ART. XXXII.—*Some Sharks' Teeth from the California Pliocene*; by DAVID STARR JORDAN.

To Mr. H. Maus Purple, general manager of the Torrance Lime and Fertilizer Company of Los Angeles, I am indebted for the opportunity to examine a number of shark teeth of the man-eater type (*Lamnidae*), surprising in the fact of their coming together in one place. These teeth were found in deposits of bones and shells of Pleistocene age, composing hills at Torrance and Lomita, suburbs of Los Angeles, between the city and the ocean. The shark teeth may be described in detail.

1. *CARCHARODON BRANNERI* Jordan.

Two specimens—both of extraordinary size, as large as the largest *Carcharodon megalodon* of deposits along the Atlantic.

The largest of these has the crown three inches in height, the oblique length of its distal margin six inches. It is somewhat oblique, the interior more convex and relatively vertical; tip rather blunt. Edges of the tooth somewhat irregular with obsolete serrations—but no well-defined serrations except near the base.

A second specimen shows about half the tooth, split lengthwise. It shows the long exterior margin about four inches long, the crown $2\frac{3}{4}$ inches high. This like the other is flat or a bit concave on the interior side, but the sharp edge is obviously but very finely serrated, the serræ blunt, 120 to 125 in number along the side.

These teeth may be provisionally identified with *Carcharodon branneri* described by me¹ from Bolinas Bay, California. These specimens are larger than even this giant species, and the serræ much finer. The type of *Carcharodon branneri* may however have been a median tooth of a smaller example, the teeth perhaps less worn.

In the collection from Torrance, there is another large tooth which corresponds almost exactly to *Carcharodon branneri*. The crown is $2\frac{3}{4}$ inches high, the long margin somewhat over three inches. The tooth is more erect

¹ The Fossil Fishes of California, Univ. of California, Publ., V. no. 7, p. 116, 1907.

FIG. 1, a to g.

FIG. 1.—a. *Carcharodon branneri*, Jordan. b. *Carcharodon riversi*, Jordan. c. *Isurus planus*, submedian tooth, Agassiz. d. *Carcharodon carcharias*. L. e. *Isurus* (?) *glauca*, submedian tooth, M. and H. f. *Isurus* (?) *glauca*, lateral tooth, M. and H. g. *Isurus* (?) *glauca*, median tooth, M. and H.

than the others, the interior edge quite flat and the exterior quite convex. The tooth is serrulate to the tip, the serræ coarser than in the larger examples, all bluntish and about eighty to be counted, twenty or more apparently broken off.

This tooth is plainly identical with the type of *Carcharodon banneri* but it may be different from the two larger examples. Perhaps the distinction is due to its being less worn and from a different part of the mouth.

From *Carcharodon megalodon* Charlesworth, the giant species of deposits along the Atlantic Coast, the present form is plainly different as in *C. megalodon*, the serræ are far larger and coarser.

In life, the present species must have reached a length of more than one hundred feet, as *Carcharodon carcharias*, the living species of "Man-Eater," reaching a length of thirty-five feet, has teeth barely an inch in height.

2. CARCHARODON ARNOLDI Jordan (*Carchorodon riversi* Jordan).

In the same collection from Torrance is a specimen which corresponds perfectly to the type of *Carcharodon riversi* Jordan, described by me on page 115, of the same paper, from Pliocene deposits near Santa Monica. In this example the crown is nearly two inches high, the tooth narrowly triangular, nearly flat, and about as high as broad at base. The denticles are coarse and blunt, the total number being about 45 on each side. This species is however very doubtfully distinct from *Carcharias arnoldi* described by me (p. 113) from the Pliocene of Pescadero, and since found in different deposits of the California Miocene at Lompoc, in Kern County, and elsewhere.

3. CARCHARODON CARCHARIAS (L.).

From the same deposits at Torrance, but possibly at a higher level I have a small tooth which must belong to the living "Man-Eater," still extant on the California Coast. It is an inch in elevation, $1\frac{1}{4}$ in slant height, narrower than *C. arnoldi* and with the edges more flexuous. The

FIGS. 2 and 3.

FIGS. 2, 3.—*Carcharodon branneri*, Jordan. Pleistocene: Torrance, California.

serræ are strong and sharp, much larger and sharper than in the extinct species found in California, about 32 on each side, besides eight or ten much smaller ones on the lower angle of the tooth, the median serræ much larger than

those at the base and tip. Tip of the tooth sharper than in any of the others, the root less concave in outline, the crown narrower, its base $1\frac{1}{4}$ in its height.

4. *ISURUS PLANUS* (Agassiz).

(*Oxyrhina tumulus* Agassiz: *Isurus smithi* Jordan).

From the same deposit, I have the tooth of an *Isurus*, the crown of which is $1\frac{1}{2}$ inches high, the tooth narrow and nearly erect, corresponding fairly to the figures of *Isurus smithi* Jordan (p. 11), but broader at the base than any of those figured, the base of the crown being two-thirds its height.

As in this genus, the teeth are very differently formed in different parts of the mouth. I do not lay stress on these differences, and I have no doubt of the identity of *Isurus planus*, *tumulus* and *smithi*, all from the Kern County beds. And these differ but slightly from *Isurus hastalis* (Agassiz) of Europe, with which Jordan and Beal, in a later paper (op. cit., vol. VII, 251, 1913), following Maurice Leriche, have identified them. In most of the specimens figured by Agassiz, however, as *hastalis*, the inner face of the tooth has an obsolete ridge. This appears on one or two only of our multitude of specimens of *Isurus planus*. In view of the fact that all these California fossils have been described as distinct species, it is better to retain these names until adequate comparison can be made with related species in European deposits. The living sharks along the Pacific Coast have yet to be critically compared with their Atlantic relatives, and in most cases where comparison has been made, the species are found to be distinct.

From Torrance, I have also three much smaller teeth which may be merely the young of the same species as they seem too large for the living Mackerel Shark, *Isurus glaucus* (Müller & Henle), still extant in the Pacific. These come from different parts of the mouth, one, a slender median tooth, being an inch high.

The genus *Isuropsis* Gill, represented in both oceans, has the teeth essentially as in *Isurus* proper (*Oxyrhina* Agassiz) but the lateral teeth are more slender. *Isuropsis* is probably not tenable as a distinct genus.