CHAPTER 4

ORIGINS

HOMINIDS AND HOMININS

The many similarities between people and Africa's great apes suggested to Darwin (1871) that the continent was the birthplace of the human lineage. Subsequent genetic studies and fossil discoveries have confirmed his hypothesis, beginning in the 1920s with finds from Zambia and South Africa; the latter, the Taung child, is the type-specimen of the genus *Australopithecus* (Dart 1925). A century of research has left southern Africa with a rapidly improving chronological framework, some of the continent's oldest archaeological assemblages, and an extensive hominin record. Indeed, one site, Sterkfontein, is the single richest source of early hominins anywhere, with 'Little Foot' the most complete australopithecine individual ever found (R. Clarke *et al.* 2021). This chapter summarises this wealth of evidence down to the beginnings of the Middle Stone Age. Klein (2009), Gamble (2013), and Humphrey and Stringer (2018) detail the broader global context for it and the next two chapters, Barham and Mitchell (2008) that from the rest of Africa.

Studies of evolution remain framed by the classificatory terminology Linnaeus devised in the eighteenth century. This places *Homo sapiens* and its extinct relatives within the family Hominidae, which groups with the apes in the superfamily Hominoidea. Old and New World monkeys, tarsiers, lemurs, and bushbabies and lorises form the other divisions of the order Primates. However, in applying this taxonomy to the fossil record several problems emerge. First, Linnaeus' scheme, formulated in a pre-Darwinian era, does not lend itself to discussing evolution. Where to draw lines within a single, evolving population is problematic, made worse where populations show strong **sexual dimorphism**. Second, being unable to observe past behaviour directly, we cannot be certain that past populations conform to the standard definition of species as reproductively isolated groups. Palaeoanthropologists must therefore use morphological (skeletal) characters, even though many of the features distinguishing species today are superficial traits (like plumage in birds) or behaviours that do not fossilise. This risks under-estimating the number of species present. On the other hand, since the fossil record samples only a tiny fraction of the variable populations from which it derives, we may also over-emphasise observed differences, inflating the number of taxa recognised – a problem of excessive splitting, rather than too much lumping. For these reasons, it is helpful to think of human evolution in terms of successive adaptive radiations (cf. Foley 1992), rather than sharply defined species (Figure 4.1; Table 4.1).

Other perspectives come from analysing the DNA of modern apes and humans. This confirms our extraordinary similarity to chimpanzees (*Pan troglodytes*) and bonobos (*P. paniscus*) (Prüfer *et al.* 2012). For some, this is so close (~98.8 per cent) as to warrant placing all three species in the same taxonomic tribe (Hominini; Andrews and Harrison 2005), with gorillas (*Gorilla* spp.) and orangutans (*Pongo* spp.) joining them as **hominids**. While no universal agreement exists (R. Clarke *et al.* 2021), here I employ 'hominin' exclusively for humans and their most immediate fossil ancestors and relatives.

Molecular genetics indicates that chimpanzees and humans last shared a common ancestor ~10–7 mya (White *et al.* 2009). Relevant fossils have yet to be found, but several more recent hominins are known (Figure 4.2). They include *Orrorin tugensis* from Kenya, *Ardipithecus kadabba* from Ethiopia, and possibly *Sahelanthropus tchadensis* from Chad (a useful reminder that human evolution was not confined to Africa's Rift Valley); all date to ~7.0–5.5 mya. Better known is *Ardipithecus ramidus*, also from Ethiopia and dating to ~4.4 mya. Small in stature and weight and with an ape-sized brain but teeth smaller than those found in African apes, its pelvis and foot suggest some capacity for bipedalism, even though its hand bones signal continued competence in tree-climbing in relatively humid wooded environments (Gani and Gani 2011). The combination justifies thinking of *Ar. ramidus* as near the baseline from which all other hominins evolved (White *et al.* 2009). Those hominins conventionally fall into two genera, *Australopithecus* and *Homo*, although more robustly built australopithecines from eastern and southern Africa are often placed in a third, *Paranthropus*. In broad terms, bipedal australopithecines retained features suggesting that tree-climbing was still important, and had relatively small brains (458–563 cm^3)[1] set above relatively large faces accompanied by relatively large cheek teeth (molars and premolars). Members of the genus *Homo*, in contrast, show more obligatory bipedalism and exhibit trends towards increasing cranial capacity (609–1,478 cm^3), stature, and body weight, reductions in dentition, jaws, and cranial crests, and delayed maturation rates, as well as expanded ecological range (Klein 2009).

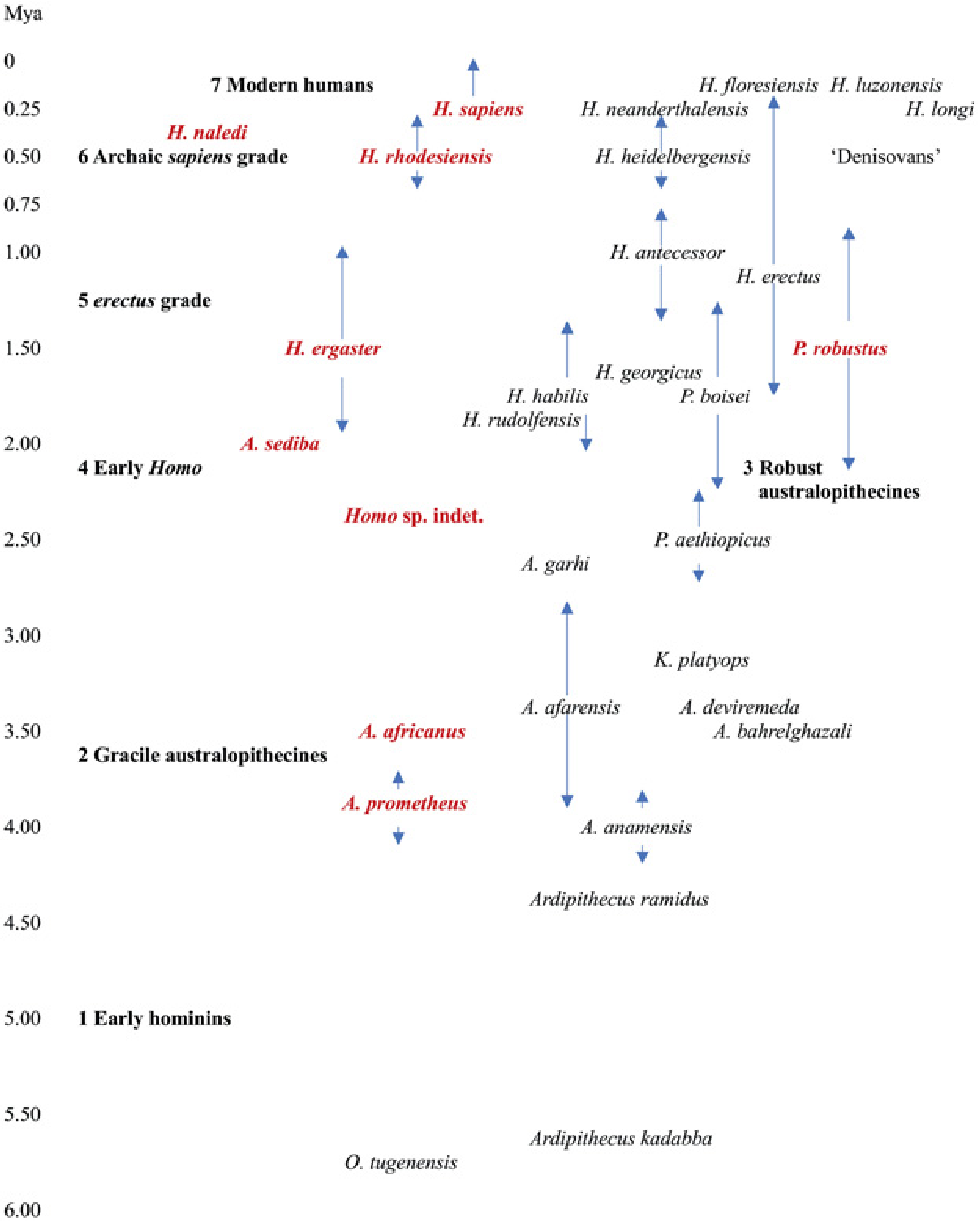

Figure 4.1 Successive radiations in hominin evolution (modified after Foley 1992), showing the approximate time ranges of the taxa illustrated. Note that the arrows do not imply evolutionary relationships. Taxa present in the southern African archaeological record appear in red.

Between 4.2 and 2.9 mya East Africa's hominin record includes several hundred specimens, some assigned to the earliest known australopithecine taxon, *Australopithecus anamensis*, but most to *A. afarensis*, which includes the famous Lucy skeleton from Hadar, Ethiopia (Johanson and Edey 1981). Fossilised

Table 4.1 Linnaean names of current and fossil hominins and African apes (extant species in bold typeface)

Linnaean name	Common name	Age	Comments
Gorilla gorilla	Western gorillas	Extant	Two subspecies: *G. g. gorilla* and *G. g. diehli*
Gorilla beringei	Eastern gorillas	Extant	Two subspecies: *G. b. beringei* and *G. b. graueri*
Pan sp.		0.55–0.28 mya	Only known *Pan* fossil. From Kenya
Pan troglodytes	Chimpanzees	Extant	Four subspecies: *P. t. ellioti*, *P. t. schweinfurthii*, *P. t. troglodytes*, and *P. t. verus*
Pan paniscus	Bonobos	Extant	
Sahelanthropus tchadensis		~7–6 mya?	Hominin status in dispute (Callaway 2018). Known only from Chad
Orrorin tugenensis		6.1–5.7 mya	Known only from Kenya
Ardipithecus kadabba		5.8–5.5 mya	Known only from northern Ethiopia
Ardipithecus ramidus		4.5–4.3 mya	Known only from northern Ethiopia
Australopithecus anamensis		4.2–3.8 mya	Known only from northern Kenya
Australopithecus prometheus	Gracile australopithecines	4.02–3.67 mya	Known only from Sterkfontein and Makapansgat, South Africa
Australopithecus afarensis		3.8–2.9 mya	Known only from East Africa
Australopithecus bahrelghazali		3.5 mya	Known only from Chad
Australopithecus africanus	Gracile australopithecines	3.5–3.4 mya	Known only from South Africa. Possibly younger at Makapansgat and Taung
Australopithecus deyiremeda		3.5–3.3 mya	Known only from northern Ethiopia
Kenyanthropus platyops		3.3–3.2 mya	Known only from northern Kenya. Present at Lomekwi where stone tools are dated ~3.3 mya
Homo sp. indet.	Early *Homo*	2.8–1.9 mya	Known from East and South Africa. May include specimens assignable to *H. habilis* and/or *H. rudolfensis*

(*continued*)

Table 4.1 (*continued*)

Linnaean name	Common name	Age	Comments
Paranthropus aethiopicus	Robust australopithecines	2.7–2.3 mya	Known only from East Africa
Australopithecus garhi		2.6–2.5 mya	Known only from northern Ethiopia. Present at Gona where stone tools date to 2.5 mya
Paranthropus boisei	Robust australopithecines	2.3–1.34 mya	Known only from East Africa
Paranthropus robustus	Robust australopithecines	2.2–0.8 mya	Known only from the Cradle of Humankind, South Africa
Australopithecus sediba		1.95 mya	Known only from Malapa, South Africa
Homo rudolfensis		1.9–1.8 mya	Known only from East Africa. May be identical to *H. habilis* (R. Clarke 2017)
Homo habilis		1.9–1.44 mya	Known only from Africa. May be present from 2.3 mya, but several specimens may belong to *Australopithecus* (R. Clarke 2017)
Homo ergaster		1.9–1.0 mya	Known only from Africa. May include DNH 134 from Drimolen (2.04 mya)
Homo georgicus		1.8–1.6 mya	Taxonomic validity disputed. Possibly *H. habilis* or *H. erectus*. Known only from Dmanisi, Georgia
Homo erectus		1.8–0.1 mya	Reserved here for specimens from East and Southeast Asia (B. Wood 1992)
Homo antecessor		1.4–0.78 mya	Known only from Spain
Homo rhodesiensis		0.6–0.3 mya	Known only from Africa; sometimes subsumed within *H. heidelbergensis*. Ancestral to anatomically modern humans. Inclusion of the Elandsfontein cranium pushes the dates cited back to 1.0–0.78 mya

(*continued*)

Table 4.1 (*continued*)

Linnaean name	Common name	Age	Comments
Homo heidelbergensis		0.6–0.3 mya	Known from western Eurasia. May subsume *H. rhodesiensis*. Ancestral to Neanderthals
Homo naledi		0.34–0.24 mya	Known only from the Rising Star cave system, South Africa
Homo longi		0.3–0.1 mya	Dating uncertain, but a late Middle Pleistocene age probable. Known only from China
Homo neanderthalensis	Neanderthals	0.3–0.04 mya	Known only from western Eurasia. Interbred with *H. sapiens*
Homo floresiensis		0.1–0.06 mya	Known only from Flores, Indonesia. Probably also of much greater antiquity (~0.8 mya)
Homo luzonensis		>0.05 mya	Known only from Luzon, Philippines. Probably also of much greater antiquity (~0.7 mya)
Homo sapiens	Anatomically modern humans	<0.3 mya	Expands to inhabit all land masses

footprints from Laetoli, Tanzania, confirm the bipedal status of *A. afarensis* (Hay and Leakey 1982). For *A. anamensis*, stable isotope analyses and dental wear suggest an omnivorous diet, high in fruit, consistent with its woodland setting, and forearms and long bones allowing it to climb trees with ease. In contrast, while retaining arboreal adaptations (Heaton 2016), *A. afarensis* had a more variable diet and ecology, including savanna settings where it consumed C_4 plants and others following a CAM photosynthetic pathway in contrast to the largely C_3 signal of chimpanzees living in such environments today (Sponheimer *et al.* 2013). Its degree of sexual dimorphism is disputed (Heaton 2016), but, if high, may reflect chimpanzee- or gorilla-like social systems or lumping together of multiple taxa. Those proposed in the 3.5–3.2 mya range include *Kenyanthropus platyops* from Lomekwi, Kenya, where stone tools are dated to ~3.3 mya (Harmand *et al.* 2015).

THE CRADLE OF HUMANKIND

South Africa's Cradle of Humankind (Figure 4.3) has produced an extraordinarily high number of australopithecine fossils plus a few assignable to *Homo* (see Caruana and Stratford 2019 for the Cradle's research history and R. Clarke *et al.* 2021 for an

Figure 4.2 Plio-Pleistocene fossil hominin localities in Africa mentioned in the text (copyright Jonathan Lim).

overview of its fossils). In Gauteng, the original trio of sites in the Sterkfontein Valley – Kromdraai, Sterkfontein, and Swartkrans – is now enriched by Cooper's Cave, Drimolen, Gladysvale, Gondolin, Malapa, and the Rising Star cave system. They are joined by the child from Taung (North West Province) and a few dozen fossils from Makapansgat in Limpopo (Table 4.2). Earlier fossil-bearing localities like Langebaanweg in the Western Cape (~5 mya) lack hominins. If not a sampling problem, this may suggest that they migrated into southern Africa after this time, although an association with the expansion of C_4 grasses (Ségalen *et al.* 2007) is now less clear (Lombard *et al.* 2021b).

Figure 4.3 The Cradle of Humankind: a view to the north in the Malapa Valley, Gauteng, South Africa (Profberger, CC BY-SA 3.0; https://commons.wikimedia.org/wiki/File:The_Malapa_valley.jpg).

Southern Africa lacks volcanic ash and tephra deposits directly datable by techniques such as argon-argon dating. For a long time, all its early hominin fossils had therefore to be dated via correlations with the better-controlled East African sequence, a situation that developments like cosmogenic nuclide dating have now considerably changed (Herries 2022). Another contrast with the Rift Valley is that known sites are all dolomitic limestone caves into which sediments and individual hominins (as well as other animals indicative of prevailing environmental conditions) were repeatedly introduced from the surface. Their hardened breccia deposits typically require hammers, chisels, and even explosives as excavation tools, in marked contrast to the lacustrine and riverine sedimentary contexts common in East Africa. These caves are clearly not places where hominins lived. Indeed, some finds undoubtedly represent the remains of hominins that entered them after being killed and eaten by leopards (Brain 1981). Although its puncture wounds and depressed fractures suggest transport by a large raptor, possibly the crowned eagle (*Stephanoaetus coronatus*; Berger and Clarke 1995), the Taung child's fate may have been similar (Hedenström 1995).

The Taung child (Figure 3.2), some of those from Makapansgat, and a few teeth from Gladysvale belong to the relatively gracile taxon *Australopithecus africanus*; relevant dates of 3.03–2.07 mya at the first two sites depend entirely on palaeomagnetic and biostratigraphic correlation (Herries 2022). Cosmogenic

Table 4.2 Dating of early hominin-bearing deposits in southern Africa of Pliocene and Lower Pleistocene age

Site	Provenance	Age (after Granger *et al.* 2022; Herries 2022)	Fossil hominins (after Herries 2022; Zanolli *et al.* 2022)
Cooper's Cave	D	<1.4 mya	*P. robustus*
Cornelia-Uitzoek	MYC	1.07–0.99 mya	Early *Homo*
Elandsfontein	Homo Bay – Calcrete	1.0–0.78 mya	*H. ergaster* or *H. rhodesiensis*
Drimolen	DMQ	2.04–1.95 mya	*H. ergaster*; *P. robustus*
Gladysvale	*Ex situ* dump	<2.4 mya	*A. africanus*?
Gondolin	*Ex situ* dump	~1.8 mya	Early *Homo*; *P. robustus*
Haasgat	*Ex situ* dump	?	*Australopithecus* or early *Homo*
Kromdraai B	Members 2–6	2.0–0.8 mya	*P. robustus*
Makapansgat	Member 3/4	(3.6?) 3.03–2.61 mya	*A. africanus*
Malapa	Facies D and E	~1.95 mya	*A. sediba*; early *Homo*
Sterkfontein	Jacovec Cavern – Orange Breccia	4.02–3.61 mya	*A. prometheus*
	Silberberg Grotto – Member 2	3.67 mya	*A. prometheus*
	Member 4	3.5–3.4 mya	*A. africanus*
	Member 5 StW Infill	1.8–1.6 mya	*Australopithecus* sp.
	Member 5 Oldowan Infill	1.4–1.2 mya	*P. robustus*
	Member 5 Acheulean Infill	1.3–1.0 mya	Early *Homo*
	Milner Hall	~1.3 mya?	Early *Homo*?
Swartkrans	Member 1	2.2–1.8 mya	Early *Homo*; *P. robustus*
	Member 2	1.7–1.1 mya	*P. robustus*
	Member 3	1.0–0.8 mya	*P. robustus*
Taung	Dart Pinnacle PCS	(3.6?) 3.03–2.61 mya	*A. africanus*

nuclide dating of the much larger assemblage from Sterkfontein Member 4 is more secure and places it a million years earlier than previously thought at ~3.5–3.4 mya, making *A. africanus* contemporary with, *not* a descendant of, *A. afarensis* (Granger *et al.* 2022). Features of note include reduced front teeth (canines, incisors), a still small cranial capacity (~464 cm^3), and the retention of adaptations for tree-climbing in the arm and shoulder.

Two other gracile fossils from Sterkfontein (Figure 4.4) come from slightly older contexts. The first, StW 578, a partial cranium from the Orange Breccia in the site's Jacovec Cavern, probably dates to 3.61 mya (Granger *et al.* 2022).

Figure 4.4 Partial view of the excavation area at Sterkfontein, Gauteng, South Africa.

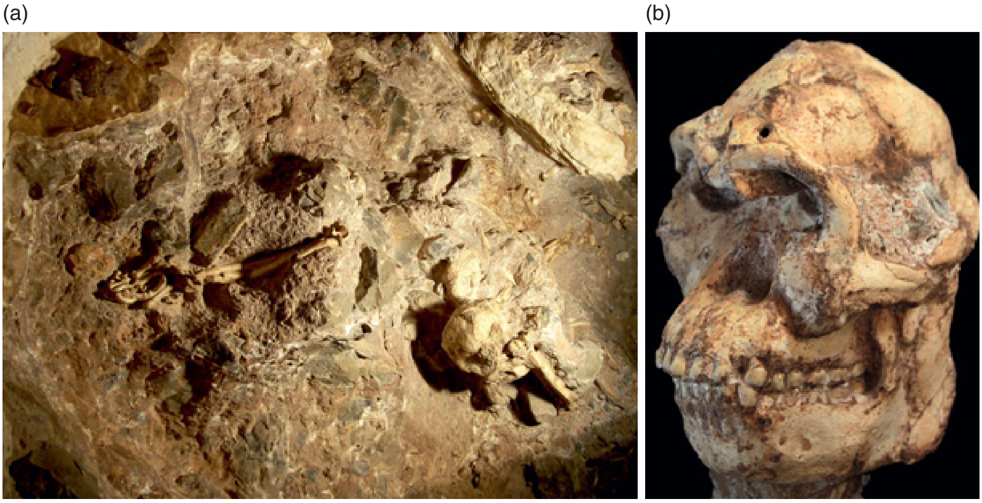

Figure 4.5 *Australopithecus prometheus* (StW 573; 'Little Foot') from Sterkfontein: (a) general view of the skeleton *in situ* (Vincent Mourre, CC BY-SA 3.0; https://commons.wikimedia.org/wiki/File:Littlle_Foot-1.jpg); (b) the skull (Wits University, CC BY-SA 4.0; https://commons.wikimedia.org/wiki/File:Litte_Foot,_Skull.JPG).

The other specimen, StW 573 ('Little Foot'), is a ~90 per cent complete skeleton from Member 2 in Sterkfontein's Silberberg Grotto (Stratford and Crompton 2021) (Figure 4.5). Cosmogenic nuclide dating places the associated sediments at 3.67±0.2 mya (Granger *et al.* 2015); faunal, palaeomagnetic, and

Figure 4.6 Skull (minus the mandible) of *Paranthropus robustus* (SK48) from Swartkrans, Gauteng, South Africa (José Braga and Didier Descouens, CC BY-SA 4.0; https://commons.wikimedia.org/wiki/File:Original_of_Paranthropus_robustus_Face.jpg).

uranium-lead estimates for an age nearer 2.2 mya come from much younger intrusive flowstones and solution cavities (Bruxelles *et al.* 2019). R. Clarke and Kuman (2019) assign StW 573 to another gracile species, *A. prometheus*, to which some of the Makapansgat fossils and roughly half of those from Sterkfontein Member 4 also belong. StW 573 was an effective biped both on the ground and in trees (Crompton *et al.* 2021), ate a relatively low-quality, high-fibre diet (Stratford and Crompton 2021), and had a relatively small brain (408 cm^3) that resembled chimpanzees more than *Homo* (Beaudet *et al.* 2019). Collectively, it and the other Sterkfontein graciles now have a relatively constrained mid-Pliocene age that significantly extends the range and diversity of hominins known from this time (Granger *et al.* 2022, 2023).

Southern Africa's robust australopithecines (Figure 4.6) are known only from the Cradle of Humankind. They include almost all the fossils from Kromdraai B and Swartkrans Members 1–3, plus a few more from Cooper's D, Drimolen, Gondolin, and the older part of Sterkfontein Member 5. Associated dates place them ~2.2–0.8 mya. They are generally assigned to *Paranthropus* (*Australopithecus*) *robustus*, although differences in cranial capacity, cheek teeth size, and limb robusticity led Howell *et al.* (1978) to follow Broom (1949) in differentiating the Swartkrans sample as *P. crassidens*. *P. robustus* and its East African sister species *P. boisei* both probably derive from an older taxon, *P. aethiopicus* (2.7–2.3 mya; A. Walker *et al.* 1986). However, whether they all belong to a single lineage is uncertain (Constantino and Wood 2007): a recent phylogenetic assessment suggests that eastern and southern African robust australopithecines may have separately diverged from a more gracile ancestor (Martin *et al.* 2020). Redating *A. africanus* to much earlier than previously thought (Granger *et al.* 2022) would certainly allow for this. In any event, the longevity and success of the robust adaptation are not in doubt, making social and ecological interactions between different, but contemporary, hominin taxa an important topic for research.

GRACILES, ROBUSTS, AND EARLY *HOMO*

Although still widely used, 'gracile' and 'robust' may be misnomers. The larger cranial capacity of the robust australopithecines (~563 cm^3) is probably not significant and differences in body size may have been limited. McHenry (1992) estimates that female and male *A. africanus* individuals weighed 30 and 41 kg respectively compared with 32 and 42 kg for *P. robustus*, no bigger, in other words, than chimpanzees, although some *P. robustus* individuals may have been much larger (Grine *et al.* 2012; Pickering *et al.* 2016). More striking are the contrasts in teeth and jaws. Robust australopithecines had greatly expanded cheek teeth, thick enamel, and very thick, deep mandibles worked by muscles anchored to powerfully built **zygomatic arches** on the face and **sagittal crests** on the top of the skull. This distinctive architecture reflects a specialisation for applying substantial force between upper and lower cheek teeth during chewing (Rak 1983). Most explanations for the differences between robust and gracile taxa focus on this, suggesting, for example, that *P. robustus* was exclusively vegetarian, *A. africanus* more omnivorous (J. Robinson 1954). Studies of jaw mechanics, enamel thickness, and dental microwear later suggested that robust australopithecine diets emphasised crushing small, hard items like fruits and nuts (Grine and Kay 1988).

Stable isotope analyses show that things are not this simple. The strontium/calcium and carbon isotope compositions of *P. robustus* specimens from Swartkrans indicate considerable omnivory with substantial (~30 per cent) consumption of C_4 plants (or animals that ate them) and a significantly broader diet than *P. boisei* (Lee-Thorp *et al.* 1994; Sponheimer *et al.* 2013). Dental morphology and microwear now exclude large-scale seed consumption, but eating C_4 plants (grasses, sedges) remains plausible (Towle *et al.* 2021; Lombard and van Aardt 2022). Scavenging carnivore kills and eating small grass-eating vertebrates (reptiles, rodents, young antelope) and insects (especially termites) are also likely (Sponheimer *et al.* 2013), consistent with arguments that *all* hominins needed some animal foods to obtain sufficient high-quality nutrients to support the **encephalisation** demanded by the increasing size and complexity of the social networks in which they lived (Aiello and Dunbar 1993; Aiello and Wheeler 1995). In contrast, *A. africanus* diets varied from almost purely C_3 to almost entirely C_4 in composition, implying considerable opportunism and adaptability (N. van der Merwe *et al.* 2003) or that the taxon subsumes more than one ecological species (Sponheimer *et al.* 2005).

Although dietary differences between hominins were thus more subtle than previously supposed, this does not deny the importance of processing plant foods in driving robust australopithecine evolution nor, as we shall see, the possibility that their acquisition was tool-assisted. Such differences likely played out in different ecologies. Thus, at Makapansgat and Sterkfontein *A. africanus* lived in subtropical forest or forest fringe conditions where substantial patches of grasses were also present. In contrast, more open grassland dominated when *P. robustus* lived in the Cradle of Humankind over a million years later, with locally wet habitats offering a source for the C_4 sedges mentioned earlier (Reynolds *et al.* 2011). Correspondence analysis of associated faunas nevertheless suggests that *P. robustus* was more woodland-adapted and thus something of a habitat generalist (de Ruiter *et al.* 2008). Strontium isotope signals, which use the ratio of ^{87}Sr to ^{86}Sr to identify the underlying geology from which food came, indicate that some *P. robustus* individuals arrived in the Swartkrans and Kromdraai localities from elsewhere as juveniles or mature adults, although earlier assignations of individual specimens to sex – and inferences drawn from this (Copeland *et al.* 2011) – are questionable (Sillen and Balter 2018).

Gracile and robust australopithecines are the most common of South Africa's early Pleistocene hominin fossils, but they are not alone. Within the Cradle of Humankind, Malapa has produced two partial skeletons attributed to a third australopithecine, *A. sediba*, likely descended from *A. africanus* and dating to ~1.95 mya. This was initially considered to share morphologically derived traits with – and thus potentially be ancestral to – *Homo* (Berger *et al.* 2010). However, the Malapa individuals probably represent different species: MH1 an immature australopithecine whose stable isotope signature and dental phytoliths indicate a C_3-rich diet like savanna-dwelling chimpanzees (Daegling *et al.* 2016), and MH2 *Homo* (Kimbel and Rak 2017; Rak *et al.* 2021). An ancestral position vis-à-vis the latter is, in any case, impossible given that *Homo* occurs in East Africa as much as 2.8 mya (Villmoare *et al.* 2015).

The other southern African fossils potentially assignable to *Homo* and predating 1.0 mya also come from the Cradle of Humankind, but their taxonomic assignment is uncertain (Dusseldorp *et al.* 2013). In fact, recent revision of relevant post-canine teeth suggests that few can be unambiguously attributed to that genus, while offering no support for them constituting a new species, *H. gautengensis* (*pace* Curnoe 2010). Instead, most are australopithecines (Zanolli *et al.* 2022). A rare example to the contrary is the well-preserved SK 847 cranium from Swartkrans (R. Clarke *et al.* 1970) (Figure 4.7).

In East Africa the earliest *Homo* specimens are not assigned to a species, but at least two taxa have been recognised around 2 mya: *H. rudolfensis* and the smaller-brained, less robust *H. habilis* (B. Wood 2010), although the two may be identical, with many of the specimens assigned to *H. habilis* actually belonging to *Australopithecus* (R. Clarke 2017). A much clearer picture emerges ~1.8 mya, marked by the presence in both Africa and Eurasia of fossils labelled

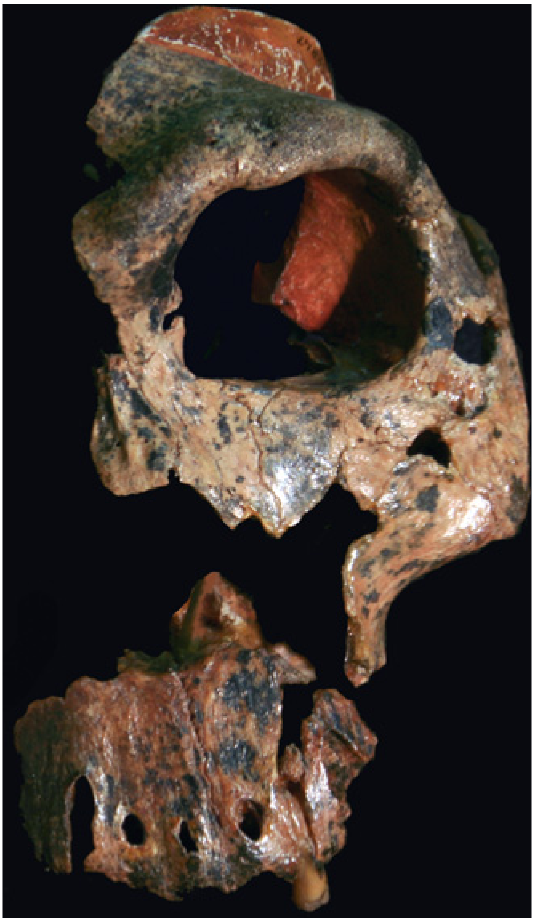

Figure 4.7 *Homo ergaster* (SK 847) from Swartkrans, Member 1, South Africa (copyright Ron Clarke and Jason Heaton).

H. erectus, although they are probably too variable to form a single species (B. Wood 1992). As a result, *H. erectus* is often reserved for fossils from China and Indonesia, with African specimens assigned to *H. ergaster* (Tattersall 2007). Compared with earlier representatives of *Homo* both taxa share many features, including increased body and brain size, reduced sexual dimorphism, thicker cranial bones, and a long, low skull (Klein 2009). The DNH 134 cranium from Drimolen may be the oldest known specimen (2.04 mya), arguing against the Asian origin for the lineage sometimes proposed (Herries *et al.* 2020).

Given the spareness of southern Africa's fossil hominin record after the australopithecines, East Africa delivers our best insights into *H. ergaster*'s biology. A young male from Nariokotome, Kenya (1.53 mya), is particularly well known, not least for his size: ~1.63 m tall and 56 kg in weight had he survived to adulthood (Gibbons 2010). His tall lean physique resembles that of many contemporary equatorial Africans, with a narrow pelvis suggesting highly efficient walking and endurance running, while a robust, heavily muscled skeleton speaks to routine heavy physical exertion. Cumulatively, this constitutes a very different adaptation from earlier hominins, one in which improved thermoregulation was probably key to an active life in dry, open savanna environments rather than more closed, wooded ones (Ruff 1991). The smaller pelvis and an adult cranial capacity of ≥850–910 cm^3 also imply a more human-like maturation rate, coupled with a longer period of infant dependency than that inferred for the australopithecines (A. Walker and Leakey 1993). All these differences carry behavioural implications, for example with respect to diet quality and how mothers with young acquired food (from others?). From this point on, if not before, such questions can be increasingly explored in the archaeological record that early hominins left behind.

THE EARLIEST TECHNOLOGIES

Southern Africa's earliest archaeological traces come from the Cradle of Humankind and exemplify a Mode 1 technology (J. G. D. Clark 1969) of flakes and cores (R. Clarke *et al.* 2021). They belong to the Oldowan **technocomplex** (Toth and Schick 2018). Thus far, there is no sign of older stone artefacts or of cut-marked animal bones as argued in East Africa (McPherron *et al.* 2010; Harmand *et al.* 2015). Although surviving assemblages are palimpsests that accumulated over hundreds, if not thousands, of years and we cannot reconstruct individual stone-knapping or butchery events, considerable progress continues to be made in understanding how tools helped hominins exploit the landscapes in which they lived (Caruana 2017).

Sterkfontein's Member 5 provides the largest Oldowan assemblage (Figure 4.8). Cosmogenic nuclide dating places it at 2.18±0.21 mya, somewhat older than previously estimated using faunal correlations with East Africa (Granger *et al.* 2015). The Lower Bank of Swartkrans Member 1, where

Figure 4.8 Oldowan cores from Sterkfontein Member 5 made in quartzite transported from nearby gravels (copyright Kathleen Kuman).

Oldowan artefacts have also been found, has a slightly earlier age (2.22±0.09 mya; Kuman *et al.* 2021). Two artefacts from Kromdraai B, a handful from Drimolen and Gladysvale, and a few dozen of more indeterminate status from Cooper's Cave also likely fall in this interval (Kuman 2016; M. Sutton *et al.* 2017; Hanon *et al.* 2021). Rare flakes and cobbles from Makapansgat's Member 5, which substantially post-dates the site's australopithecine fossils, do not unequivocally result from deliberate flaking or introduction by hominins (Maguire *et al.* 1980).

Almost all the Sterkfontein artefacts were made in quartz, with only small amounts of the chert and quartzite that occur nearer the site. Chert was more heavily used at Swartkrans, 1.5 km away, but quartz remains dominant and was the only material employed at Cooper's Cave (Kuman and Field 2009; M. Sutton *et al.* 2017; Kuman *et al.* 2018). It may have been deliberately selected for its ease of fracture, sharp edges, and durability (Caruana 2017). However, Oldowan toolmakers could clearly adjust their flaking technique to different raw materials, sizes, and shapes, using direct percussion, **bipolar** flaking, and radial flaking methods. They focused on producing flakes with sharp edges suitable for cutting tasks with little retouch and no flaking to predetermined patterns, but – as in East Africa (de la Torre 2004) – show evidence of systematically efficient manufacture. Hammerstones, **manuports**, and the cores from which flakes were struck comprise the rest of the industry; variability among core forms relates to raw material, initial size, and degree of reduction, not deliberate creation of specific end-products (Toth 1985). Given the informality and simplicity of Oldowan technology, independent evidence of early Quaternary age is needed to substantiate assemblage identification. Beyond the Cradle of Humankind, the most compelling example comes from Wonderwerk Cave in the Northern Cape, one of South Africa's longest sequence sites (Horwitz and Chazan 2015). Here, Stratum 12 has produced sixty-five artefacts ~30 m from the cave's mouth; cosmogenic nuclide dating, palaeomagnetism, and faunal markers suggest an age of 1.96–1.78 mya (Chazan *et al.* 2012; Shaar *et al.* 2021).

Oldowan artefacts probably served multiple purposes. Microwear and experimental studies in East Africa show that flakes were used to remove meat from carcasses, saw wood, and cut grass or reeds, with core-tools employed in heavier-duty butchery and wood-cutting tasks (Isaac 1984; Toth and Schick 1986). However, identifications of butchery residues on stone tools from Sterkfontein likely reflect post-excavation contamination (Langejans 2012). Swartkrans offers better evidence, with percussion- and cut-marks testifying to defleshing animals and extracting marrow from long bones, especially those of small and medium ungulates (Pickering *et al.* 2004, 2008). Whether this reflects hominin kills or scavenging of those made by carnivores, hominins probably faced competition from predators. This may explain why flaking was more expedient at Swartkrans and cores were mostly sourced from the surface very close to the site, not from the gravels of the Bloubank River, which is 140 m away today and was the major source of the materials flaked at Sterkfontein (Kuman *et al.* 2018; Caruana 2020a). The highly expedient (and thus quickly produced) artefacts from Cooper's Cave, where the fauna also shows some butchery marks (Hanon 2019), likely represent a second instance of tool-aided meat acquisition in a potentially dangerous situation. Trees growing around cave openings may have provided shade, shelter, and potential refuge at all three sites (Kuman *et al.* 2018).

Stone does not exhaust the Oldowan toolkit, and we should envisage hominins making and using a range of organic artefacts like, if not some way beyond, those of chimpanzees (McGrew 1992). Evidence comes from polished long-bone fragments at multiple sites in the Cradle of Humankind, mostly Swartkrans Members 1–3 and Drimolen (Figure 4.9); two more occur at Kromdraai B, one each at Cooper's Cave and the Sterkfontein Name Chamber (Hanon *et al.* 2021). Similar wear patterns imply that all were used in a similar way. Experiments and microscopic wear suggest digging out edible plants, which are present here in exceptional richness (Lombard and van Aardt 2022), from rocky soils (Brain 1985); excavating termite mounds to extract edible insects (Backwell and d'Errico 2001; Lesnik 2014); and defleshing marula fruits (d'Errico and Backwell 2009). All the tools occur in contexts where *P. robustus* fossils dominate or are the only hominin present. They may thus

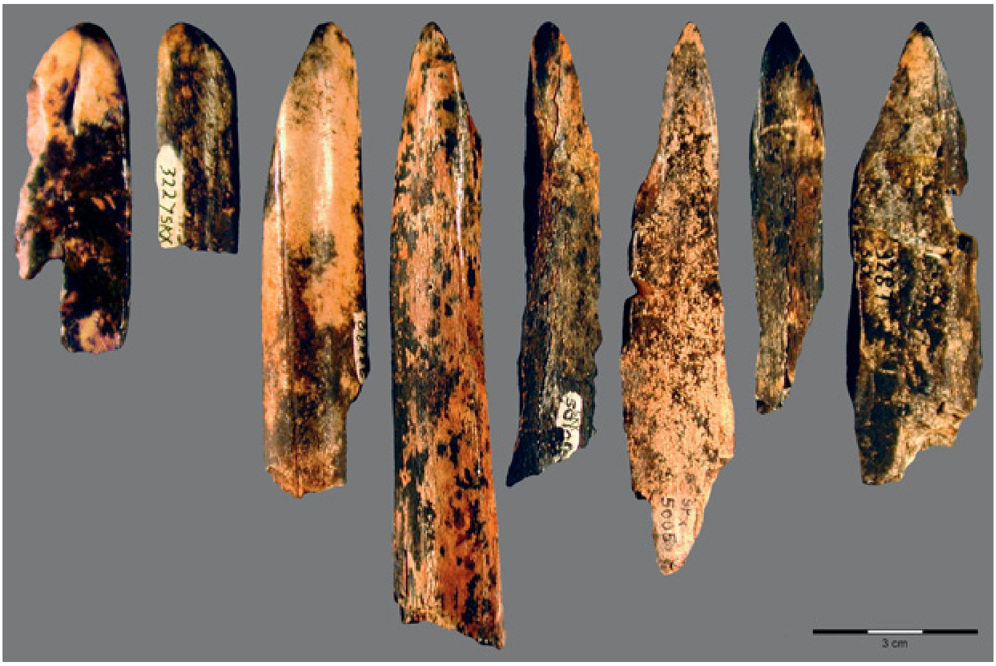

Figure 4.9 Polished bone fragments from Swartkrans Members 1–3 thought to have been used in excavating underground plant foods and/or termite nests (copyright Lucinda Blackwell).

have provided robust australopithecines with a tool-assisted means of procuring food not dissimilar to the termite probes recorded for chimpanzees. Comparison of respective distributions confirms that bone and stone tools did not enter Swartkrans at the same time and were thus perhaps associated with different hominin taxa (Backwell and d'Errico 2003). That the bone tools are not found after *P. robustus* disappears from the fossil record supports this, although the lack of deposits for most of the Middle Pleistocene at Swartkrans, in particular, means that we cannot be sure. While some selectivity is evident in preferring weathered straight, diaphyseal bone flakes from medium to large mammals, the cognitive demands required to make these tools were probably less than those needed for manufacturing Oldowan stone artefacts (Caruana *et al.* 2013) or the flaked bone tools from Olduvai Gorge, where attribution to early *Homo* is likely (Stammers *et al.* 2018).

Can we also identify which hominin(s) made southern Africa's first lithic assemblages? The co-occurrence of *Homo* and *P. robustus* in Swartkrans Members 1 and 2, the presence of *P. robustus* alone in Member 3, and the broader contemporaneity of the two taxa on the wider Cradle landscape (Herries *et al.* 2020) certainly invite the possibility that they were made by more than one kind of hominin, an issue that also arises in East Africa (Klein 2009). Both chimpanzees and bonobos can make and use stone tools under experimental conditions (Toth *et al.* 1993) and, like other primates, they sometimes employ them to crack open nuts or other food sources in the wild, creating the basis for the rapidly developing field of primate archaeology (Haslam *et al.* 2017). All hominins therefore probably had some ability in this area. Nevertheless, *A. africanus* and *A. prometheus* lacked a completely human-like degree of manual dexterity, consistent with the absence of stone artefacts in the contexts where they occur (Pickering *et al.* 2018). Susman's (1988) contention that robust australopithecine hands were well adapted to the precision gripping needed for artefact manufacture is also uncertain (Marzke 1997). Moreover, the lack of two distinct artefact traditions in both the Cradle and East Africa argues against two different hominin lineages producing stone tools, even if the Oldowan's informality renders this conclusion less than definitive (Klein 2009). Perhaps more convincingly, if a primary role for stone tools was in accessing meat and bone marrow, as experimental, cut-mark, and microwear evidence suggests, this would fit a presumed greater interest in meat-eating in early *Homo* compared with the robust australopithecines. Admittedly, the antiquity of non-Oldowan artefacts at Lomekwi (~3.3 mya; Harmand *et al.* 2015; but see Domínguez-Rodrigo and Alcalá 2019; cf. Harmand *et al.* 2019) and of Oldowan tools associated with multiple activities, including hippopotamus butchery, at Nyayanga, also in Kenya (~3.03–2.58 mya; Plummer *et al.* 2023), urges caution. However, the fact that stone toolmaking persisted after *Paranthropus* became extinct sustains the link with the lineage including/leading to *Homo*. In the longer term, the combination of extended tool use, increased sociality, and greater dietary breadth with more efficient heat regulation and bipedal locomotion was probably crucial in *Homo*'s expansion into mid-latitude regions of Eurasia and (by excluding them from food resources) the eventual extinction of the robust australopithecines.[2]

Because the Cradle of Humankind's faunas were almost wholly accumulated by non-hominin agents, southern African sites have limited ability to address these questions. Far more work has been undertaken in East Africa. Important and interrelated research themes include the importance of meat in early hominin diets, how it was obtained, and whether the frequent co-location of animal bones and stone artefacts signals food-sharing, perhaps accompanied by a sexual division of labour and provisioning of a home-base as among recent hunter-gatherers (Isaac 1984). Critical assessments of site formation processes suggest, however, that many associations of fauna and artefacts are not causally linked, that supposed early shelters did not exist, and that scavenging of carnivore kills or of animals that died naturally was more significant than hunting as a source of meat and bone marrow (Klein 2009). Even stone tool production, although clearly more intentional and controlled than anything seen in experiments with bonobos and chimpanzees, may have been transmitted via imitation and emulation, not language-mediated teaching (Toth and Schick 2018). In the early part of the Pleistocene – and possibly for long afterwards – a superficially human-like appearance may thus have partnered a way of life distinctly unlike that of modern people.

ACHEULEAN TOOLKITS AND THE TRANSITION TO THE MIDDLE STONE AGE

Forming the world's most persistent artefact tradition (~1.75–0.2 mya), Acheulean technologies were made from Cape Town to Europe's British peninsula and as far east as Korea. The oldest dates broadly coincide with, or are perhaps slightly younger than, the oldest *Homo ergaster* fossils (Gallotti and Mussi 2018), and at Sterkfontein Member 5 West one such (StW 80) is directly associated with Acheulean artefacts ~1.7–1.4 mya (Kuman and Clarke 2000). Compared with the Oldowan, the Acheulean occurs much more widely across southern Africa, with some 'sites' producing millions of artefacts (e.g. Kathu Townlands; S. Walker *et al.* 2014). Although organic remains are rare and well-excavated sites few, it no longer constitutes the prehistoric dark age that Inskeep (1978) lamented fifty years ago. Instead, we can now see that it was a crucial period in hominin evolution, encompassing the transition from *H. ergaster* to the earliest *H. sapiens* and marked by quantum shifts in subsistence, ecological adaptability, and technology.

From the narrower perspective of stone tools, however, the Acheulean retains an 'unimaginably conservative' image (Dennell 2018: 195) since for more than a million years it emphasised large, generally bifacially worked cutting tools. Both handaxes and cleavers were made from a diversity of rocks depending on local availability (Figure 4.10), with small numbers of picks and more generic bifaces also

Figure 4.10 Acheulean handaxes and an *Elephas reckii* tooth (bottom left) from Kathu Pan 1, Northern Cape, South Africa, photographed during the Southern African Association of Archaeologists excursion, September 1990.

produced (Lotter 2020). In some areas, cobbles were the blanks from which bifaces were manufactured, but more typically African – and an Acheulean innovation – was the use of large flakes struck from cores. While handaxes terminate in a point and are typically elongated, pear-shaped, or triangular, the flake from which they were struck gives cleavers a broad, axe-like cutting edge. These large cutting tools, which sometimes comprise only a tiny fraction of an assemblage, are complemented by cores and flakes. The latter were sometimes retouched, often to make **scrapers**, but sometimes also **backed** knives and other forms (Lotter 2020; Caruana *et al.* 2023).

Handaxes and cleavers give the impression of purposeful design, but their final shape frequently depended on the dimensions of the original blank, the intensity with which the edges were used, the degree of resharpening, raw material choice, and the knapper's skill, all factors potentially influenced by functional and group mobility considerations (Meneses 1996; Caruana and Herries 2021; Caruana and Lotter 2022). While the finished product may not always have been the primary objective, bifaces were more than just cores, even if this was among their functions. Experiments show that they perform better than retouched or unretouched flakes in virtually all heavy-duty butchery contexts, especially when dealing with large mammals or working for long periods (P. R. Jones 1980). However, microwear analyses indicate that they were also sometimes used to work plant materials like wood and sedges (Binneman and Beaumont 1992). Consistent with this, waterlogged contexts at Amanzi Springs in the Eastern Cape ~400 kya (H. Deacon 1970; Herries *et al.*

Figure 4.11 Southern Africa: Middle Pleistocene archaeological sites. Site names are abbreviated thus: AK Anyskop; AP Apollo 11; AZI Amanzi; B Bushman Rock Shelter; BA Berg Aukas; BC Border Cave; BP Biessiesput 1; BUN Bundu; CH Cave of Hearths; CK Canteen Kopje; COR Cornelia-Uitzoek; DFT Duinefontein 2; EB Elands Bay Cave; EFT Elandsfontein; FL Florisbad; HOE Hoedjiespunt; KAB Kabwe; KAT Kathu Pan 1 and Kathu Townlands; KF Kalambo Falls; KK Kudu Koppie; MGN Maunganidze; MON Montagu Cave; MRP Maropeng; NAM Namib IV; NGP Ngxaishini Pan; PC Peers Cave; RIE Rietputs 15; SDR Sundays River Valley; SK Swartkrans; ST Sterkfontein; WK Wonderwerk; WNB Wonderboompoort (copyright Jonathan Lim).

2022) and Kalambo Falls, Zambia (J. D. Clark 2001), preserve examples of worked wood. A range of uses is therefore likely.

Almost all southern Africa's Acheulean assemblages come from open-air sites (Figure 4.11). Exceptions include Cave of Hearths (McNabb and Sinclair

2009), Montagu Cave (Keller 1973), and Wonderwerk (Chazan 2015), all in South Africa. Broad chronological distinctions are possible, but most sites cannot be, or have not been, directly dated. Pre-dating 1.0 mya, rare early Acheulean assemblages come from Sterkfontein (Member 5 and Member 5 West) and Swartkrans (Members 2 and 3), with dates reaching back to ~1.5, possibly as much as 1.7, mya (Kuman 2016). Undated sites in the Cradle of Humankind include the large open-air collection from Maropeng (Pollarolo *et al.* 2010), while further afield the early Acheulean occurs in the Northern Cape at Rietputs 15 (Kuman and Gibbon 2018; Leader *et al.* 2018), Canteen Kopje (McNabb and Beaumont 2011), and Wonderwerk (Chazan 2015). The Eastern Cape is another focus, with occurrences along the Sundays River pre- and post-dating ~1 mya (Lotter *et al.* 2023). Although almost all these sites are in secondary contexts, their technology closely resembles that known from East Africa (Kuman 2016) and, at Rietputs 15, has a similar antiquity (~1.7 mya; Leader *et al.* 2018).

Sites falling between ~1.0 and 0.6 mya include further material from Wonderwerk (Chazan 2015) and Cornelia-Uitzoek in the Free State, where an early *Homo* tooth represents the oldest hominin outside the Cradle of Humankind and associated dolomitic landscapes (1.07–0.99 mya; J. Brink *et al.* 2012). Later Acheulean assemblages dating to ≤0.6 mya are significantly more numerous and widespread than those of older date (Kuman 2016). Earlier claims of increasing symmetry over time no longer seem justified and significant morphological variation exists, although the tendency for handaxes to become thinner and have more refined tips would have demanded increasing biomechanical control and organisation of knapping skills (Caruana 2020b; Pargeter *et al.* 2020; Caruana and Lotter 2022). Other innovations discussed below – including possible pigment use, increased employment of prepared core techniques, and **blade** production – also seem to fall after 600 kya. It is unlikely to be coincidental that, after a million-plus years of relative stasis, encephalisation quotients (and, by implication, social network size and group range) increased considerably between 600 and 200 kya, perhaps associated with the osteological changes needed to produce human speech (Gamble 2013: 150–151).

The Acheulean exemplifies a Mode 2 technology, that is one characterised by large bifacial cutting tools rather than simply flakes (J. G. D. Clark 1969). The transition to Middle Stone Age traditions in which flakes and blades struck from prepared cores dominate (Mode 3) remains incompletely understood. MSA assemblages overlie Acheulean ones at a few caves and the open-air site of Kudu Koppie (see below), but in each case a long hiatus may separate the two. A degree of core preparation allowing production of a single large flake of predetermined size and shape nevertheless did develop within the Acheulean; dating to ~1.0 mya, the oldest known instance at Canteen Kopje (Li *et al.* 2017) may be prefigured by cores with asymmetrical properties at Rietputs 15 (Leader

Figure 4.12 Fauresmith artefacts from Kathu Pan 1, Northern Cape, South Africa, photographed during the Southern African Association of Archaeologists excursion, September 1990.

et al. 2018). This Victoria West technique involved flaking the area from which the desired flake was to come to a low dome, leaving the lower part of the core deep and steeply flaked. Striking the core at the correct point then detached a flake with the size and shape of the dome (Lycett 2009). Producing a range of flake tools from the same core likely facilitated development of more task-specific toolkits and suggests significant advances in planning depth and efficient raw material use (Li *et al.* 2017).

A later development of these capacities is represented by the Fauresmith of South Africa's interior (Figure 4.12). Assemblages, almost all from open-air contexts, feature both prepared core techniques and blades, with convergent flakes and retouched points also common. That large cutting tools are rare compared with the Acheulean confirms a shift to a lighter toolkit using more advanced core reduction strategies and the beginning of hafting (Kuman *et al.* 2020). Assemblage content varies between sites, with hornfels, once thought to be a defining feature (Humphreys 1970), only dominating at some. Available dates suggest an age of 500–280 kya, fitting an extended transition from Acheulean to MSA technologies (Chazan 2015). Kathu Pan 1's Stratum 4a (~500 kya) is among the oldest Fauresmith assemblages, using blades struck from extensively prepared **Levallois** cores to make unifacial points, **denticulates**, and scrapers (Wilkins and Chazan 2012).

Near the Limpopo River other late Acheulean sites resemble the Charaman Industry of Zimbabwe. The best preserved is Kudu Koppie, where refitting indicates a high degree of site integrity and Levallois flaking was used (Sumner and Kuman 2014). The Charaman itself may contain fewer large cutting tools (though more points) than the Acheulean (Cooke 1966), but assemblages come from disturbed contexts, handicapping efforts to assess links to those elsewhere or of later date (N. Walker and Thorp 1997). Recent work has, however, identified an *in situ* (if undated) open-air Acheulean assemblage at Maunganidze south of Mutare that combines handaxes and cleavers made from cobbles and flakes with prepared core technologies, including the Victoria West technique (Mercader *et al.* 2016). Acheulean sites in Botswana and Namibia are likewise poorly dated, although some, such as Ngxaishini Pan (Robbins and Murphy 1998) and Namib IV (J. Kinahan 2020), do preserve faunal remains.

Across southern Africa, most surviving MSA occurrences date to the Last Interglacial (MIS 5) or later, with those of Middle Pleistocene (780–127 kya) age rare. Previously classified as MSA 1 (Volman 1984), these highly variable assemblages are now often termed 'Early Middle Stone Age' (EMSA) (Lombard *et al.* 2022; Wurz 2022). Some may date back as far as 300 kya, in line with the Acheulean/MSA transition in East Africa (McBrearty and Tryon 2006), but most probably belong to MIS 6 (~191–127 kya; Wurz 2013, 2022; Schmid *et al.* 2016; Chazan *et al.* 2020). Bifaces are absent and assemblages show little retouch, with scrapers rare, points lacking, and denticulates the most common form (Figure 4.13). Small, broad flakes and radial and discoid prepared cores are other distinguishing features. However, considerable variability exists in how stone was worked, detailed analyses are few, and dating remains poorly controlled (Schmid *et al.* 2016). Past emphasis on typology and its limited retouched component have also likely underestimated the EMSA's flexibility and technological effectiveness (O'Driscoll and Mackay 2020). Relevant sites include Peers Cave and Elands Bay Cave (Western Cape), Bundu and Wonderwerk (Northern Cape), Apollo 11 (Namibia), Florisbad (Free State), and Bushman Rock Shelter and Border Cave in eastern South Africa. Several of these are rock shelters and such fixed points in the landscape now feature increasingly in the archaeological record. If not a preservation bias, with many Acheulean occupations lost because of caves collapsing or water flushing out their deposits, this marks a significant shift in hominin behaviour.

ACHEULEAN ADAPTATIONS

Understanding the lifeways of Acheulean hominins is hampered by having too few fossils to sustain stable isotope studies of diet and the fact that sites rarely preserve animal bones and stone artefacts in anything like primary context. Faunas from several locations, including Cave of Hearths, Elandsfontein, Kathu Pan, and Wonderwerk, reflect moister conditions than present, with productive grassland ecosystems that may have favoured higher hominin populations (Klein 1988). This is supported by other palaeoenvironmental proxies at Wonderwerk (Ecker *et al.* 2018) and by stable isotope analysis of ostrich eggshell associated with the strikingly early EMSA (~364–270 kya) assemblage

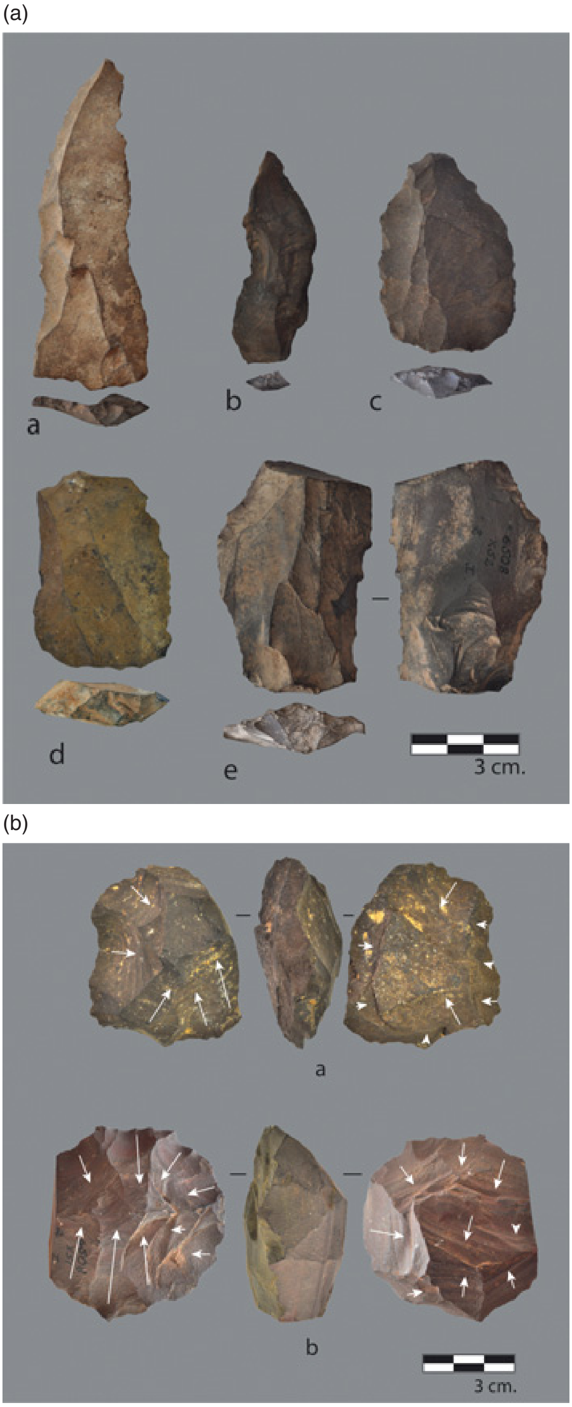

Figure 4.13 Early Middle Stone Age artefacts from Excavation 2, Stratum 2, Wonderwerk Cave, Northern Cape, South Africa: (a) a–b blades; c–d flakes; e proximal fragment of a thick blade, all with prepared platforms; (b) a selection of cores showing unidirectional exploitation focused on one surface with the opposed surface used for the organisation of striking platforms. The assemblage dates to ~240–150 kya (Chazan *et al.* 2020) (copyright Michael Chazan).

at Bundu (Kiberd and Pryor 2021). The lack of Acheulean material under more arid conditions in areas like this may indicate limited effectiveness in coping with reduced resource productivity, with Hilary Deacon (1975) attributing a focus close to rivers compared with MSA and LSA sites in the Fynbos Biome to an absence of containers for moving water. Analysis of ecological patterning in site distributions in the Clanwilliam area of the Western Cape supports this (Hallinan and Parkington 2017), although in the eastern Karoo Sampson (2001) argues that late Acheulean hominins avoided water sources where predators might have been present in favour of camping at hornfels outcrops; repeated visits to the waterless hilltop at Anyskop near Langebaan Lagoon, Western Cape, also suggest that water was less of a constraint than sometimes thought (Kandel and Conard 2012). Combining raw material access with closeness to water, Kudu Koppie adds elevated locations able to act as focal points and places from which to monitor game movements to the factors attracting hominins to specific points in regional landscapes (Sumner and Kuman 2014).

Most sites show little evidence of hominins moving artefacts since raw materials typically occur near where assemblages are found. Whether this reflects limitations on long-term planning depth or confidence in being able to find suitable **toolstone** and make artefacts as needed is unclear. Exceptions certainly exist. For example, in Zimbabwe's Hwange National Park hominins moved chert over 30–50 km (Klimowicz and Haynes 1996), while at Cornelia-Uitzoek they completed and used bifaces introduced as blanks from off-site (J. Brink *et al.* 2012). Finds from Anyskop also document artefacts moving up to 25 km from source (Kandel and Conard 2012). Rare instances of pigment transport do not necessarily imply non-technological uses, but hominins introduced **specularite** and **haematite** to Kathu Pan 1 from >20 km away after 500 kya, moving small amounts of both to Wonderwerk (≥38 km) and Canteen Kopje (170 km) from ~300 kya; rare jaspelite artefacts at the same sites may have been transported over similar distances (Watts *et al.* 2016). Whether a strange Fauresmith assemblage deep within Wonderwerk (Figure 4.14) featuring flakes and bifaces introduced from elsewhere, quartz crystals, chalcedony pebbles, and incised banded ironstone slabs signals ritual activity is difficult to say, but its context and unusual nature bely any obvious utilitarian interpretation (Chazan and Horwitz 2009).

Precisely how (and how often) Acheulean hominins acquired meat is uncertain. A rarity of cut-marks and high frequency of carnivore tooth marks at the Western Cape sites of Duinefontein 2 (290–270 kya) and Elandsfontein (~1.0–0.6 mya) led Klein (2000) to conclude that large mammals were probably only rarely taken, with artefacts and animal bones mostly accumulating independently of each other near waterholes (Cruz-Uribe *et al.* 2003; Klein *et al.* 2007). However, more recent assessments dispute this, identifying a much higher frequency of butchery marks at Elandsfontein, including instances on Cape buffalo and black rhinoceros (*Diceros bicornis*) (Forrest *et al.* 2018). Mortality

Figure 4.14 Interior view of Wonderwerk Cave, Northern Cape, South Africa (copyright Michael Chazan).

profiles may also imply non-selective ambush hunting by hominins, rather than carnivore predation (Bunn 2019). Although selective preservation of skeletal parts urges caution (Klein *et al.* 2007), ongoing work at Wonderboompoort near Pretoria (Figure 4.15) supports ambush hunting, or at least mass harvesting of meat, as game was predictably forced through the narrow valley of the Apies River when moving north–south between Savanna and Grassland Biomes; later Acheulean handaxes date sites here to ~800–500 kya (Lombard *et al.* 2021b; Lotter *et al.* 2022).

Wooden spears capable of killing large ungulates go back 300,000–400,000 years in Europe (Allington-Jones 2015; D. Richter and Krbetschek 2015). However, claims for projectile weapons with hafted stone points in Kathu Pan 1 Stratum 4a ~500 kya (Wilkins *et al.* 2012) probably represent 'over-optimistic interpretation' of supposed retouch and putative impact fractures (Rots and Plisson 2014: 163); hafting is more usually considered an MSA innovation apparent from after 300 kya (Wadley 2015). The utility of bifaces in butchery and the likelihood that access to meat was crucial in driving encephalisation, the so-called 'expensive tissue hypothesis' (Aiello and Wheeler 1995), nevertheless make it likely that Acheulean hominins ate more meat, including meat from large animals, than their Oldowan predecessors. Plants, which probably formed the bulk of the diet, are largely unknown, although fruits and seeds of edible taxa survive at Kalambo Falls (J. D. Clark

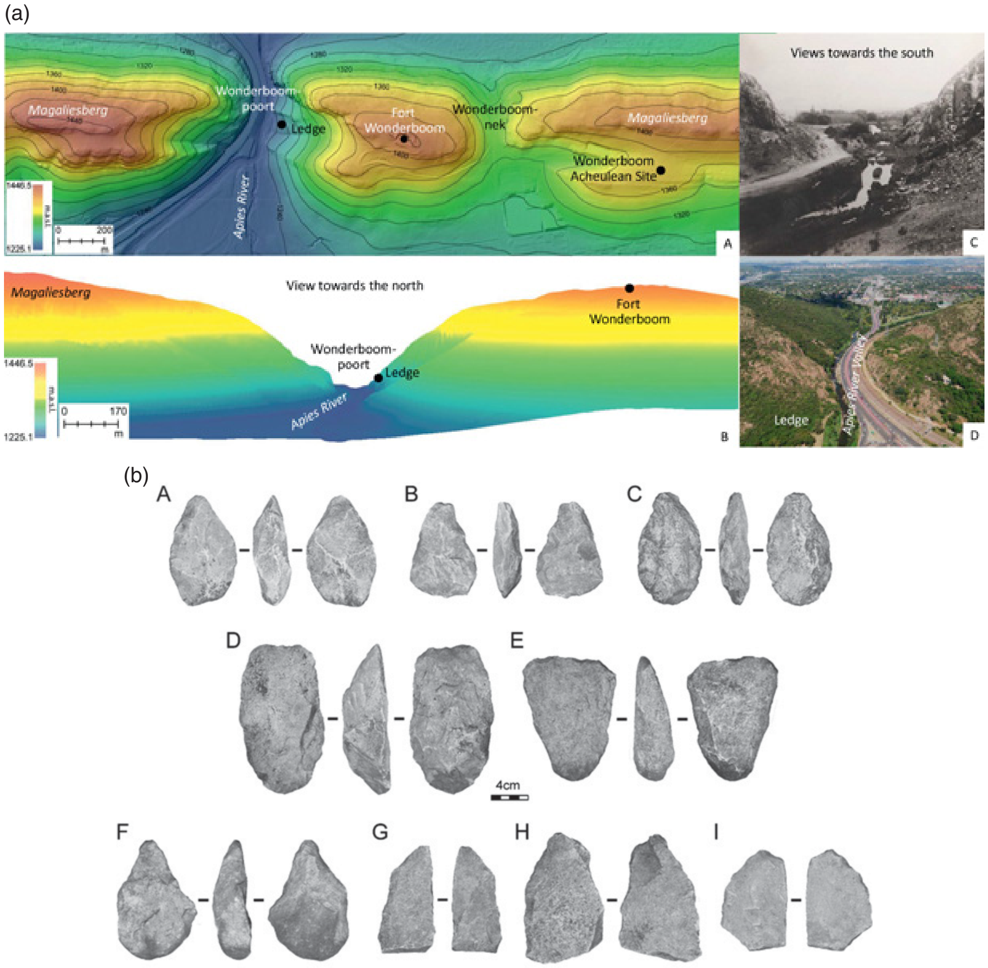

Figure 4.15 Wonderboompoort: (a) microtopography and profile of the immediate landscape with historical and contemporary photographs at right of the defile along the Apies River valley; (b) later Acheulean handaxes recovered in excavation (photograph by Matt Lotter; copyright Marlize Lombard; after Lombard *et al.* 2021b).

2001), and bean seeds and wild date (*Phoenix reclinata*) occur in a late Acheulean context (Stratum 7) at Wonderwerk (Bamford 2015).

For both meat and plants, the ability to control fire and cook what was eaten likely significantly extended the range of edible foods and their nutritional value (Gowlett and Wrangham 2013). The antiquity of hominin use of fire is disputed, but southern Africa offers some of the oldest evidence. Bone fragments from Swartkrans Member 3, which dates to 1.0–0.8 mya (Herries 2022), experienced prolonged heat of ≥315–450°C, higher than anything a natural fire could probably produce (Brain and Sillen 1988); four also show cut-marks. Burnt bone fragments, wood ash, and calcified grasses and sedges associated with Acheulean artefacts in Wonderwerk's Stratum 10 ~1.0 mya are likewise unlikely to reflect natural fires (Berna *et al.* 2015). How far this implies an ability to make fire at will is uncertain, but by MIS 6 clearly defined hearths occur at Border Cave and they are common thereafter (Wadley 2015).

Fire also offered security from predators, warmth, possibilities for hardening wooden artefacts, and opportunities for extended social behaviour in the evenings (Gowlett and Wrangham 2013). Furthermore, it probably assisted territorial expansion into more temperate regions, including the Fynbos Biome and the Maloti-Drakensberg Mountains (Carter 1978). Profound technological conservatism, at least in respect of stone tools, coupled with the limitations of the archaeological record, may mask the evolution of important new social capacities – and organic artefacts – responsible for facilitating this range extension (Gamble 2013). However, there is little sign that it involved using artefacts as symbols encoding information about places and people in ways that could build expansive social networks, even though handaxes show an engagement with concepts of symmetry and measurement not evident in the Oldowan (Wynn 1991). While nothing in their manufacture demands verbal communication in a form we might find recognisable (Noble and Davidson 1996), and the Nariokotome boy was incapable of producing human-like speech (MacLarnon and Hewitt 1999), by the Acheulean's end – and certainly from the onset of hafted technologies that imaginatively combined different materials using recursive analogical reasoning of the kind underpinning language (Barham 2010) – we are probably looking at much more recognisably human hominin societies.

MIDDLE PLEISTOCENE HOMININS

Southern Africa's Middle Pleistocene fossil record is sparse. Material comes from Kabwe, Zambia, and five sites south of the Zambezi, and includes the startlingly different *Homo naledi* specimens from the Cradle of Humankind. The Kabwe (Broken Hill) cranium derives from cave fill deposits that produced fragments of other individuals and doubtfully associated Acheulean/Sangoan artefacts. Direct dating of it and other fossils suggests an age of ~300 kya (Grün *et al.* 2020). Acheulean associations are certain in Bed III at Cave of Hearths where a juvenile mandible is ESR-dated to 600–400 kya, although the dosimetry readings are problematic (Herries 2011). In the Western Cape, the Hoedjiespunt hyena den produced a tibia and some teeth of broadly Middle Pleistocene age (Stynder *et al.* 2001), while a cranium from Elandsfontein falls between 1.0 and 0.78 mya on biostratigraphic and palaeomagnetic grounds (Braun *et al.* 2013). The Florisbad cranium (Figure 4.16) is much younger, with ESR and OSL dates obtained in the early years of both techniques placing it at 300–230 kya (Herries 2022), but the massive femur from Berg Aukas, Namibia, is of unknown age (Grine *et al.* 1995).

Figure 4.16 Front view of the Florisbad cranium (copyright Lloyd Rossouw).

Interpretation of this small sample is facilitated by fossils elsewhere. All the specimens mentioned appear archaic compared with humans today, with Kabwe having particularly massive brow ridges and a low skull. Its cranial capacity (1,236 cm^3) and that of its Elandsfontein counterpart (1,200–1,250 cm^3) nevertheless demonstrate a significant increase on *H. ergaster* as, for example, represented by the Nariokotome boy. Several morphological features reinforce this, and both specimens, as well as the partial mandible from Cave of Hearths, are assignable to *H. heidelbergensis* (*H. rhodesiensis*), the name often applied to the most recent common ancestor of modern humans and Neanderthals (Lombard 2022a). The Florisbad cranium, which occurs at a site that produced EMSA artefacts (Kuman *et al.* 1999), represents a further step along that trajectory (Bruner and Lombard 2020). Middle Pleistocene fossils elsewhere in Africa, such as Ethiopia's Bodo skull (J. D. Clark *et al.* 1994), likewise show increasing evidence of *sapiens*-like features. The oldest known instance of *Homo sapiens* itself comes from Jebel Irhoud, Morocco (Figure 4.2), where a cranium (1,375 cm^3) falls in the modern range (Hublin *et al.* 2017). Its recent redating to ~300 kya requires us to seek *H. sapiens*' origins on a pan-African, rather than uniquely sub-Saharan or more specifically regional, scale as well as earlier than previously thought, adding complexity to debates over how far changes in skeletal anatomy imply others in behavioural and cognitive capacity (Scerri *et al.* 2018).

Within southern Africa these debates are further complicated by the more than twenty hominins from the Cradle of Humankind's Rising Star cave system. First discovered in 2013, *Homo naledi* was initially assumed to date to ~2.0–1.0 mya (Berger *et al.* 2015), but uranium series-ESR dating of its teeth now places it at 335–241 kya (Dirks *et al.* 2017). If correct, this overlaps with

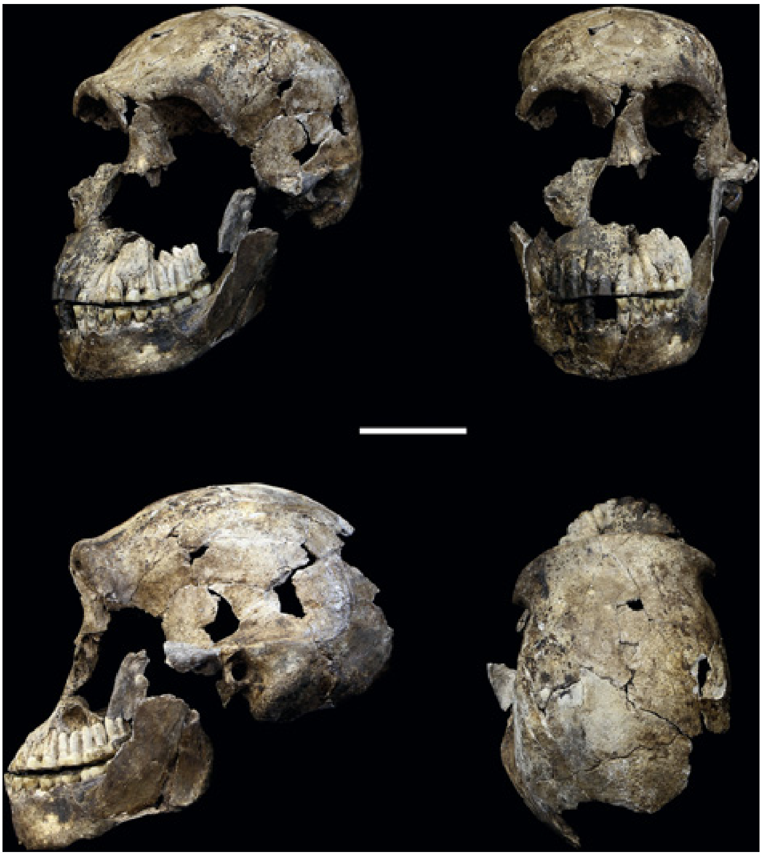

Figure 4.17 The LES1 *Homo naledi* cranium. Clockwise from upper left the photograph illustrates three-quarter, frontal, superior, and left lateral views of the cranium (Hawks *et al.* 2017; CC BY 4.0; https://commons.wikimedia.org/wiki/File:Homo_naledi_LES1_cranium.jpg).

Jebel Irhoud and Florisbad, but *H. naledi* is remarkably different (Figure 4.17). Details of the hand and wrist, lower limbs adapted for efficient long-distance bipedalism, and small post-canine teeth collectively warrant inclusion in *Homo* (Berger *et al.* 2015), but cranial capacity (~513 cm^3) and encephalisation quotient fall below all other *Homo* specimens except Indonesia's *H. floresiensis* (P. Brown *et al.* 2004). Body size and sexual dimorphism are also low compared with *H. ergaster* or *H. sapiens*, challenging established notions of *Homo* and *Australopithecus* as distinct adaptive grades in hominin evolution (Garvin *et al.* 2017).

Rising Star is notoriously difficult to access (Berger *et al.* 2015; Hawks *et al.* 2017; Brophy *et al.* 2021). Carnivore and porcupine activity is absent, but the exclusive presence of hominins among the large vertebrate fauna and high numbers of infants and juveniles would fit a sleeping location, particularly if another, more accessible entrance existed at the time (Nel *et al.* 2021). With no such entrance known and alternative mechanisms like water transport unsupported, Dirks *et al.* (2015, 2017) maintain that the remains were deliberately introduced as complete bodies, that is buried. Debate continues over these claims and their cognitive implications (Val 2016; Egeland *et al.* 2018; cf. Pettitt 2022).

Separate ecological niches for *H. naledi* and other hominins are unavoidable. Dusseldorp and Lombard (2021) suggest that the former focused on more mosaic grassland/forest settings and rocky outcrops. Additionally, its small brain size implies reduced sociality and/or cognitive capacity, while dental and limb features suggest a more limited foraging radius, less emphasis on processing food before consumption, and a degree of tree-climbing linked to food acquisition and/or predator avoidance. *H. naledi*'s low encephalisation makes production of Mode 3 artefacts unlikely, but use of simple flake technologies like those from Maropeng (Pollarolo *et al.* 2010; Moll 2017) or unmodified stones and organic artefacts is not impossible.

All this leaves many avenues open for research, including the question of whether *H. naledi* represents one of potentially several highly divergent, but now extinct populations that perhaps hybridised with modern humans (Berger *et al.* 2017; Scerri *et al.* 2018). The next chapter looks in detail at the southern African evidence for the origins of *H. sapiens* and of behaviours that more closely resemble those known from the ethnographic and historical records.

NOTES

1. Cranial capacities cited here are mean values taken from Gamble (2013: table 4.2). Subsequent changes in hominin classification may necessitate some amendment.
2. Although outside this book's framework, evidence is slowly accumulating for the presence of stone-toolmaking hominins in Asia >2.0 mya (e.g. Shen *et al.* 2020).