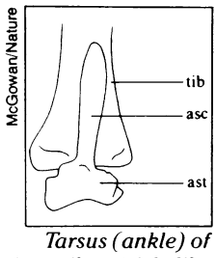
An ostrich place in bird family tree



Tarsus (ankle) of juvenile ostrich, like theropod dinosaur's, includes tibia, ascending process and astragalus.

While most birds soar up in the sky, the ostrich runs along the ground at 50 kilometers an hour. Sturdy legs substitute for flight-worthy wings and strong breast muscles. Once it was thought that ostriches were degenerate, or more kindly, "specialized" versions of modern birds. Now a Canadian scientist presents evidence that ostriches derive from a more primitive avian form.

Chris McGowan of the Royal Ontario Museum in Toronto has recently examined the tarsus joint, the avian equivalent of an ankle, in modern flying and flightless birds, which include ostriches and emus. From the bone structure, he argues that the birds share an ancestor that flew, but was far more primitive than the modern versions.

Students of bird anatomy have long argued about whether one section of the tarsus joint is an ascending process of a structure called the astragalus or whether it is a distinct "pretibial" bone. McGowan recently examined tarsus structures of more than a dozen flying birds and fowl. He reports a uniform pattern of development resulting in a pretibial bone. The result is clearest in studies of embryos. "In the mature bird, the structures have already been incorporated into one, so you can't be absolutely sure what you are looking at," he says.

In contrast, McGowan finds a different structure in ostriches and emus, and in tinamous, which are weak fliers that share some characteristics with the flightless birds. These birds all have an ascending process and no pretibial bone. The only other animals known to have an ascending process are theropod dinosaurs, which many scientists believe are the progenitors of birds.

"This implies that, since carinates [modern flying birds] possess the unique pretibial bone, they could not have given rise to the ratites [flightless birds], which are primitive for this feature," McGowan says in the Feb. 23 NATURE. This view is also supported by studies of bird palates by Peter Houde of Howard University and Storrs L. Olson at the National Museum of Natural History in Washington, D.C.

"The common ancestor was a flying bird, but not so highly modified as present-day carinates," McGowan says. "The flying birds have gone one way and the flightless birds have gone another."

— J. A. Miller

Academic memories: The long goodbye

Harry Bahrick has encouraging news for students and educators: When academic material is well-learned in the first place, a surprising amount of it can be remembered for at least 25 years even if it is never used or rehearsed.

Bahrick, a psychologist at Ohio Wesleyan University in Delaware, Ohio, tested 773 subjects, who ranged in age from 17 to 70, for their memories of Spanish learned in high school or college. He reports in the March JOURNAL OF EXPERIMENTAL PSYCHOLOGY: GENERAL, that students of Spanish soon begin to forget some of what they have learned in class, but after five or six years a substantial amount of their academic knowledge remains in storage and is accessible for from 25 to 50 years.

"It seems unbelievable," Bahrick told SCIENCE NEWS, "that this is the first study of long-term memory for educational content acquired in a natural setting."

His data suggest that it is what happens during learning, not periodic practice after schooling ends, that is critical for long-term memory. The more years of Spanish that subjects took in school and the better their grades were, the more they remembered later on. Everyone stopped forgetting after six years, coming to rest at different retention levels corresponding to their initial training and grades.

Why do some memories for a foreign language last for over a quarter of a century, entering what Bahrick calls "permastore"? Do memories for other subjects, such as mathematics and music, follow a similar pattern? At this point, says Bahrick, all that is known is that some foreign language knowledge achieves longevity during learning."

The transition to permastore appears to be sudden, he explains; memories check in, but they do not check out, at least for several decades.

His study sample included 146 students who at the time of testing were enrolled in or had just completed a high school or college Spanish course. Another 587 people were recruited who had taken one or more Spanish courses in high school or college from one to 50 years prior to being tested. The remaining 40 subjects had no Spanish training. The entire group was given a Spanish test to measure reading comprehension; recognition and recall for vocabulary, grammar and idioms; and knowledge of proper word order in sentences.

The subjects indicated the number of Spanish courses taken, the time elapsed since the last course and the grades received in the courses. These data were checked against school records for 14 percent of the sample and found to be accurate. To pick up any effects of rehearsal on Spanish retention, individuals estimated the amount of time they spend each year reading, speaking or writing in Spanish. They also listed foreign travel and training in other romance languages.

The data reveal "no significant rehearsal effects," says Bahrick. Subjects reported only one or two hours of exposure to Spanish per year. The important predictors of test scores, he explains, are training and grades. For example, people who earned a grade of C during one year of high school Spanish retain little knowledge in permastore. In contrast, individuals who had an A average during three years of high school Spanish can translate about 72 percent of the Spanish vocabulary that they originally learned, even when they are quizzed up to 50 years after taking their last class.

"Taking a single language course seems useless," says Bahrick. "Taking three or four courses becomes progressively more useful."

Few researchers dispute the finding that semantic knowledge, such as that acquired in a Spanish course, can be long lasting. There is a disagreement, however, with Bahrick's explanation of how recall takes place.

In an essay following Bahrick's report, Ulrick Neisser, a psychologist at Emory University in Atlanta, questions whether memories enter permastore during learning. Recent research on memory for events, conversations, stories and crimes witnessed suggests that remembering is like problem solving rather than like reproduction. "People use their general knowledge to answer even very specific questions," says Neisser. Intervening experiences often alter memories and interfere with recall.

Students develop a "cognitive structure" or "schema" for Spanish, he notes. When retested years later, they use this general knowledge to generate correct responses rather than dredging up specific memories from permastore.

Bahrick concedes that learning involves more than the gradual strengthening of associations between items, some of which gain permanence. "But a lot of educational content is repeated semantic knowledge that can often be literally replicated and is not subject to constant modification by one's experiences," he adds.

Modifications are in order, Bahrick contends, for the goals of memory researchers and educators. "They must establish in more detail the ways in which permastore learning can be achieved."

Adds Neisser, "Whatever the correct interpretation of [Bahrick's] discoveries turns out to be, they are certain to have a profound influence on the study of memory."

— B. Bower