control and for the permanent stabilization of, for example, roads, culverts and firebreaks.

- A hedge of the grass grown on the contour of a steep hillside acts as a very efficient filtering agent, allowing water to flow through (albeit at a reduced run-off rate and thereby encouraging soil infiltration above the hedgerow and increasing moisture retention in the soil), but trapping sediment. In this way, natural terraces are formed which may be used for growing various crops without the attendant risk of soil erosion which would be the case if these crops were grown on steep hillsides without hedgerows.
- It recovers very well after burning and so is no problem when burning firebreaks.
- It will grow in poor soils and tolerates very dry conditions as well as frost.
- It can be cut regularly during the growing season in the summer months and the harvested material can be used for both weaving and thatching.
- A chemical present in the roots of the grass is used in the manufacture of perfumes.

Given a plentiful supply of planting material, which means adequate nursery facilities, the widespread distribution of information about the grass and its various conservation and economic benefits, and good extension support, there is every reason to believe that vetiver grass could be used as a significant tool in soil and moisture conservation in southern Africa, particularly in the less-developed rural areas. □

Observations on the carnivorous activities of chacma baboons at the Buxton Limeworks, Taung District, Bophuthatswana

Jeffrey K. McKee

Predation of animals is a relatively rare behaviour among baboons, although they are opportunistic omnivores occupying a wide range of ecological niches. Assessments of the mode and purpose of predation by baboons may have implications for studies of the origins of carnivorous behaviour and hunting among early hominids.[1,2]

Information on carnivorous activities among baboons is largely anecdotal, although some systematic studies exist.[3-5] In this article I add further anecdotal information on the carnivorous activities of the chacma baboon (*Papio cynocephalus ursinus*) due to the uniqueness of the events witnessed. The opportunity for these observations arose during the excavation of the Taung hominid fossil site at the Buxton Limeworks in Bophuthatswana.[6] This is an arid area at the south-eastern edge of the Kalahari Desert. The nearby Thabasikwa River is frequented by a troop of up to 30 baboons.

The usual diet of the Buxton baboons comprises plant matter, primarily grass seeds and the fruits of the invasive South American pepper trees (*Schinus molle*[7]). Collections of baboon faeces revealed that this is supplemented by insects and freshwater crabs. The inclusion of crabs in the diet is unique for inland baboons, although it has been reported that baboons along the Cape coast eat crabs.[8] This is an opportunistic behaviour because observations of the faeces of a separate troop, 3 km to the south where there is a less substantial water source, revealed no crab remains. The crabs were apparently eaten whole as most of their body parts were represented in the faeces.

Baboon predation on kid goats was witnessed near the excavation site on two occasions. The first instance on 30 August 1989, appeared to be an example of cooperative hunting. Two large males ambushed a kid goat from a domestic herd (Fig. 1). From their starting point where they were hidden by a tree, one of the baboons climbed to the top of the escarpment and chased the herd down a slope. As the goats approached the bottom, the second baboon charged at the herd and mortally wounded a kid goat with a single swipe of the forelimb. Some local herders then chased the baboon away and he carried the goat for a short distance before dropping it and fleeing empty-handed.

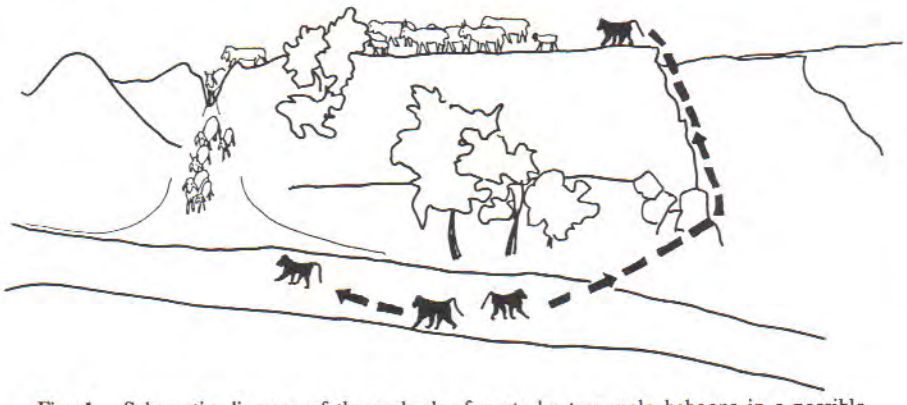

Fig. 1. Schematic diagram of the ambush of goats by two male baboons in a possible co-operative hunt.

Although the ambush may not have been as planned as it appeared, some forethought seems likely. The first baboon scaled the cliff from near the position of the second baboon before chasing the herd at a leisurely pace. This baboon, moreover made no attempt to capture a goat, despite ample opportunity in the presence of younger kids. Although cooperative hunting among baboons has been reported,[1,2] it is extremely rare. This is the first reported case of an ambush apparently involving dual-stage logic of 'planning' and execution.

Records from a second instance of predation, on 10 July 1990, add further to our knowledge of carnivorous habits among baboons. The kill was made by a single male baboon which isolated a kid goat on a cliff face, caught it with his large canines and carried it in his mouth to the top of the escarpment. The live goat was then laid out for consumption and the abdomen was torn open. Although the baboon was immediately chased away by local residents, I tracked him as he rejoined the troop. When he returned to the kill about 10 minutes later, he was allowed to eat without disturbance so that we could observe his behaviour from a distance. After three or four minutes of eating and manipulation of the goat, the baboon slowly left and again we observed him rejoin the troop.

In each example of predation, the baboon used its hand to slash open the goat's flank. The baboon that was allowed to eat consumed only the liver after breaking away a lower rib, leaving all other parts untouched. He inspected the hind-quarters, which in reports of

Dr Jeffrey K. McKee is in the Department of Anatomy and Human Biology, University of the Witwatersrand Medical School, 7 York Road, Parktown, 2193 South Africa.

other similar events has usually been the next part to be consumed.[1,4,5] It has been reported that in East Africa, the uneaten portions of the kill are often consumed by other members of the troop.[3,4] Our presence, although at a distance of about 200 m, may have prevented further consumption of the goat, but the rest of the troop stayed about half a kilometer away. Furthermore, it has been noted that in southern Africa it is generally the rogue males that attack the herds,[9] but in the instances reported in this article, the male was clearly a member of the locally resident troop.

As is common in other recorded cases of predation, the baboons attacked young, vulnerable members of a herd.[3,5,8,9] These events both occurred during dry winter months, as is most common in southern Africa.[1,9] Local residents have observed predation at any time of year, but it is more common in the winter when there are as many as four or five cases of predation a month. Indeed, the baboons in this area had sufficient plant food and were observed to co-exist peacefully with the herd in the preceding and succeeding weeks.

Meat-eating and predation by baboons has been attributed to hypothetical causes ranging from the 'instinctive need for animal protein'[1] to social reinforcement of the troop,[4] none of which is supported by all of the evidence. In the assessment of any theory, it should be noted from the events described here that the meat was not shared with, or even consumed by, other troop members; that alternative sources of protein, vitamins and other nutrients were available in plants, insects and crabs and that cooperative hunting can involve an apparent degree of forethought.

Support for the Taung research project was generously provided by the Centro Studi e Ricerche — Ligabue. I wish to thank Phillip V. Tobias, the project director, as well as Wallace Scott, Lee Berger, Vivian Ferraz and Andrew Black for their assistance, and Jean McKee for drawing the figure.

1. Dart R.A. (1963). The carnivorous propensity of baboons. *Symp. Zool. Soc. Lond.* **10**, 49–56.
2. Strum S.C. (1983). Baboon cues for eating meat. *J. hum. Evol.* **12**, 327–336.
3. Strum S.C. (1975). Primate predation: Interim report on the development of a tradition in a troop of olive baboons. *Science* **187**, 755–757.
4. Hausfater G. (1976). Predatory behavior of yellow baboons. *Behaviour* **56**, 44–68.
5. Harding R.S.O. (1973). Predation by a troop of olive baboons (*Papio anubis*). *Am. J. phys. Anthrop.* **38**, 587–592.
6. McKee J.K. and Tobias P.V. (1990). New fieldwork at the Taung hominid site: 1988–1989. *Am. J. phys. Anthrop.* **81**, 266–267.
7. Palgrave K.C. (1983). *Trees of Southern Africa*. Struik, Cape Town.
8. DeVore I. and Hall K.R.L. (1965). Baboon ecology. In *Primate Behavior*, ed. I. DeVore. Holt, Rinehart and Winston, New York.
9. Stoltz L.P. and Saayman G.S. (1970). Ecology and behaviour of baboons in the northern Transvaal. *Ann. Transv. Mus.* **26**, 99–143.

Technology sources and contribution to productivity in the South African sugar industry

P.A. Donovan

Three sources of technology are postulated in the South African sugar industry: craft skill, which was the only source available for the first 40 years of sugar production in South Africa, imported technology, which had to suffice for the next 35 years, and locally generated technology, which has been available since the founding of the Sugar Association's Experiment Station in 1925. Technology has been found to be only one of the four main factors contributing to productivity in the sugar industry, but appropriate and reliable data have only been available since 1925 to allow estimates to be made of its contribution and value. Before that date, only approximations are possible. Despite this limitation, it is suggested that although yield of sucrose per hectare has increased nearly tenfold during the 130 years of sugarcane production, productivity (in terms of yield per hectare per annum) has increased only 78% and technology's contribution to productivity has declined, although its value probably has not changed significantly throughout the 130 years.

Technology has been defined as the sum of knowledge of the means and methods of producing goods and services.[1] This is particularly appropriate in the South African sugar industry because it excludes neither experience nor management. In this paper, experience, in the guise of craft skills, is shown to be an important source of technology, while management has been shown elsewhere[2] to have a significant effect on technology in sugarcane production. The inclusion of services in the definition of technology is also appropriate because it has been shown in another study[3] that services are an important component of research and development for sugarcane production.

Because appropriate data are not available, any attempt at determining when a source of technology was superceded, or of estimating its contribution to the industry's productivity prior to 1925 when the Sugar Association's Experiment Station was founded, can only be subjective. From 1925 data are available and it is possible to define the sources and quantify the contribution of technology to the industry's productivity more precisely.

Pretechnology era (1862–1890)

For the first 40 years of sugarcane production in South Africa, until about 1890, improvement in yield was probably due largely to the craft skills of cane growers.

There are records of the introduction of sugar-making machinery and visits by people with experience in sugar manufacture during this period[4] but only craft skills seem to have been available for the field production of sugarcane. Craft skill has been described as 'early technology' in which production methods are used without precise knowledge of how or why they are followed. They are acquired by the diffusion of knowledge within an industry and not by formal training, research and development.[1]

By 1890 only a few varieties of sugarcane, obtained fortuitously rather than selected scientifically, had been introduced. These came mostly from Mauritius and Reunion and were described as '..... ill adapted to lower average rainfall, frequent droughts and nearly all cane diseases ....'[5] The variety Uba had been a chance introduction, probably from India[6] in 1883, and by 1890 had become the mainstay of the industry. No other technology seems to have been introduced by that date.

Recording of sugar production data appears to have started in 1862,[7] 12 years after the first sugarcane crop was harvested, but until 1925/26[8] records are not available on the age of cane at harvest or the area under cane. At least one of these figures is needed to calculate a yield per unit area per annum. 'To obtain the actual area under cane ... the (area harvested) should be doubled, especially for the years after 1899 when (the variety) Uba, requiring an average of 22 months to mature, became the standard variety.'[8]

The author's address is 9 Gunda Crescent, Umhlanga Rocks, 4320 South Africa.