

## j15 The first bony fishes < freshwater haven, marine origin >

We say a calme sea, or Becalmed, when it is so smooth the ship moves very little, and the men leap over board to swim. —Captain John Smith (Pocahontas's friend), 1626. And the lie to the notion that fearing stranding over drowning, sailors shunned learning how to swim.<sup>1</sup>

A skeleton is made of two tissues (cartilage and bone) and three cell types (chondrocytes, osteoblasts and osteoclasts).<sup>2</sup>

The first bony fishes (**Figure j15.1**) that become noticeably abundant and varied as fossils occur in the sediments of freshwater environments of the Devonian and, to a much lesser extent, in similar of the Silurian before. A suggestion (now much challenged) is that bony fishes got their start in freshwater where they did not have to contend with larger invertebrate predators then in the marine realm. However, marine bony fishes already present in the Early Devonian are: from China, 400 million year old *Psarolepis*,<sup>3</sup> and from Taemas limestone, Wee Jasper, NSW, Australia, a fish designated AMF101607 with the primitive condition (retained in sharks, skates, and rays and the extinct placoderms) of an opening in the brain case for a cartilaginous eyestalk.<sup>4</sup>

Fossils of bony fishes older than the Silurian have *only* been found in marine sediments and are identified from osteichthyan scraps with form-genera names as *Lophosteus* and *Andreolepis*, and from scales of *Anatolepis heintzi* from localities distributed around the margin of Laurentia<sup>5</sup> that range in age from Middle Ordovician (Union City, Colorado, found by T. W. Stanton and dated by Walcott in 1890)<sup>6</sup> back to Early Ordovician (Ny Friesland, described by T. G. Bockelie and R. A. Fortey, in 1976).<sup>7</sup>

Late Cambrian fish fossils are *rare* minute bone-like fragments in 510 My marine sediments in Wyoming, New York, Utah, and Oklahoma. Similar, described by Gavin Young in 1996 in Queensland, Australia, consist of an unbroken, three-layered sheet of hard tissue, with pores but, in the absence denticles or dentine-like structures, are enigmatic (they could be crustacean).<sup>8</sup>

An Early Cambrian fish is the agnathan *Haikouichthys*. Numerous specimens from a locality near Haikou, China, allowed Shu Degan (D.-G. Shu) in 2003 to detail its backbone (a notochord with separate vertebral elements) and a small lobate extension to its head with eyes and possible nasal sacs, as well as what may be otic capsules. Phylogenetic analysis puts this fish in the stem-group craniates (meaning that it has a cartilaginous, or bony, skull and a dorsal vertebral column).<sup>9</sup>

**Reprise** *If* the earliest remains of bony fishes in marine sediments were not simply washed in from the land, and *if* their absence in freshwater sediments is real, and not simply a bias in the fossil record, the implication is that marine fishes with little initial diversity moved from the ocean realm to become diverse in estuaries and rivers. From there, vigorously evolving bony fishes fed members back into the sea. □

Figure j15.1<sup>10</sup> A bony fish

