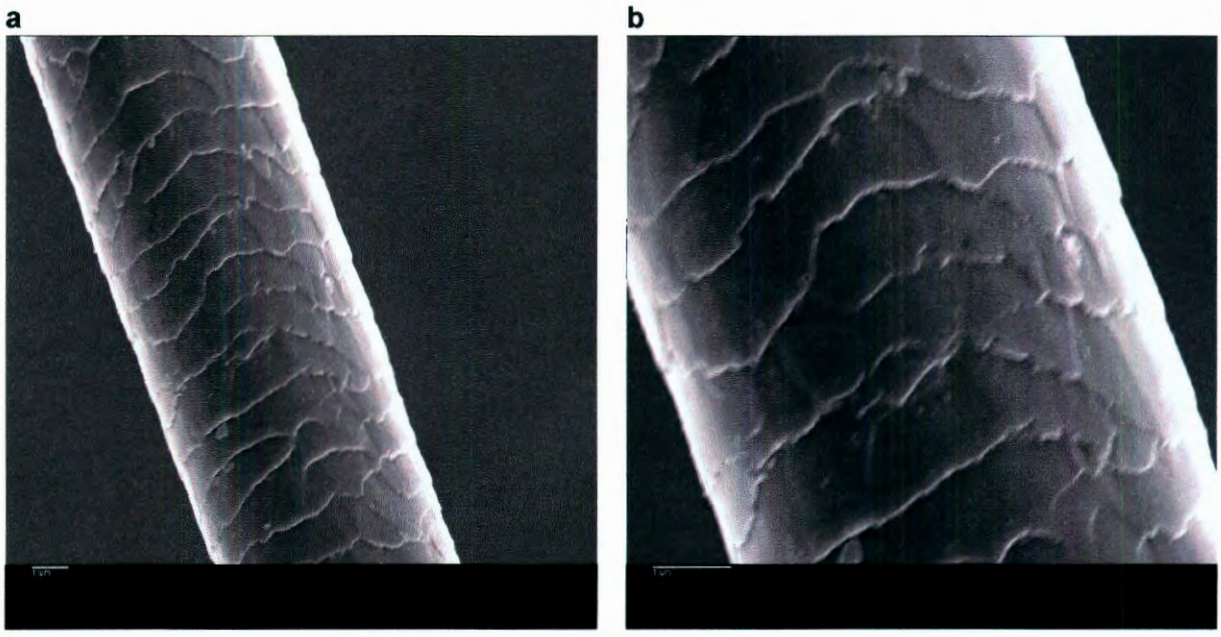


Figure 6.22 Electron microscopic photographs of the cuticular scale pattern of the hair from the ear of the impala (a = 750x, b = 1 600x).

6.3.2 Diameter measurements of the hair from different body parts of an impala

The result of the measurements of the diameter of the hair from different body parts of the impala is presented in Table 6.1.

6.4 DISCUSSION AND CONCLUSIONS

From this study it would appear that the features of the hair from the different body parts of the impala, as viewed in a cross-section, are relatively similar. It is only the hair from the ears and tail that differ somewhat from the rest (see Figures 6.5 and 6.21). The hair from the other nine body parts have a papillo-convex shape, while those from the ears and tail have oval to oblong shapes. In the final analysis it is apparent that no single factor, except the cross-section outline of the hair of the impala can be used as an indication of the body part from which it originates. It was also established that the papillo-convex and related shapes of the hair of an impala are unique and differ from all the other mammal species included in this study.

The cuticular scale patterns proved less useful in distinguishing between the hair of the different body parts. The scale patterns are very similar and only minor differences can be observed between the hair from the eleven body parts. The scale pattern tends

towards a regular, mosaic pattern in the mid-shaft region of the hair, except in the hair from the foreleg and brisket, which show an irregular, mosaic pattern.

Table 6.1 Diameter measurements of the hair from different body parts of the impala

	Hair diameter (µm)			
Body part	**Mean**	**Range**	**Standard deviation**	**n**
Face	41	36 – 50	*	7
Back	12	490 - 150	±18.3	10
Tail	55	50 - 65	*	3
Neck	83	70 - 100	*	7
Shoulder	122	110 - 150	±11.4	10
Thigh	84	70 - 100	±11.3	10
Throat	49	44 - 51	± 2.1	10
Abdomen	128	100 - 140	±12	10
Foreleg	80	60 - 100	±16.2	10
Brisket	102	70 - 130	± 20	10
Ears	34	27 - 39	± 24.6	10

* The standard deviation of the hair from those body parts where less than ten hairs were measured, was not calculated.

In terms of diameter measurements of the hair, the largest variation was found in the hair from the ears, brisket, back and foreleg. The hair of the abdomen have the largest mean diameter, followed by the hair from the back, shoulder, brisket, thigh, neck, foreleg, tail, throat, face and ears, respectively.

Van Wyk (2003) observed that the leopard has the following preferred order when feeding on the carcass of an antelope such as the impala: thighs, foreleg, abdomen, shoulder, back and tail, neck, brisket, throat and head. Based on this preference, it is evident that hair from body parts with the most typical hair features, will be ingested. It can thus be concluded that in all likelihood it will be possible to identify the impala from hair remains in the feaces of a predator such as the leopard.

Dreyer (1964) studied the hair from five different body parts of the impala, namely throat, shoulder, leg, tail and mane and came to a similar conclusion as found in this study. Similar results were also reported by Keogh (1983), especially with regard to the unique papillo-convex shape of the hair of the impala.

CHAPTER 7

KEY TO THE IDENTIFICATION OF SELECTED MAMMAL SPECIES FROM MICROSCOPIC HAIR CHARACTERS

7.1 INTRODUCTION

A key points out the most distinctive characteristics of hair of the different mammal species (Perrin & Campbell 1980). According to Oli (1993) an identification key is never perfect. Firstly, it is primarily based on the structure of the guard hair and could be vulnerable to incorrect identification if the hair sample does not contain guard hair. Secondly, a key normally does not include details of the hair from the extreme parts of an animal's body, such as the face and food pads. Thirdly, hair of mammals which may occur in the study area but are not included in the key, may be incorrectly identified. Coman & Brunner (1974) also noted that inter-species overlap in certain hair characteristics can limit the usefulness of some structures as diagnostic features.

In recognition of all these limitations, an attempt was made to compile two identification keys to assist in the identification of thirty-six of the mammal species included in this study. The most used features in this key include the shape and arrangement of the cuticular scale patterns, the shape of the hair in the cross-section and the shape and arrangement of the medulla and cortex, which are also visible in the cross-section of the hair. Hair diameter was not used extensively in this key, but colouration was used to some extend. It has been documented that knowledge of hair pigmentation and colour can aid in the identification (Perrin & Campbell 1980).

In many smaller mammals the guard hair have a groove running longitudinally along one side of the hair and this groove usually occur at the region of the hair with the largest diameter (Perrin & Campbell 1980). Keogh (1985) discarded the use of the medullary configuration as a diagnostic feature in rodents as this was found to vary along the length of the hair. For that reason the cuticular scale pattern, together with the morphology of the groove, have been used for identification and the formulation of the key of the rodents. Subsequently, the key to the identification of the mammal species in this study is divided into two parts. The Bovidae, Viverridae, Procaviidae, Mustelidae, Gliridae, Suidae, Leporidae, Orycteropodidae, Sciuridae and Cercopithecidae in the first group and the

Muridae and Thryonomyidae in second group. Since the key does not always key out on individual species, it should be used only to narrow down the number of possible species. For the final identification the detailed description of the hair in Chapter 5 must be consulted.

7.2 KEY TO THE HAIR OF THE MAMMAL SPECIES INCLUDED IN THE STUDY

7.2.1 Key I (Bovidae, Viverridae, Procaviidae, Mustelidae, Gliridae, Suidae, Leporidae, Orycteropodidae, Sciuridae, Cercopithecidae)

1. Hair are flattened, spiny and stiff; light-coloured at the base, darkening towards the tip; in the cross-section hair appear deeply concavo-convex, hair have a distorted circular shape in the cross-section with large 'spongy' medulla without any striations and with narrow soft cortex.

   Klipspringer (*Oreotragus oreotragus*) Figure 5.15

   Hair not as above.....2

2. Hair in the cross-section have a unique papillo-convex shape with small medulla and reddish cortex. A regular waved mosaic scale pattern is visible in the mid-shaft region of the hair.

   Impala (*Aepyceros melampus*) Figures 6.3 and 6.4

   Hair not as above.....3

3. Hair in the cross-section are large and circular in shape.

   Common warthog (*Phacochoerus africanus*) Figure 5.32

   Bushpig (*Potamocherus larvantus*) Figure 5.30

   (In the hair of the bushpig the cortex appears light brown, and in the hair of the warthog the cortex appears reddish to light brown).

   Hair in the cross-section not as above.....4

4. The cortex and medulla are seldom distinguishable in the cross-section and appear mainly black. Hair are stiff and wiry. An irregular mosaic scale pattern is visible in the mid-shaft region of the hair.

   Sable antelope *(Hippotragus niger)* Figure 5.1 and 5.2

   Cortex and medulla not as above.....5

5. The hair in the cross-section are concavo-convex, reniform or dumb-bell shaped (some may also be circular or oval shaped) and are grooved.

South African large spotted genet (*Genetta tigrina*) Figure 5.59

Scrub hare (*Lepus saxatilis)* Figure 5.39

Blue duiker *(Philantomba monticola)* Figure 5.25

Common duiker *(Sylvicapra grimmia)* Figure 5.17

Sharpe's grysbok *(Raphicerus sharpei)* Figure 5.21

Shapes of the hair in the cross-section not as above or they are not grooved.....6

6. Medulla in cross-section has a clear visible cortex with medium sized medulla and the cortex are reddish or light brown in colour.

Bushbuck (*Tragelaphus scriptus*) Figure 5.11

Steenbok (*Raphicerus campestris*) Figure 5.19

Medulla in cross-section does not have a clearly visible cortex 7

7. Hair in the cross-section are medium to large in diameter. Hair with a wiry texture.

Gemsbok *(Oryx gazelle)* Figure 5.3

Hair in the cross-section are small in diameter. Hair not wiry as above.....8

8. The shape of the hair in the cross-section can vary from concavo-convex, reniform, oval to circular, but hair are not grooved

Southern reedbuck (*Redunca arundinum*) Figure 5.13

Hair not as above.....9

9. In the cross-section hair have a strict concavo-convex shape with pigments aggregated in the distal points of the cortex

South African ground squirrel *(Xerus inauris)* Figure 5.41

Hair not as above.....10

10. Hair have an irregular, waved mosaic cuticular scale pattern in the mid-shaft region of the hair with more than three cuticular scales across the width.

Dwarf mongoose *(Helogale parvula)* Figure 5.64

Springhare *(Pedetes capensis)* Figure 5.38

Striped polecat *(Ictonyx striatus*) Figure 5.65

Hair not with more than three cuticular scales across the width of the hair.....11

11. In the cross-section the cortex are distinctly visible and under light microscopy the colour varies from orange, yellow to light brown.
    Waterbuck *(Kobus ellipsiprymnus)* Figure 5.5
    Banded mongoose *(Mungos mungo)* Figure 5.60
    Hair not as above.....12

12. Appearance of cross-section of the hair singular homogeneous.
    Red duiker (*Cephalophus natalensis)* Figure 5.23
    Suni (*Neotragus moschatus*) Figure 5.27
    Appearance of hair in the cross-section not as above 13

13. White hair in the cross-section have distinctive large cortex and small medulla.
    Syke's monkey (*Cercopithecus albogularis*) Figure 5.57
    Nyala (*Tragelaphus angasii*) Figure 5.9
    Cortex of white hair in cross-section does not appear large as described above.
    Greater kudu (*Tragelaphus strepsiceros*) Figure 5.7
    African striped weasel (*Poecilogale albinucha*) Figure 5.65
    (white hair in cross-section of the striped polecat, African wild cat and African striped weasel are bigger than those of darker hair)
    Hair not as above.....14

14. The hair are oval or circular in the cross-section. A large percentage of distinctive under fur hair are usually present with small medulla and yellow cortex.
    Rock dormouse (*Graphiurus platyops*) Figure 5.37 and 5.33
    Hair not as above.....15

15. In the cross-sections of the hair large oval or distorted oval cortex are visible, while the medulla are indistinguishable or are only visible as narrow slits.
    Aardvark (*Orycteropus afer*) Figure 5.75
    Rock hyrax (*Procavia capensis*) Figure 5.35

7.2.2 Key II (Muridae, Thryonomyidae)

1. Hair with a shallow groove and two to three scales across the width. Hair have a chevron shape in the mid-shaft region.
    Red veld rat (*Aethomys chrysophilus)* Figure 5.48.
    Hair with a shallow groove and two scales across the width. No chevron shape is

visible in the mid-shaft region of the hair.

Woodland thicket rat (*Grammomys dolichurus)* Figure 5.51

Hair not as above.....2

2. Hair are lanceolate-pectinate in the mid-shaft region with two to three scales across the width. Grooves not clearly defined.

Mozambique thicket rat *(Grammomys cometes)* Figure 5.53

Hair not as above.....3

3. Hair with poorly defined grooves. Scales are shallow and wide with two scales across the width and the scale margins are crenate in the mid-shaft region.

Gambian giant rat (*Cricetomys gambianus*) Figure 5.46

Bushveld gerbil (*Tatera leocogaster*) Figure 5.49

A mosaic pattern is visible in the mid shaft region of the hair, which can be irregular (figure 5.44) or regular (figure 5.56)

Greater cane rat *(Thryomys swinderianus)* Figure 5.44

Four-striped grass mouse (*Rhabomys pumilio*) Figure 5.56

CHAPTER 8

GENERAL DISCUSSION AND CONCLUSIONS

The method of Keogh (1983) and Oli (1993) according to which the hair of the different mammal species were taxonomically described in this study, is considered to have given satisfactory results. The taxonomic hair features were best observed with a combination of light microscopy and more sophisticated, high magnification, electron microscopy.

The forty mammal species that were studied, covered a broad range of families, namely bovidae, viverridae, procaviidae, mustelidae, gliridae, muridae, suidae, leporidae, orycteropodidae, sciuridae, felinae, cercopithecidae and thryonomyidae. Since it was impossible to obtain hair samples from fresh carcasses or live specimens, all hair samples, except those of the impala, were taken from preserved material hosted in the Transvaal museum. Keogh (1975) compared the cuticular scale pattern of hair from live specimens with those of museum specimens to determine the effect of museum storage on cuticular structure. He found the effect of museum storage to be negligible.

In this study, mainly the guard hair of the fourty mammal species were considered for study, but the fine hair in some species were also studied. It was found that it is mainly the guard hair that showed variation in shape and characteristics between different mammal species. Fine hair are generally circular or oval in cross-sections and are not of much use in identification. The four features of hair morphology that were considered the most important for identification are the cuticular scale patterns and the cross-section shape of the hair itself, the cortex and medulla. Keogh (1983) used these four characteristics of hair in the formulation of a key. Amerasinghe (1983) explained the limited value of pigmentation in hair identification, as it may vary with age, season and nutrition. In addition, it may undergo deterioration when subjected to weathering or the action of digestive enzymes of a predator (Perrin & Campbell, 1980). However, the colour of the hair and the appearance and distribution of the pigments can sometimes aid identification. In this study pigmentation was considered in the description of the cross-section of the hair.

Keogh (1983) carried out his study on thirty three species of bovids. The results of this study are comparable to the results of his study with regards to the following species: waterbuck, sable antelope, common duiker, greater kudu, bushbuck, klipspringer and

impala. Compared to this study, differences were observed with regard to the southern reedbuck, in which oval, oblong and dumb-bell shaped hair were observed, while Keogh (1983) reported only dumb-bell shaped hair for the same part of the hair.

The results of Buys & Keogh (1984) showed that the warthog has large medulla with an irregular mosaic scale pattern in lighter hair. A similar scale pattern was observed in this study. The taxonomic characters of the hair of the bushpig as described in this study also correspond with those of Buys and Keogh (1984). They also found that there was no distinction between the cortex and the medulla in darker hair, while the cortex is light brown in pale coloured hair.

The scale patterns of the common duiker, greater kudu and bushbuck, as described in the study of Perrin and Campbell (1980), correspond in all respects with those observed in this study (regular, mosaic scale pattern). In the case of the caracal the results are difficult to compare since the illustration by Perrin and Campbell (1980) only showed the base and mid-shaft region of the hair of this species. In this study it was found that in the cross-section the hair of the klipspringer has the most unique features. According to Keogh (1983) the large 'spongy,' medulla of the hair of the klipspringer offers protection against heat or cold.

The hair of the impala taken from the different body parts varied in colour. Hair on the underside of the body are totally unpigmented and are subsequently paler in colour than those from the upper parts. However, although useful, difference in hair colour is unreliable for the purpose of identification, except, in certain specific instances (Oli 1993). The papillo-convex shape in the cross-section of the hair of the impala is also unique among the mammal species described in this study.

Wildman (1954) stated that hair scale patterns cannot be considered diagnostic features under all conditions, since scale patterns of hair from species of the same genus may be similar and even species of different groups may sometimes have similar scale patterns. Microscopic examination of hair structure from different body parts of the impala did reveal a number of differences, but in support of the statement of Wildman (1954) the scale patterns of hair from the different hair body parts were found to be very similar. The only exceptions were hair from the brisket and foreleg that differed from the hair of the rest of the body.

A key using the taxonomic characters of the hair was presented to assist in the identification of thirty six of the studied mammal species. In support of Wildman (1954); Dreyer (1964); Perrin & Campbell (1980); Oli (1993) and Bryce (1994), it is concluded that the appearance of the scale pattern, the thickness of the cortex, structure of the medulla and the shape of the hair in the cross-section can be used as identification of the mammal species, but they should only be used as supporting evidence in conjunction with other characteristics such as the groove of the hair, pigmentation, length and shape of the hair.

SUMMARY

THE MICROSCOPIC IDENTIFICATION OF MAMMAL SPECIES FROM HAIR SAMPLES

The expansion of the game ranching industry in South Africa has benefited predators such as the leopard through expanding habitat availability and increased divesity availability of prey animals. In view of the value of game, especially rare game species, losses due to predators are often viewed by land owners in a more serious light than stock losses. This has led to increased prosecution of predators such as the leopard. In an attempt to address the conflict between predators and game- and livestock farmers, a research project on leopards was initiated in the Limpompo Province, South Africa (Smit 2002; Van Wyk 2003). As part of this larger research project, the need has arisen to be able to identify the remains of mammal prey species in the feaces of leopards.

A list of fourty expected prey mammal species that potentially occur in the northern savanna areas of South Africa was compiled. They covered a broad range of families, namely bovidae, viverridae, procaviidae, mustelidae, gliridae, muridae, suidae, leporidae, orycteropodidae, sciuridae, felinae, cercopithecidae and thryonomyidae.

The objectives of this study were to prepare hair samples from these selected mammal species for microscopic analyses with a view to obtain detailed illustrations of the cuticular scale patterns and cross-sections of the hair, to study and describe the taxonomic features of the hair of the various mammal species and to compile a key that can assist with the identification of these mammal species from microscopic analyses of hair samples. Hair samples were taken from the dried skins of specimens of the selected mammal species that were hosted in the Transvaal Museum in Pretoria.

A study was also conducted to determine if the characteristics of hair from distinctly different body parts of mammals differ. The impala was selected for this study in view of its importance as a preferred prey species of the leopard in the northern savanna of South Africa. Hair samples for this study were obtained from a fresh impala carcass.

After preparation of the hair samples, the cuticular scale patterns were photographed using a scanning electron microscope. Cross-sections of the hair were photographed with a Nikon light microscope. In this study, mainly the guard hair of the mammal species

were considered for study since they showed the most distinct variation in shape and characteristics. The four features of hair morphology that were considered the most important for identification, are the cuticular scale patterns, the cross-section shape of the hair itself, the cortex and medulla. The colour of the hair and the appearance and distribution of the pigments can sometimes serve as aids to identification and in this study pigmentation was considered in the description of the cross-section of the hair.

The hair of the impala taken from the different body parts varied in colour. Microscopic examination of hair structure from the different body parts revealed a number of differences namely the cross-section shapes, diameter of hair and the pigmetation of the cortex, but the scale patterns of hair from the different hair body parts were found to be very similar. The only exceptions were hair from the brisket and foreleg that differed from the hair of the rest of the body.

A key using the taxonomic characteristics of the hair, was compiled to assist in the identification of the thirty-nine mammal species. Since the key does not always key out on individual species, it is recommended that the key only be used to narrow down the number of possible species. For the final identification the detailed description of the hair must be consulted.

Keywords: Body parts, Cortex, Medulla, Predators, Prey, Scale patterns, Taxonomy

OPSOMMING

DIE MIKROSKOPIESE IDENTIFIKASIE VAN SOOGDIERSPESIES VANAF HAARMONSTERS

Die uitbreiding van die wildbedryf in Suid-Afrika het roofdiere soos die luiperd bevoordeel deur groter habitat beskikbaarheid en die groter getal en diversiteit prooi wat beskikbaar is. In die lig van die waarde van wild, veral skaars wildspesies, beskou grondeienaars wildverliese deur roofdiere dikwels in 'n meer ernstige lig as veeverliese. Dit het tot verskerpte jagmakery op roofdiere soos die luiperd gelei. In 'n poging om die konflik tussen roofdiere en wild- en veeboere aan te spreek, is 'n navorsingsprojek op luiperds in die Limpopo Provinsie van Suid-Afrika geloods (Smit 2002, Van Wyk 2003). As deel van hierdie groter navorsingsprojek het die behoefte onstaan om die oorblyfsels van soogdier-prooi in die mis van luiperds te kan identifiseer.

'n Lys van nege-en-dertig soogdierspesies wat potensieël in die noordelike savanna dele van Suid-Afrika kan voorkom is saamgestel. Hulle sluit 'n wye verskeidenheid van families in, naamlik bovidae, viverridae, procaviidae, mustelidae, gliridae, muridae, suidae, leporidae, orycteropodidae, sciuridae, felinae, cercopithecidae en thryonomyidae.

Die doelstellings van die studie was om haarmonsters van hierdie geselekteerde soogdierspesies vir mikroskopiese analise voor te berei ten einde gedetaileerde illustrasies van die kutikulêre skubpatrone en die dwarsdeursnee van die hare te verkry, tweedens om die taksonomiese eienskappe van die hare van die onderskeie soogdierspesies te bestudeer en te beskryf, en laastens om 'n identifikasiesleutel saam te stel wat die identifikasie van soogdiere vanaf mikroskopiese analise van haarmonsters sal vergemaklik. Haarmonsters is geneem van droë huide van die geselekteerde soogdierspesies wat in die Transvaal Museum in Pretoria gehuisves word.

A studie is ook onderneem om te bepaal of die eienskappe van hare afkomstig van verskillende liggaamsdele van soogdiere, verskil. Die rooibok is vir hierdie studie gekies aangesien dit so 'n belangrike prooispesie van die luiperd in die noordelike savanna dele van Suid-Afrika is. Die haarmonsters vir hierdie studie is van 'n vars rooibok karkas verkry.

Na voorbereiding van die haarmonsters is die kutikulêre skubpatrone met behulp van 'n skanderings-elektronmikroskoop gefotografeer. Die dwarsdeursnit van die hare is met behulp van 'n Nikon ligmikroskoop gefotografeer. In hierdie studie is hoofsaaklik skuthare vir die studie gebruik aangesien hulle die duidelikste verskille in vorm en eienskappe toon. Die vier eienskappe van haarmorfologie wat as die belangrikste vir identifikasie beskou is, is die kutikulêre skubpatrone, die vorm van die hare op die dwarsdeursnit, die korteks en die medulla. Die kleur van die hare en die voorkoms en verspreiding van die pigmente kan soms as hulpmiddel gebruik word, en in hierdie studie is pigmentasie in ag geneem by die beskrywing van die dwarsdeursnit van die hare.

Die hare afkomstig van die onderskeie liggaamsdele van die rooibok het verskil in kleur. Mikroskopiese analise van die haarstruktuur het 'n aantal verskille getoon, maar daar is gevind dat die skubpatrone min van mekaar verskil het. Die enigste uitsonderings was die hare afkomstig van die bors en voorbene wat verskil het van dié van die res van die liggaam.

'n Sleutel wat berus op die taksonomiese eieskappe van die hare is saamgestel om met die identifisering van die nege-en-dertig soogdierspesies behulpsaam te wees. In die lig van die feit dat die sleutel nie in alle gevalle lei tot die seleksie van slegs een spesie nie, word daar aanbeveel dat die sleutel slegs gebruik word om die moontlike spesies te verminder tot 'n kleiner getal. Vir die finale identifikasie moet die gedetaileerde beskrywing van die hare geraadpleeg word.

Sleutelwoorde: Liggaamsdele, Korteks, Medulla, Prooi, Roofdiere, Skubpatrone, Taksonomie

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