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NOTES ON SEA TURTLES[1]

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It is perhaps the great size attained by sea turtles that has made them at once a subject of unusual interest to writers on natural history and an apparently unwelcome accession to museum curators. At any rate, a great deal has been written about a very few specimens, with often bewildering results. The recent work of Deraniyagala (1939) represents the first serious attempt at a revision based on adequate material, and includes a welcome contribution to the natural history of the group. This writer's taxonomic studies, however, were concerned chiefly with Indo-Pacific material, and certain of his conclusions appear to require further examination.

With regard to the loggerhead turtles, prevailing opinion among American zoologists assigns the three forms, *caretta*, *kempii*, and *olivacea*, to a single genus, Caretta. That this is an unnatural association, was pointed out by Deraniyagala (1934), who followed earlier workers in allocating each

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species to a monotypic genus,[1] and Pope (1939), in his excellent popular book on North American turtles, has accepted this scheme. Later, in a short note in Nature, Deraniyagala (1939b) mentioned that studies made by him in 1938 had demonstrated that *kempii* should be regarded as a race of *olivacea*, but apparently he published no account of these studies. I was particularly interested in this opinion, however, since before seeing the paper I had made an appraisal of the characters of the three loggerheads and had concluded that recognition of but two genera was necessary.

The distinction between *kempii* and *caretta* presents no problem. The two may be separated at a glance on the basis of color, shape of carapace and number of inframarginal scutes, while osteological features show differences of at least generic value. Much closer, in all respects, to *kempii* is the Pacific form, *Lepidochelys olivacea*. These two species, set off from all other sea turtles by conspicuous morphological differences, occupy mutually exclusive ranges, yet are distinguished from one another only by minor structural features which show marked tendency to overlap or to intergrade. It thus seems evident that *kempii* should be associated with *olivacea* in the genus Lepidochelys Fitzinger. This obviously logical disposition was proposed by Baur (1890) who, however, misdefined the genus[2] and was not followed by later workers. The accompanying key lists the characters which appear to me to constitute ample basis for the separation of Lepidochelys and Caretta and for the inclusion of *kempii* in the former.

[1] Garman (1880) described *kempii* as a species of *Thalassochelys*, but erected the subgenus *Colpochelys* to receive it. Hay subsequently (1908a) elevated *Colpochelys* to generic standing in a detailed and well illustrated osteological study of *kempii* and *caretta*.

[2] Baur, *loc. cit. supra*, described the frontal bone of Lepidochelys as not entering the orbital rim, and yet, with characteristic intuition, assigned to the genus both the above species. Hay accepted Baur's classification in his Fossil Turtles of North America (1908), but later abandoned it.

KEY TO THE GENERA OF CHELONIIDAE

1 One pair of prefrontals; horny cutting edge of lower jaw coarsely dentate, that of upper jaw strongly ribbed vertically; bony alveolar surface of upper jaw with a low but regularly raised auxiliary ridge behind the anterior ridge which is very strong and terminates anteriorly in a tooth at the postero-lateral corner of the premaxillary pit; costal scutes 4 . . *Chelonia*

Although not definitely illustrated by available material, it seems probable that the Atlantic and Pacific green turtles may prove to be different and that the latter may even break up into two or three species or races. The forms of Chelonia, including certain nominal species the status of which requires investigation, are as follows:

Chelonia mydas (Linné). — Type locality, Ascension Island.

C. agassizii (Bocourt). — Type locality, Pacific coast of Guatemala.

C. japonica (Thunberg). — Type locality, Japan.

C. depressa Garman. — The type of *depressa* (Museum of Comparative Zoölogy, no. 4473), from northern Australia, is a most extraordinary specimen, possessing features of both Chelonia and Lepidochelys. Baur, *loc. cit.*, regarded it as probably belonging in a separate genus, while Fry (1913) believed it to represent a distinct species (of which he had seen several specimens), and to have coextensive range with *C. mydas* in Australian waters. Loveridge (1934), however, is convinced that the type specimen is an aberrant *mydas*. Dr. Barbour, who discussed the form with Garman on several occasions, is inclined to consider it a valid species.

1′ Two pairs of prefrontals; horny cutting edge of lower jaw smooth or feebly denticulate, that of upper jaw without markedly elevated vertical ribbing on its inner surface; bony alveolar surface of upper jaw smooth or with a single ridge, this ridge not terminating anteriorly in a sharp tooth; costal scutes 4-9 2

2(1′) Costal scutes in four pairs; nuchal scute not in contact with first costals; snout elongate, narrow, the mandibular symphysis deeply excavated and not terminally toothed; bony alveolar surface of upper jaw with a sharp-crested ridge; dorsal shields usually conspicuously imbricated; marginal bones usually 11 . . . . . *Eretmochelys*

Beside the Linnaean form, *imbricata*, of the Atlantic, there appears to be at least one rather feebly differentiated Pacific race; this is *E. i. squamata*, described by Agassiz (1857) without specific type locality.

2′ Costal scutes in five or more pairs; nuchal scute in contact with first costals; snout relatively short and broad, the mandibular symphysis either terminally toothed or blunted by wear, not deeply scooped; bony alveolar surface of upper jaw smooth or with a rounded ridge; dorsal shields not conspicuously imbricated; marginal bones usually 12 or more 3

3(2′) Maxillaries not in contact, separated by vomer; frontal bone entering rim of orbit; pterygoids markedly broadened anteriorly, the ectopterygoid processes strong; fontanelles in choanal chamber near opening, not hidden by alveolar surface in ventral aspect; external openings of orbits not concealed by overlying bones in ventral aspect; descending processes of prefrontals not reaching palatines; lower jaw with a more or less sharp and strong triangular median elevation at the posterior border of the bony alveolar surface, which may or may not extend forward as an elevated ridge; four enlarged inframarginal scutes on the bridge; neural bones 11-15; color gray to olive green . . . . . *Lepidochelys*

There are at least two forms in this genus, perhaps more in the Pacific. The two recognized species are very similar but may be distinguished as follows:
L. kempii (Garman); Atlantic Ocean and Gulf of Mexico. Bony alveolar surface of upper jaw with a median ridge extending parallel to the cutting edge; combined widths of pterygoids behind expanded anterior portion contained about three times in greatest diameter of orbit; inframarginal scutes without pores; costal scutes usually in five pairs; color usually gray.
L. olivacea (Eschscholtz); Indian and Pacific oceans. Bony alveolar surface of each side of upper jaw usually

with a gentle elevation extending parallel to the cutting edge, but never with a conspicuous ridge; combined widths of pterygoids behind expanded anterior portion usually contained no more than two to two and one half times in greatest diameter of orbit; each inframarginal scute usually with a pore at its posterior border; costal scutes usually in more than five pairs; color olive.

3′ Maxillaries in contact, not separated by vomer; frontal bone not entering orbital rim; pterygoids not, or but slightly, broadened anteriorly, the processes vestigial or lacking; fontanelles far forward in choanal chamber, completely concealed by alveolar surface in ventral aspect; external openings of orbits concealed by overlying bones in ventral aspect (in mature specimens); descending processes of prefrontals connected with palatines; bony alveolar surface of lower jaw smooth at postero-median border; symphysis of mandibles without longitudinal ridge; bridge with three enlarged inframarginal scutes; neural bones usually 7 or 8; color brown or reddish brown..... *Caretta*

Deraniyagala (1933) has described an Indo-Pacific form (*gigas*) as distinct from the Atlantic *C. caretta*. The separation would appear logical, but has thus far not been supported by a clear diagnosis.

Of the several systems which have been proposed for the classification of the superfamily Chelonioidae, Deraniyagala has selected that which recognises one family for Chelonia and Eretmochelys (Cheloniidae) and another for Lepidochelys and Caretta (Carettidae), while more widely held opinion assigns all the genera to a single family. In an effort to reach an independent conclusion concerning this problem, I have recently examined the considerable skeletal material in the Museum of Comparative Zoölogy, and have compiled the list of characters presented in table 1. From this tabulation, in which only those characters which appear to have possible bearing on the question of family relationships are listed, the following conclusions may be drawn.

DISTRIBUTION OF CHARACTERS AMONG THE FOUR GENERA OF CHELONIOIDAE. PLUS SIGNS INDICATE THE AFFIRMATIVE, MINUS SIGNS, THE NEGATIVE.

Characters	*Lepidochelys*	*Caretta*	*Eretmochelys*	*Chelonia*
Maxillaries in contact	—	+	—	—
Descending process of prefrontals connecting with palatines	—	+	—	+
Choanal fontanelles far forward, hidden	—	+	—	+
Frontal entering orbital rim	+	—	+	+
External openings of orbits visible in ventral aspect	+	—	+	+
Pterygoids deeply concave	+	+	+	—
Mandibular symphysis	long	long	long	short
Premaxillary pit bordered laterally by strong ridges	—	—	—	+
Anteriorly projecting boss for attachment of posterior ectopterygoideus muscle at symphysis of quadrate and proötic	strong	strong	strong	none
Inner surface of upper beak strongly ribbed vertically	—	—	—	+
Edge of lower beak deeply dentate	—	—	—	+
Median alveolar tooth of lower jaw connected with terminal tooth by sharp ridge	—	—	—	+
Papillae in each choanal opening	1	1	1-2	numerous
Pairs of prefontal scutes	2	2	2	1
Three ridges on carapace of young	+	+	+	—
Pairs of costal scutes	5 or more	5 or more	4	4

Plastron of young with dark pigment	+	+	+	—
Claws, usual number on fore flippers	2	2	2	1
Postocular scales	3—4	3	3	4
Last marginal not entered by rib lies between ribs numbers	7-8	7-8	7-8	8-9
Sacral ribs	2	2	2	3
Marginal bones	12-13	12	11	11
Nuchal scute in contact with first vertebrals	+	+	—	—
Posterior edge of narial septum	rounded	sharp	rounded	sharp
Length of coracoid exceeds length of scapula	slightly	slightly	greatly	greatly

The basis for separating Chelonia and Eretmochelys on the one hand from Lepidochelys and Caretta on the other is weak, being supported by a relatively small number of characters (four in the table) which are for the most part involved in a possibly independent reduction of the number of dorsal scutes in the former pair. Since scute number is generally subject to considerable variation, and is apparently a much less fundamental character than the osteological features, in which Chelonia and Eretmochelys diverge markedly, it seems likely that the points of agreement between the two forms should be attributed to parallelism. The elongate coracoids of these two genera are associated with the functional adaptation of increased speed in swimming,[1] and may also represent purely fortuitous agreement.

[1] I have frequently been impressed by the speed attained by frightened green turtles and hawksbills. Dr. Barbour informs me that he once had the opportunity of making a direct comparison of the green turtle and the loggerhead in this respect, when both species fled before an approaching boat. He estimates that the speed of the former was easily twice that of the latter.

If subdivision of the chelonioids is to be made, what appears to me as by far the most acceptable arrangement would restrict the Cheloniidae to the single genus, Chelonia and place Eretmochelys in the Carettidae with Lepidochelys and Caretta. No fewer than fifteen characters supporting this disposition may be found in the table. On the other hand, there are certain striking similarities between the skulls of Chelonia and Caretta and between those of Lepidochelys and Eretmochelys. Moreover, the argument for monotypic family designation for each of the genera is not altogether unreasonable. Thus, until examination of large series of skeletons of each species has determined the relative constancy of the osteological characters involved, it would appear preferable to recognize only one family for all the marine Thecophora.

I have recently examined the type of *Carolinochelys wilsoni* Hay (Museum of Comparative Zoölogy, no. 1005-A), a beautifully preserved cheloniid skull from the Ashley Marl of Charleston, South Carolina, thought by Cooke (1936) to be of Miocene age. A comparison of this specimen with skulls of existing Cheloniidae shows an apparently close affinity between Carolinochelys and Lepidochelys, so close, in fact, that it appears reasonable to regard the former as a direct ancestor of the latter. Although differences between the two are certainly of generic value, the similiarities which exist suggest that most of the evolution of the thecophoran sea turtles took place at a very early date, and that Lepidochelys was probably fully differentiated from the other genera during Miocene time.

In addition to the generic transfer suggested above I believe that a change in the non-technical designation of *kempii* is indicated. Some time ago my good friend, Stewart Springer, who was then in charge of a shark fishery at Islamorada on Lower Matacumbe Key, told me of a species of sea turtle, known locally as the 'ridley,' which was recognized as distinct by natives of the Keys and which he believed to be *kempii*, a conclusion which subsequently

proved to be correct. I had long been somewhat puzzled that the name 'bastard turtle,' so ubiquitous in the literature, should be virtually unknown among the inhabitants of the Florida coast, and had decided that *kempii* must be excessively rare in the area. However, since my original correspondence with Springer on the subject I have discussed sea turtles with numerous fishermen and turtle hunters along the Gulf Coast from Cedar Key to Key West, and have everywhere found the ridley to be a well-known member of the fauna.

Thus, although the term 'bastard turtle' is admittedly a venerable one, having been used by Lacépède in 1788, and having been communicated to Garman as the proper vernacular name of his discovery by Kemp himself, I nevertheless propose that it be relegated to synonymy. It is my conviction that in such cases priority should bow to prevalence, that a common name which is not common is a mockery; and henceforth I shall use ridley.

The scarcity of published information concerning the natural history of *kempii* should probably be attributed chiefly to the failure of observers to distinguish it from the loggerhead, rather than to innate secretiveness on the part of the animal. It is certainly not rare, being well known along the Gulf Coast of Florida where it is variously regarded as the hybrid offspring of loggerhead and green turtle, loggerhead and hawksbill, or green turtle and hawksbill. The meat occasionally is eaten, and is said to be better than that of the loggerhead but inferior to that of the green turtle.

My observations and inquiries, and those of Springer, appear to locate the center of abundance of the ridley in Florida Bay, where local residents agree that it is more numerous in the vicinity of Sand Key than anywhere else. Here, alone, it is said to be more abundant than the loggerhead. Springer and I accompanied shark fishermen on a bait-catching trip to Sand Key in June, 1941, with the hope of substantiating this report, and while the results—one

ridley, one loggerhead and three green turtles—were inconclusive, we had nevertheless gone in search of ridleys and had seen one. While it is difficult to understand what attraction not afforded by a hundred others this small island might hold, the word of the people who know the animal best cannot be disregarded.

All who are acquainted with *kempii* agree that temperamentally it is unstable and irascible. While captive loggerheads and green turtles may be handled with comparative (the latter with complete) impunity, the ridley exhibits almost hysterical violence and obstinacy when caught. It is frequently pointed out by the people on the Keys that a ridley will die, apparently of rage and frustration, if placed on its carapace out of water. A large, uninjured and apparently healthy male specimen which we left in a shaded spot on the deck of a boat at Lower Matacumbe died within five hours. Throughout this period it thrashed its flippers frantically, snapped at every object within reach, and never for a moment relaxed frenzied efforts to right itself. A small individual observed in a tank at the turtle dock in Key West behaved in a similarly inconsolable fashion.

I have been unable to substantiate Kemp's rather surprising statement (quoted by Garman, *loc. cit.*) that *kempii* breeds during the winter months. With regard to the feeding habits of the species, DeSola (1933) found the spotted lady crab (*Ovalipes ocellatus guadulpensis*) to be the only food of Georgia specimens dissected by him, while the stomachs of two specimens examined by Springer and myself contained large quantities of fragments of the dolly varden crab (*Hepatus epheliticus*).

The known distribution of *L. kempii* is outlined by the following locality records:

Florida: Key West (MCZ,[1] types on exhibition and observation records, Carr); Tortugas (MCZ, 1406); Cedar Key (Carr, 1940);

[1] MCZ = Museum of Comparative Zoölogy.

Sand Key, Florida Bay (MCZ, 46,549 and observation records, Springer and Carr); Salerno (observation record, Springer). Georgia: southern coast (DeSola, 1933). North Carolina: (USNM,[1] 52,015, 029,244); Beaufort, USNM, 55,735 and Coker, 1906). Virginia: Northumberland Co., near Reedville (USNM, 86,814). New Jersey: Atlantic City (Hay, 1908a). New York: Lower New York Bay (DeSola, 1931). Massachusetts (USNM, 55,734). Ireland: Galway Bay and Miltown Malbay, County Clare (Deraniyagala, 1938). Azores: Corvo (Deraniyagala, 1939a).

After I had finished this manuscript and returned to the University of Florida at Gainesville, Mr. Barbour found another ridley in the collection of the Boston Society of Natural History. This is a young specimen with a carapace 12 inches long, purchased from S. F. Denton in May, 1903. Mr. Denton secured it from fishermen who found it dead on the beach of the island of No-Man's-Land, thirty miles south of Gay Head, Martha's Vineyard. Mr. Denton was a taxidermist and must have had time to prepare the specimen before he sold it to the museum. Therefore it is fair to assume that this tropical specimen perished from the cold, probably in March. The specimen is a typical one in every way and is well prepared.

The European records are of great interest and have stimulated considerable explanatory comment by British writers. Russel (1939) pointed out that the unusual occurrence of several specimens of *Caretta caretta* in the English Channel coincided with the recent northward extension of the ranges of other marine animals, and might indicate a general increase in the incursion of warm water from the southwestern Atlantic. Parker (1939) also sees a "strong indrift from the southwestern Atlantic" as the probable agent, but later (1939a) suggests a possible correlation between the movements of *kempii* and those of eel larvae, which pass both the British Isles and the Azores as they

[1] USNM = United States National Museum.

move in from the breeding area. Deraniyagala (1939b) had previously implied that the Azores might be a breeding ground and secondary center of distribution of *kempii*, since the specimen examined by him from the Azores was only 100 mm. in length. Both these writers attach significance to the consistently small size of the European specimens of *kempii*.

As was previously mentioned, it seems evident that the center of abundance and distribution of the ridley is Florida Bay, between the southern tip of the peninsula and the Keys. If this is true, and if we regard the young individuals of the species as relatively helpless plankton, subject to frequent expatriation by the powerful northward sweep of the Gulf Stream, it is in no way strange that an occasional individual should reach the eastern shores of the Atlantic. Although the northeastern extension of the so-called Gulf Stream becomes diffuse and loses considerable velocity, it nevertheless splits to continue as two moderately steady drifts, one moving northward past the British Isles, the other southward past the Azores and the Canary Islands. Dr. Henry Bigelow informs me that there is little reason to believe, as some have suggested, that any appreciable component of the warm northward drift off the British Coast is derived from the southeastern Atlantic, and he sees no objection to the assumption that the European specimens of *kempii* were of American origin. Of a large number of drift bottles set out by Dr. Bigelow (1924) in coastal waters off New England in 1921 and 1922, seven were recovered on the eastern side of the Atlantic in the following localities: Azores, 1; Canary Islands, 1; Ireland, 3; English Channel, 1; Scotland, 1; France, 1.

Parker (*loc. cit.*) and Deraniyagala (*loc. cit.*) pointed out that, while their specimens of *kempii* were all of about the same small size, British specimens of *Caretta caretta* varied markedly in this respect, ranging up to 900 mm. in length. I believe that a difference in habitat preference may have some bearing on this point. Although both the ridley

and the loggerhead are characteristically inhabitants of shallower, littoral waters, the loggerhead is unquestionably the more pelagic of the two, and its breeding range almost certainly extends farther north along the coast of the United States. Thus, while the only ridleys which make the Atlantic crossing are the young, weak and altogether casual waifs picked up by the Gulf Stream, the loggerheads, which rove well out to sea, are caught in the drift at all ages.

In my opinion available evidence does not support the assumption that the European records indicate extension of the breeding ranges of either of these forms.

The drawings of the skulls of Lepidochelys and Caretta were made by Mrs. Myvanwy Dick and the photographs by Dr. Frank Carpenter. For this assistance I am extremely grateful. To Dr. Thomas Barbour, Mr. Arthur Loveridge and Dr. T. E. White I am indebted for valuable suggestions and for the use of facilities of the Museum of Comparative Zoölogy.

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Explanation of Plates

Plate I. *Caretta caretta* (juv.). M.C.Z., no. 1469. West Indies. Died in the Aquarial Gardens in 1862.

Plate II. *Lepidochelys kempi* (juv.). M.C.Z., no. 1406. Tortugas, Florida. Collected by Louis Agussiz in 1858. The contrast in shape of carapace between this species and *C. caretta* may be seen in specimens of all ages.

Plate III. Skull of *Caretta caretta*, ventral view. Florida.

Plate IV. Skull of *Lepidochelys kempii*, ventral view. Type, Key West.

Plate V. Skull of *Lepidochelys olivacea*, ventral view. Pacific coast of Mexico.