

9.8 Monkeys on the Move

At the same time as the evolution and proliferation of ape taxa, an expansion and adaptive radiation of monkeys occurred, both in the New World (see “How Anthropoids Got to South America” earlier) and in the Old World. Primates recognizable as cercopithecoids—they have the distinctive bilophodont molars of Old World monkeys—first appeared during the Early Miocene in North Africa and East Africa. These primitive primates are generally called **victoriapithecids**. *Victoriapithecus*, a prominent genus of the group, is just the kind of primate that would be expected for the ancestor of Old World monkeys.

Beginning in the Late Miocene, especially in the Pliocene and Pleistocene, and continuing to the present day, monkey taxa have proliferated enormously. While ape species were far more prevalent and diverse during the Early and Middle Miocene, far outnumbering the living groups, monkey species are far more diverse since the end of the Miocene. Today's monkey taxa are for the most part the descendants of the fossil species from the Pliocene and Pleistocene. By contrast, most of the ape and apelike taxa from the Miocene went extinct and left no descendants.

ANTHROPOLOGY MATTERS

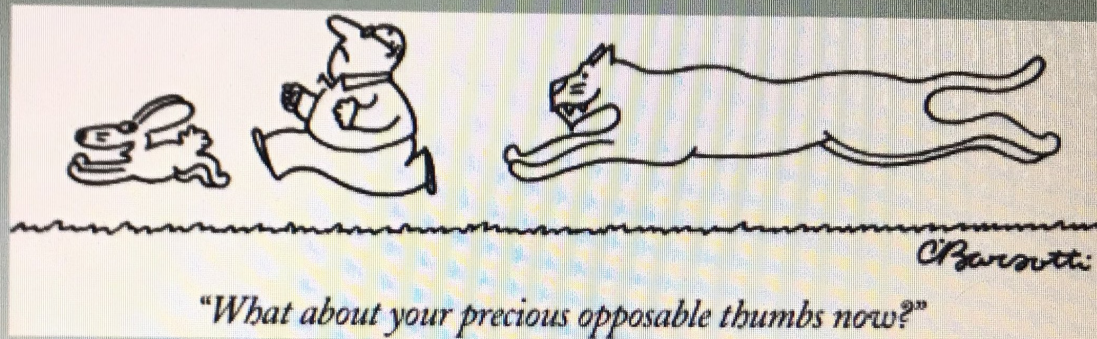
FINE MOTOR SKILLS

Are They Uniquely Human?

Humans have a unique form of grip. Take a look at your own thumb—the right one if you are right-handed, the left one if you are left-handed. In its general form, your thumb is very similar to those of many other primates, except that the one you are looking at in your hand is proportionately longer in relation to the other four digits than is the case in other primates, both fossil and living species.

The relative length of your thumb makes possible the ability for you to touch and press the tip of your thumb against the tip of your index finger and other fingers. This special anatomy gives you a precision grip, allowing you to write with a pen or pencil. Moreover, at the base of the second through fifth digits—your index finger to your pinky finger—the articulation between the phalanges and the metacarpals has two surfaces, reducing the range of motion. At the base of the thumb, however, the joint is more complex and allows a much greater range of motion and the ability to grasp using a power grip. The

range of motion and the ability to grasp using a power grip. The power grip is used, for example, for gripping a hammer and many other tools.



Without the level of opposability of thumbs that humans possess, we would not be able to use the precision grip for finely manipulating small objects, as in holding a pencil, picking up a coin, or threading a needle (see "Arboreal Adaptation—Primates Live in Trees and Are Good at It" in chapter 6).

The hand bones of one Miocene ape, *Oreopithecus*, have received considerable attention. The Spanish paleontologist Salvador Moyà-Solà and his colleagues have argued that *Oreopithecus* had a relatively long thumb. If so, then this primate, like humans (and hominin ancestors), was able to touch the tip of its thumb to the tip of its index finger—it had the full opposability of the thumb that is uniquely human, allowing for precision and power gripping. The American paleoanthropologist Randall Susman has studied the hand bones of many primates, human and nonhuman, and found fundamental errors in Moyà-Solà's assessment of *Oreopithecus*'s hand. The bone that

errors in Moyà-Solà's assessment of *Oreopithecus*'s hand. The bone that Moyà-Solà thought was the base of the thumb—the proximal phalanx—was actually a middle phalanx from another finger. Rather than being long like a hominin's, *Oreopithecus*'s thumb was short, just like any other ape's, past or present. *Oreopithecus* lacked the unique attributes of the hominin hand for either precision or power gripping. *Anthropology matters!*



The basic structure of the thumb is similar in all living primates, with two phalanges (the other four digits have three phalanges each) and one metacarpal making up the length of this digit; however, the thumb is substantially longer in humans.

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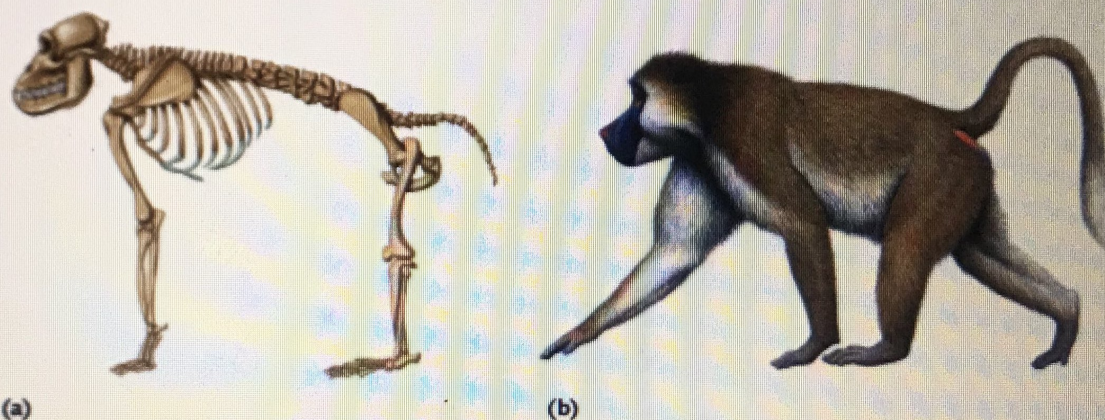


FIGURE 9.26

Theropithecus (a) Of the same genus as living gelada baboons, fossil *Theropithecus* species have been found in many areas of Africa. *Theropithecus* ate predominantly grasses. (b) Like their living counterparts, fossil *Theropithecus* species were likely terrestrial quadrupeds as their front and hind limbs were of similar length; however, the fossil species were substantially larger than the living gelada baboons.

The rise in number and diversity of monkey species and the decline in ape species were not due to competition between the two groups. Rather, the origin and diversification of monkeys reflect habitat changes. The climates and environments of the Early Miocene seem to have favored the adaptive radiation of apes, with most taxa then

to have favored the adaptive radiation of apes, with most taxa then going extinct as climates and environments changed. The climates and environments of the Late Miocene, and into the Pliocene and Pleistocene, seem to have favored the adaptive radiation of monkeys.

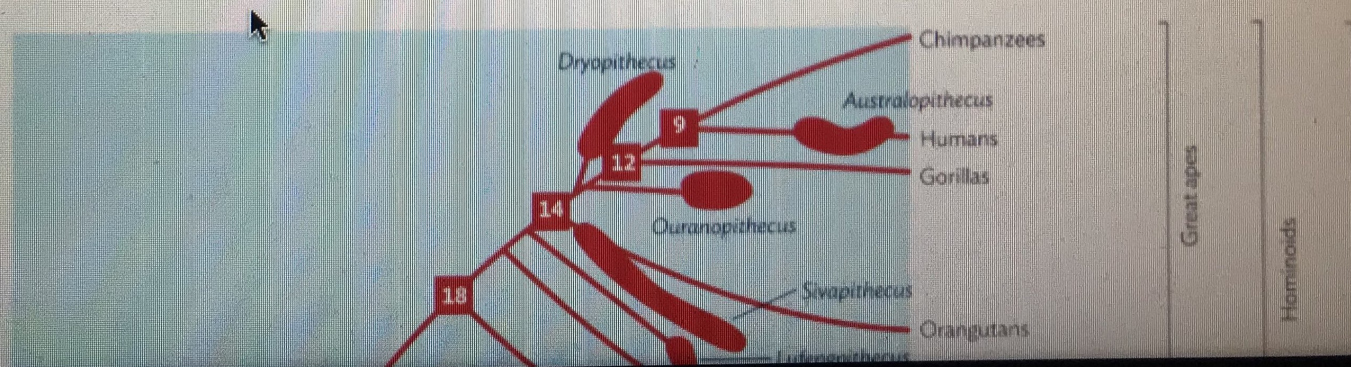
The Pliocene and Pleistocene fossil monkeys are divided into the same two subfamilies as Old World monkeys: cercopithecines and colobines. The cercopithecines are represented by three major groups: macaques; mangabeys, baboons, and geladas; and guenons. The fossil monkeys were widespread, as living species of monkeys are. The fossil monkeys and their living descendants are similar in many respects, such as skeletal and dental anatomy. For example, the fossil and living monkeys have virtually identical teeth (large, projecting canines) and cranial morphology.

Some of the Pliocene and Pleistocene monkeys were quite large. For example, *Theropithecus oswaldi*, one of the best-known fossil species of Old World monkeys from East, North, and South Africa in both the Pliocene and the Pleistocene, may have weighed as much as 80 kg (176 lb), the weight of a modern female gorilla (**Figure 9.26**). Males had enormous canines and would have been avoided by early hominins because they were so dangerous.

The colobines included three geographic groups of species: European, Asian, and African. These species differed in many ways from their living descendants, in part reflecting their greater geographic distribution and the diverse environments they occupied. One clear evolutionary trend in many monkey species is a decrease in

One clear evolutionary trend in many monkey species is a decrease in body size. In other words, around the world during the later Pleistocene there were widespread extinctions of large animals, including primates. These extinctions might have been caused by human hunting, climate change, competition with other mammals, or a combination of these factors (discussed further in chapter 14).

All of primate evolution is a dynamic story, peaking at different times and different places with key events, such as the origins of all the major groups of higher primates (**Figure 9.27**). The record becomes even more fascinating in the Late Miocene, with the appearance of a new primate that is similar to but different from other primates. The first 50 million years of primate evolution, from the beginning of the Eocene to the past several million years of the Miocene, set the stage for the appearance of this new taxa—a primitive, humanlike primate. This ancestor's origin begins the 7-million-year history of the appearance, rise, and dominance of humans. That story begins in the next chapter.



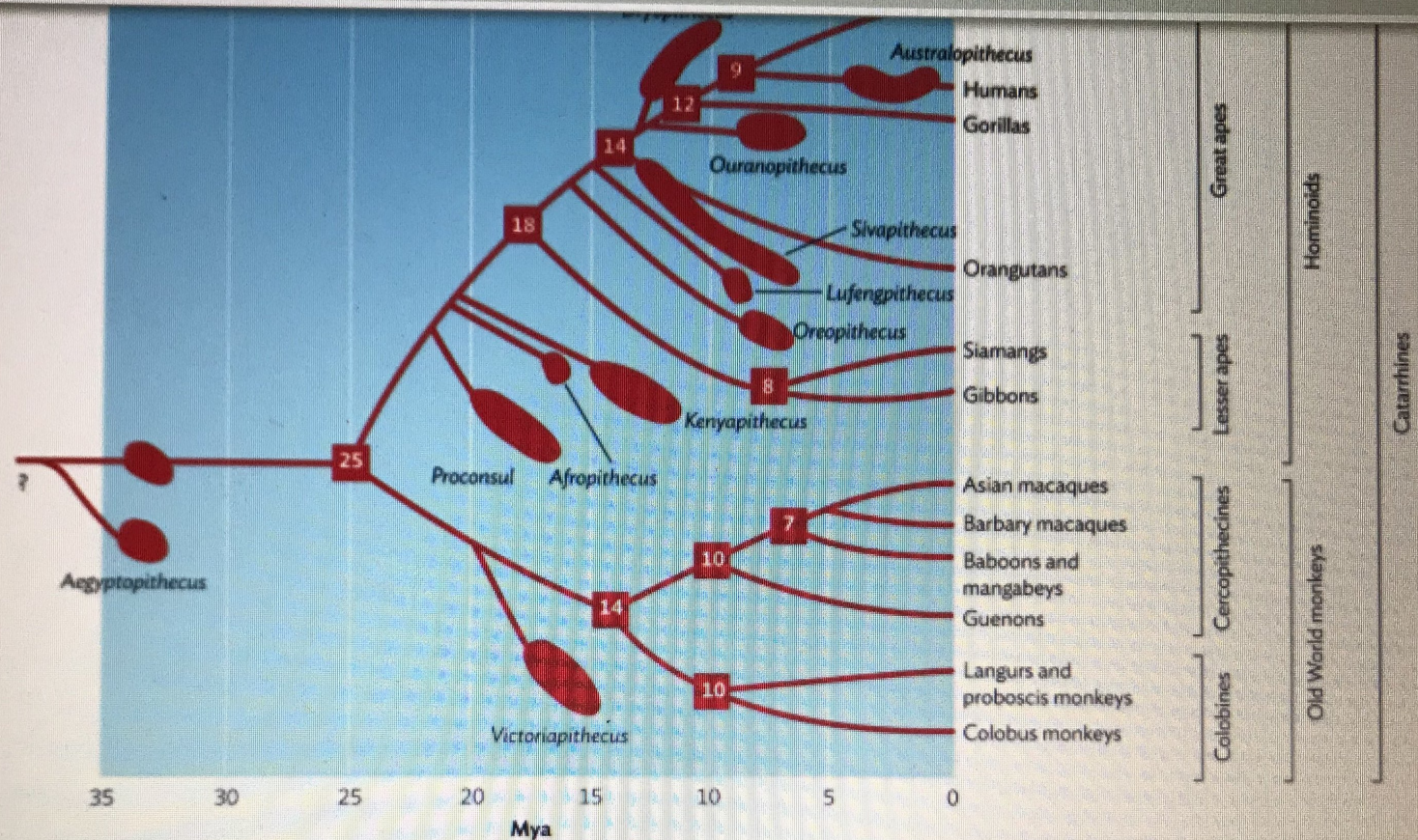


FIGURE 9.27

Catarrhine Origins This phylogeny represents catarrhine evolution. The numbers set in squares represent the estimated times of divergence. Balloons refer to approximate time ranges for fossil taxa. Old World monkeys and hominoids share a common ancestor; however, approximately 25 mya, Old World monkeys and hominoids split, each creating a separate evolutionary lineage. This last common ancestor, though, has not been discovered. Within the hominoid lineage, branching has occurred many times, including the branch leading to the lesser apes, around 18 mya, and most recently the branch leading to humans, approximately 9–8 mya. The Old World monkey lineage has also branched several times, most notably when colobines and cercopithecines split, approximately 14 mya.

CHAPTER 9

REVIEW

ANSWERING THE BIG QUESTIONS

1. Why become a primate?

- According to the predominant theory, primate origins represent the radiation of a primitive mammalian ancestor that adapted to life in the trees. Other theories suggest that the origins may be more closely linked to preying on insects or eating fruit.

2. What were the first primates?

- The first radiation of primates included the appearance of two primitive primate groups, adapids and omomyids, both at about 55 mya. These animals may have given rise to modern strepsirrhines and modern haplorrhines, but the exact phylogenetic relationship between the Eocene groups and later ones is unknown.

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8. What were the first higher primates?

- In the Eocene, primate taxa possessing a combination of strepsirrhine and haplorrhine characteristics appeared in Asia and Africa. These basal anthropoids may have been the first anthropoids.
- Recognizable catarrhines (for example, *Aegyptopithecus*) were present 30 mya in Africa, and platyrrhines (for example, *Branisella*) were present 26 mya in South America. Platyrrhines likely descended from an early African anthropoid ancestor.

4. What evolutionary developments link past primate species and living ones?

- The evolution of apes began in Africa and continued in Europe and Asia. Recognizable African apes first appeared about 22 mya (for example, *Proconsul*) and various Eurasian varieties (for example, *Sivapithecus*) somewhat later with the opening of a land bridge connecting these continents. Most apes went extinct in the later Miocene, although a few survived, giving rise to modern apes and humans.
- Monkeys underwent a massive adaptive radiation in the Pliocene and Pleistocene, providing the foundation for the evolution of modern species.

KEY TERMS

Adapids

Adapis

Anguipithecus

angiosperm radiation hypothesis

Apidium

arboreal hypothesis

basal anthropoids

Biretia

Branicella

Carpolestes

Aryopithecids

Dryopithecus

Eosimias

Euprimates

Gigantopithecus

Khoratpithecus

Micropithecus

Notharctus

Oligopithecids

Oreopithecids

Oreopithecus

Oreopithecus

Parapithecids

Parapithecus

Perupithecus

Plesiadapiforms

Proconul

proconulids

propliopithecids

Propliopithecus

Proprimate

Saadanius

Sinapithecids

Sinapithecus

Theropithecus

victoriapithecids

visual predation

hypothesis

STUDY QUIZ

1. The _____ specifically links the evolution of primates to flowering plants.
 - a. arboreal hypothesis
 - b. visual predation hypothesis
 - c. angiosperm radiation hypothesis
 - d. gymnosperm radiation hypothesis
2. The earliest group with clear primate characteristics was the
 - a. plesiadapiforms.
 - b. Euprimates.
 - c. Fayum higher primates.
 - d. strepsirrhines.
3. Platyrrhine ancestors most likely originated in
 - a. Africa.
 - b. North America.
 - c. South America.
 - d. Madagascar.
4. Which statement about ape evolution is *not* currently supported?
 - a. Apes and monkeys split in the Early Miocene.
 - b. The teeth of early apes are like those of living apes.
 - c. Apes originated in Africa but later migrated to Europe and Asia.
 - d. Miocene apes and living great apes have a continuous fossil record in Africa.

5. Which statement about Old World monkey evolution is *not* currently supported?

- Fully modern bilophodont molars first appear in the victoriapithecids.
- Many monkey species decreased in body size.
- Old World monkeys became more diverse than apes in the Late Miocene.
- Ape diversity decreased due to direct competition with Old World monkeys.

EVOLUTION REVIEW

PRIMATE SOCIAL ORGANIZATION AND BEHAVIOR: THE DEEP ROOTS OF THE ORDER PRIMATES

Synopsis The origin of our own taxonomic order, the order Primates, extends more than 50 million years into the past. Various hypotheses—based on characteristics seen in both living and extinct primates, such as arboreal adaptations and visual acuity—have been proposed to explain why the first true primates arose deep in the past. The evolutionary history of the order Primates can be described as somewhat tumultuous. Fluctuations in climate and other environmental pressures during the Eocene, Oligocene, and Miocene epochs affected the survival and adaptive radiations of various fossil primate taxa to differing degrees. Fossils of primate ancestors are found across Africa, Asia, and Europe in the Old World and North and South America in the New World. The locations and

World and North and South America in the New World. The locations and characteristics of these fossils clarify the timeline of major evolutionary events that shaped the order Primates and illustrate that the geographic extent of primates in the past was much larger than the distribution of nonhuman primate species living today.

- Q1. Describe the three hypotheses for explaining primate origins, discussed at the beginning of this chapter. Do you think the environmental pressures associated with each of these hypotheses are mutually exclusive or could all of these factors have influenced the origins and adaptability of the earliest primates?
- Q2. Identify the four alternative hypotheses for explaining the presence of primates in South America. Summarize the evidence that supports each of these four hypotheses. Based on this evidence, assess how plausible each hypothesis is in explaining the origins of the New World primates.
- Q3. Explain the role of climate fluctuations in the origins and evolution of the first true primates, the earliest anthropoids, the Early Miocene "dental apes" (proconsulids), and the surviving ape species of the Late Miocene.

Hint Focus on the ways that warming and cooling episodes affected habitable land areas, caused habitat changes, and affected availability of different food sources.

- Q4. There is much less diversity among living ape species than among the many fossil ape taxa of the Early Miocene and Middle Miocene.

- Q4.** There is much less diversity among living ape species than among the many fossil ape taxa of the Early Miocene and Middle Miocene. In contrast, there is much greater diversity among living monkey species than among the fossil monkey taxa of the Late Miocene. Discuss the kinds of selective pressures operating in the Late Miocene, Pliocene, and Pleistocene that favored an adaptive radiation of monkeys and contributed to decreased diversity among apes.
- Q5.** A bumper sticker reads, "If humans evolved from monkeys, then why are there still monkeys?" Using your knowledge of biological evolution in general, and the timeline of primate origins and evolution outlined in this chapter more specifically, counter the faulty logic behind this bumper sticker.

Hint See Figure 9.27 for a timeline of the key events in primate evolution.

ADDITIONAL READINGS

Beard, C. 2004. *The Hunt for the Dawn Monkey: Unearthing the Origins of Monkeys, Apes, and Humans*. Berkeley: University of California Press.

Cachel, S. 2015. *Fossil Primates*. Cambridge, UK: Cambridge University Press.

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