

fact that the book was not written as a whole, but is a collection of lectures, delivered at various times and places, on different aspects of the general problem of the evolution of the universe.

CHAS. LANE POOR

Modern Navigation. By FRANK SEYMOUR HASTINGS. D. Appleton & Co. 1918. Pp. xvi + 84, illustrated. With introduction by Rear-Admiral Albert Gleaves, U. S. N.

In "Modern Navigation" the author has rendered a real service to all interested in the safe navigation of the seas. In the last quarter of a century there have been many improvements in the art of finding one's place at sea, and the officers of our Navy have been quick to take all possible advantage of these inventions and improvements. Not so, however, with those responsible for the vessels of the mercantile marine. These vessels have been navigated and are being navigated to-day by methods requiring long and cumbersome calculations, by methods long obsolete in the Navy.

When the necessity of manning the vessels, now being built under the emergency of war, was recognized, the government started schools for the training of many thousands of seamen to rank as mates and masters in the new mercantile marine. The attention of those in charge of this training was early called to these new methods and they were urged to start the future navigators right, to discard all the obsolete methods, and to substitute the simple modern method. This was not done: the training has gone on along the old fashioned and antiquated ideas of a past generation. The time and energy of thousands of bright, aspiring young men are being wasted, and old, worn out methods are being fastened on the next generation, all because the power to grant licenses to masters and mates rests in the hands of a few retired seamen, who have failed to keep abreast of the advances in their profession. For this reason the book of Mr. Hastings is most timely; it may help to bring the great advantages of modern methods before the officers and students of the training schools.

This small book gives a short account of the St. Hilaire method. Very wisely all extraneous matter is eliminated, and the book is confined to the bringing before the merchant officer the advantages of the Navy method. The working of this method is shown by a number of concrete examples, and the book is well illustrated with carefully prepared diagrams. The book, however, lacks a clear explanation of the fundamental principles of a "line of position," and of the real underlying basis of the St. Hilaire method.

It is certainly refreshing to see a book on navigation, which is something more than a mere compilation from treatises of a past generation.

CHAS. LANE POOR

SPECIAL ARTICLES

RHINEODON TYPUS, THE WHALE SHARK— FURTHER NOTES ON ITS HABITS AND DISTRIBUTION

In a brief note published in *SCIENCE* in 1913¹ I recorded the second taking in Florida waters of this great fish. As an interesting coincidence it may be pointed out that this specimen is the second ever taken in the Atlantic Ocean, or, so far as records go, ever seen therein. In a later and more extensive paper,² I gave the details of the capture of this fish with as full a description and as many photographs as possible, and followed these with the natural history of the fish as contained in the writings of those scientists who have been privileged to study it at first hand. Reproduced in this larger paper were all the known figures of this great shark. Inasmuch as in the course of this work there were brought to light a number of accounts and descriptions of this greatest of all sharks which up to that time had remained unknown, it was believed that the paper contained a

¹ Gudger, E. W., "A Second Capture of the Whale Shark, *Rhineodon typus*, in Florida Waters," *SCIENCE*, 1913, N. S., Vol. 38, p. 270.

² "Natural History of the Whale Shark, *Rhineodon typus* Smith," *Zoologica: Scientific Contributions*, New York Zoological Society, 1915, Vol. I., pp. 349-389, 14 figs.

résumé of all the known accounts of the fish. However, during the summer of 1917, while at work on the Bibliography of Fishes in the department of ichthyology of the American Museum of Natural History in New York City, I found a few hitherto unknown references to the whale shark. Since these are of themselves interesting and since they extend our knowledge of its recorded habitat, it seems worth while to collect and publish them as a postscript to the paper referred to above.

Lest any one, seeing the title only, should be misled by it, it may be well to say by way of introduction to our subject, that in the Report of the British Association for the Advancement of Science (Liverpool Meeting, 1870), 1871, page 171, occurs the title "On *Rhinodon typicus*, a Rare Shark lately Added to the Free Museum, Liverpool." However, no data whatever are given.

Furthermore, Lütken's³ paper, "Om Haplægten Rhinodon" (1874), consists of but a few remarks by this distinguished ichthyologist on the similarity of the gill apparatus of *Rhinodon* to that of the great basking shark, *Selache maxima*. Further than this mere statement, the paper in question does not concern us.

Taking our references chronologically, the next one is very interesting. Julian Thomas (1887) while at anchor in Red Scar Bay, on the south side of New Guinea says that:⁴

A school of sharks twenty-five to forty feet long now surrounded us. . . . The fish came right underneath the bows, and then quietly floated astern on top of the water. We could have touched him with our hands by leaning over the bulwarks. . . . This was a shark—an enormous mottled brute, which seemed as long as our ship. He turned partly over and showed his frightful jaws, which would have taken in a man whole. He was by the computation of the captain and all hands, at least forty feet long, with a six-foot "beam." . . . The sharks were all around, not one of them ap-

parently under twenty-five or thirty feet long. The "boomer" appeared to lead them, and they swam around us both to port and starboard. It almost seemed as if they meant to attack the ship.

This great fish was impervious to bullets, for when fired at with rifles, "The bullets ricocheted off the brute's back" and "shot after shot was fired without much apparent effect." Thomas calls this shark *Selache maxima*, probably because that was the largest shark known to him, but there is no reason to doubt its being *Rhineodon typus*, the giant of all the sharks. His reference to the color and great size effectually settles that.

Those who read my larger article will recall that Captain Steuart⁵ says that around the coasts of Ceylon the spotted shark was always surrounded by smaller sharks of which it was the leader. Also Thomas's ricocheting bullets recall what Mr. Brooks wrote me as to the impermeability of the hide of the second Florida specimen to rifle balls.

Of somewhat doubtful value is the following brief account found in a work compiled and edited by Paul Fountain from the notes of Thomas Ward⁶ of Australia (1907). It is of doubtful value because, although the fish passed in full view at a distance of eighty yards, no mention is made of the yellow spots and vertical bars which ornament it. These may have been indistinct, or the fish may have been in line with the sun, or it may have been a specimen of *Selache maxima*, to the presence of which in antipodal waters as recorded by the Australian ichthyologists the present writer has recently called attention.⁷ Be the explanation what it may, the incident is given for what it is worth.

Fountain had been cruising near the head of the Great Australian Bight, when he fell

⁵ Steuart, James, "Notes on Ceylon, etc.," London, 1862, p. 156.

⁶ Ward, Thomas, Paul Fountain, editor, "Rambles of an Australian Naturalist," 1907, pp. 119-120.

⁷ Gudger, E. W., "On the Occurrence in the Southern Hemisphere of the Basking or Bone Shark, *Cetorhinus maximus*," SCIENCE, 1915, N. S., Vol. 42, pp. 653-656.

³ Lütken, C. F., "Om Haplægten Rhinodon," Videnskabelige Meddelelser Naturhistoriske Forening, Kjøbenhavn aarene 1873, 1874, p. 2.

⁴ Thomas, Julian, "Cannibals and Convicts: Notes of Personal Experiences in the Western Pacific," London, 1887, p. 380.

in with a school of sixty-foot sperm whales. His words are:

Before the last of them was out of sight, an enormous shark passed so close to us that we had a full view of it. Like the whales, which it appeared to be following, it swam slowly, passing the *Swan* at a distance of 80 yards. I can therefore testify that its length was at least 40 feet; and in bulk it seemed to be nearly equal to some of the whales. From the circumstances of its great size there can be no doubt that this was a specimen of *Rhinodon typicus*, or the great Pacific basking shark.

Another even more indefinite reference deserves brief mention only here. George Bennett, in 1831 saw two large sharks which he described as follows:⁸

On the 18th of March, 1831, during my former voyage, in latitude 44° 55' north, and long. 25° 10' west; in the evening, two sharks of a very large size were seen at a short distance from the ship. A high dorsal fin, projecting from the water, was at first only discernible, and had a resemblance to a rock. It was at first stationary, but soon began to move steadily along, and then occasionally the tail could be seen partially above the water. I know not to what species to refer it; one of the crew on board, who had been in a whaler, said that it was what they named a "bone shark," which is seen in numbers alongside the ships when they are cutting up a whale. He said, also, that he had seen them as large as a *twenty-barrel whale*; that "the mouth resembled the gills of a fish, and they are spotted over the back." Whether the latter part of this account accorded with the actual appearance of the fish, I was not sufficiently near to ascertain, but it appeared correct with respect to its large size.⁸

This fish was seen in the North Atlantic near the Azores, but it is not clear that it was *Rhineodon*. However, the account seems of sufficient interest to warrant its inclusion here. If this fish was the whale shark, then we must note three occurrences in the Atlantic, this being the first.

One of the common haunts of this greatest of fishes is around the island of Ceylon, but it is not unknown in the Bay of Bengal, where it

⁸ Bennett, George, "Wanderings in New South Wales, Batavia, Pedir Coast, Singapore and China," London, 1834, Vol. II., p. 267.

has been recorded by Lloyd⁹ in 1908. However, this is not its first record for these waters, for in the year 1835 one W. Foley¹⁰ had given the following vivid account of his experiences. We will let him tell his story in his own words.

On my voyage to Madras (in May last), I saw a most extraordinary fish, and one which had never before been seen by any seaman on board, although some of the officers and crew had been employed in the whale fishery. It was of the size of a whale but differing from that animal in shape; spotted like a leopard in very beautiful manner; it came close under the stern of the ship, during a calm, and we had a magnificent opportunity for viewing it; it had a very large dorsal fin, which it moved about with great rapidity when made angry in consequence of the large stones which we threw down upon it rashly, for it possessed sufficient strength to have broken the rudder and stove in the stern of the ship. Several large fish (seemingly Dog-fish), about a cubit in length and upwards, were gambolling about the monster, entering its mouth at pleasure and returning to the water again. The following will give you some idea of its shape. The mouth very large, dorsal fin black or dark brown, tail also; body covered with brown spots like a leopard, head lizard-shape.

This description leaves no doubt that this was a *Rhineodon*, and to one acquainted with their habits it is equally plain that the "dog-fish" were remoras or echeneises. Chierchia¹¹ (1884) found several remoras in the mouth of his specimen taken in the Bay of Panama. Others have noted the same fact. Foley's mistake is, however, perfectly excusable. Numerous other writers on sharks and remoras have mistaken these later for young sharks. The present writer was inclined to scoff at such errors, until in the clear waters around Key West, he made a similar mistake in the summer of 1913.

⁹ Lloyd, R. E., "The Occurrence of *Rhinodon typicus* at the Head of the Bay of Bengal," Records Indian Museum, 1908, Vol. II., p. 306.

¹⁰ Foley, W., "An Unusual Sea Monster in the Bay [of Bengal]," *Journal Asiatic Society of Bengal*, 1835, Vol. 4, pp. 62-63.

¹¹ Chierchia, G., "The Voyage of the *Vettor Pisani*," *Nature*, 1884, Vol. 30, p. 365.

In 1901, Kishinouye of the Imperial Fisheries Bureau, Tokyo, Japan, published an interesting description with a crude figure of a *Rhineodon* taken in Japan which he thought to be a new species and which he named *pentalineatus*. Apparently this paper was reproduced in Japanese as follows: "On Yasurizame (*Rhinodon pentalineatus*)," etc., *Dobuts. Zasshi*, Tokyo, 1903, Vol. 15, 41-44. This journal I have not been able to locate in America, and my letters to Mr. Kishinouye have seemingly gone astray, but the conjecture expressed above seems reasonable.

Our next and last reference is to the occurrence of this fish in the Philippines, where however, it is not entirely unknown since Dr. H. M. Smith,¹² the present U. S. Commissioner of Fisheries, has put on record (1911) an 18-foot specimen taken at Negros Occidental in 1910. Again Dr. David Starr Jordan¹³ in 1915 recorded the capture of a 20-foot specimen at the island of Zebu in March of that year. However this last reference in question dates back to 1835 when one Captain H. Piddington published in the *Journal of the Asiatic Society of Bengal* a "Notice of an Extraordinary Fish." His account is so circumstantial and so fascinatingly interesting that it seems best to quote him verbatim.

In December, 1816, I commanded a small Spanish brig, and was lying at anchor in the Bay of Mariveles, at the entrance of the Bay of Manilla. One day, about noon, hearing a confusion upon deck, I ran up, and looking over the side, thought, from what I saw, that the vessel had parted [her chain] and was drifting over a bank of white sand and coral, *with large black spots*. I called out to let go another anchor, but my people, Manilla men, all said, "No Sir; it's only the *chacon*!" and upon running up the rigging, I saw indeed that I had mistaken the motion of the spotted back of an enormous fish passing under the vessel, for the vessel itself driving over a bank! My boatswain (*contramestre*), a Cadiz man,

with great foolhardiness jumped into the boat with four men, and actually succeeded in harpooning the fish with the common dolphin-harpoon, or grains, as they are usually called, to which he made fast the deep-sea line; but they were towed at such a fearful rate out to sea, that they were glad to cut from it immediately.

From the view I had of the fish, and the time it took to pass slowly under the vessel, I should suppose it not less than 70 or 80 feet in length. Its breadth was very great in proportion, perhaps not less than 30 feet. The back was so spotted, that, had it been at rest, it must have been taken for a coral shoal, the appearance of which is familiar to seamen. I did not distinguish the head or fins well, from being rather short-sighted, and there being some confusion on board.

As my people seemed to look upon "the *chacon*," as they called it, almost in the light of an old acquaintance, which it was to many of them who had served in the Spanish gun-boat service, I made many inquiries of them, of which the following is the result.

"1. That there were formerly two of these monsters, and that they lived (*teniam su casa*) in a cluster of rocks, called Los Puercos, at the southwest entrance of the bay of Mariveles; but that, about ten or fifteen years before this time, or say in 1800, one was driven on shore, and died close to the village in the bay; the inhabitants of which were compelled by the stink to abandon their houses for a time.

"2. That the remaining one frequented the bay of Mariveles and that of Manilla, and it was supposed that it often attacked and destroyed small fishing boats, which, never appeared after going out to fish, though no bad weather had occurred. This last account I afterwards found singularly corroborated.

"3. That it was considered as dangerous by the Spanish gunboats; that they always when there kept a swivel loaded, the report of which, they said, drove it away. My principal informant was a man, employed as pilot for the ports in the Philippine Islands, whither I was bound, who had passed his whole life in the gun-boats. He said that one instance of its voracity occurred when he was present. A man, who was pushed overboard in the hurry to look at the monster, being instantly swallowed by it.

"4. The native fishermen of the Bay of Manilla quite corroborate this account, and speak of the monster with great terror."

About 1820 or 1821, an American ship's boat,

¹² Smith, H. M., "Note on the Occurrence of the Whale Shark, *Rhinodon typicus*, in the Philippine Islands," *Proceedings Biological Society of Washington*, 1911, Vol. 24, p. 97.

¹³ Jordan, David Starr, *SCIENCE*, 1915, March 26, p. 463.

with an officer and a few men, was proceeding from Manilla to Cavite; but meeting with a severe squall and thick weather, they were driven nearly into the middle of the bay. They were pulling in what they thought the best direction, when on a sudden the sailors all dropped their oars. But the mate, who was steering, looking astern of the boat, saw the open jaws of a huge fish almost over him. Having nothing at hand, he threw the boat's tiller into the mouth of the fish, shouting as loud as possible; when, the jaws closing with a tremendous crash, the whole fish, which they described to be more like a *spotted* whale than anything else, dived beneath the boat, and was seen no more. I do not now recollect the names of the ship, or of the captain, but I thought the circumstance of the spotted appearance a remarkable proof that the story is not an invention. "We do not like to tell it," said the American captain, "for fear of being laughed at; but my officer is quite trustworthy, and we have learned from the fishermen too, that there is some strange species of large fish highly dangerous to their boats."

Like the American officer, I fear almost being laughed at, were it not that, could we collect more facts relative to these strange monsters, they might perhaps at least explain some of the "coral spots" so often mentioned in our charts: independent of its being a matter of great interest to the naturalist. I therefore add here a vague notice of monstrous spotted fish, which are known to the Moluccas.

These are called by the fishermen of Ternate, Celebes, etc., a "*Ikon Bintang*" (or star-fish) from the bright light which they occasion, and by which they are recognized at great depths at night, in calm weather. The Malay fishermen describe them too as spotted, as large as a whale and highly destructive to nets; which they instantly take up when they see the fish, if they can get time to do so; for it is known to destroy boats, and whole lines of nets and fishing stakes, if it once became entangled amongst them, to the ruin of the poor fishermen. I had the same account corroborated in the Sooloo Islands, both by the Malay and Chinese fishermen; as also at Zebu, in the Philippine Islands. At Sooloo, I was shown large quantities of the skin of a spotted fish, cut into pieces and dried, for sale to the Chinese Junks, which my people said was the skin of young "*chacons*"—"Piro no son estos como chacon de alla, Senor." "But these are not like our chacon yonder, Sir," was always added. This skin I should have called that of a spotted

shark [of the ordinary kind like the tiger shark]; the tubercles were excessively coarse and rough.

It seems thus certain, that some immense *spotted* fish, of highly destructive tendencies . . . exists in the Seas of the Eastern Archipelago.¹⁴

One hardly knows what to make of this. Andrew Smith (1829 and 1849),¹⁵ the first discoverer of the fish, says "Oesophagus rather narrow," while all the writers about *Rhineodon* who have known the fish at first hand—notably Wright¹⁶ whose opportunities for study of it were greater than all others—have commented on its mild disposition. On the other hand Dr. Jordan (1915) records that the Zamboanga, Philippine Islands, specimen had in its stomach a number of shoes, leggings, leather belts, etc. The structure of its gills, however, plainly shows that it is a whale not merely in size but in manner of feeding. Hence these stomach contents are, as Dr. Jordan notes, incongruous and inexplicable in the light of its gill structures and small oesophagus.

The latter part of Piddington's account is no less valuable than the first since it ties in well with other accounts of the occurrence of *Rhineodon* in the waters of the East Indies, particular in the Celebes. Thus Weber (1902, 1913)¹⁷ states that he saw several in the strait between Buton and Muna in this archipelago. While in the Java Sea, van Kampen (1908)¹⁸ dissected one at Batavia and later obtained a

¹⁴ Piddington, H., "Notice of an Extraordinary Fish," *Journal Asiatic Society of Bengal*, 1835, Vol. 4, pp. 218-222.

¹⁵ Smith, Andrew, "Contributions to the Natural History of South Africa," *Zoological Journal*, 1829, No. 16, p. 643. (*Do.*) Pisces, in Illustrations of the Zoology of South Africa, plate 26 and description, London, 1849.

¹⁶ Wright, E. P., "Six Months at the Seychelles," *Spicilegium Biologica*, Pt. I., pp. 64-65. Dublin.

¹⁷ Weber, Max, "Siboga-Expeditie," Vol. I., Introduction et Description de l'Expédition, p. 88. Leiden, 1902; Vol. 57, "Die Fische der Siboga-Expédition," p. 584. Leiden, 1913.

¹⁸ Van Kampen, P. N., "Die Nahrung von *Rhinodon typicus* Smith," (In Kurze notizen

photograph of still another which was taken on the north coast of Java. Pertinent here are the words with which I closed the section entitled "Habitat" in my larger paper previously referred to: "its special habitat seems to be in the Indian Ocean and the waters contiguous thereto."

E. W. GUDGER

THE BALTIMORE MEETING OF THE AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE

THE American Association for the Advancement of Science and the national scientific societies named below will meet in Baltimore, during convocation week, beginning on Thursday, December 26, 1918:

AMERICAN ASSOCIATION FOR THE ADVANCEMENT OF SCIENCE.—President, Professor John M. Coulter, University of Chicago; retiring president, Professor Theodore W. Richards, Harvard University; permanent secretary, Dr. L. O. Howard, Smithsonian Institution, Washington, D. C.; general secretary, O. E. Jennings, Carnegie Museum, Pittsburgh, Pa.

Section A—Mathematics and Astronomy.—Vice-president, Professor George D. Birkhoff, Harvard University; secretary, F. R. Moulton, University of Chicago, Chicago, Ill.

Section B—Physics.—Vice-president, Professor Gordon F. Hull, Dartmouth College; secretary, Professor George W. Stewart, University of Iowa, Iowa City, Ia.

Section C—Chemistry.—Vice-president, Professor Alexander Smith, Columbia University; secretary, Professor Arthur A. Blanchard, Massachusetts Institute of Technology, Cambridge, Mass.

Section D—Mechanical Science and Engineering.—Vice-president, Professor Ira N. Hollis, Worcester Polytechnic Institute; secretary, Professor F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

Section E—Geology and Geography.—Vice-president, Dr. David White, U. S. Geological Survey; secretary, Rollin T. Chamberlin, University of Chicago, Chicago, Ill.

Section F—Zoology.—Vice-president, Professor William Patten, Dartmouth College; secretary,

Professor W. C. Allee, Lake Forest College, Lake Forest, Ill.

Section G—Botany.—Vice-president, Dr. A. F. Blakeslee, Cold Spring Harbor, N. Y.; secretary, Dr. Mel T. Cook, Agricultural Experiment Station, New Brunswick, N. J.

Section H—Anthropology and Psychology.—Vice-president, Aleš Hrdlička, U. S. National Museum; secretary, Lieutenant Colonel E. K. Strong, Jr., Room 528 State, War and Navy Building, Washington, D. C.

Section I—Social and Economic Science.—Vice-president, John Barrett, Pan-American Union; secretary, Seymour C. Loomis, 69 Church Street, New Haven, Conn.

Section K—Physiology and Experimental Medicine.—Vice-president, Professor Frederic S. Lee, Columbia University; secretary, Professor J. A. Goldfarb, College of the City of New York, New York City.

Section L—Education.—Vice-president, Dr. Stuart A. Courtis, Detroit Department of Educational Research; secretary, Major Bird T. Baldwin, Walter Reed General Hospital, Washington, D. C.

Section M—Agriculture.—Vice-president, Professor Henry P. Armsby, State College, Pa.; secretary, Dr. E. W. Allen, U. S. Department of Agriculture, Washington, D. C.

AMERICAN FEDERATION OF TEACHERS OF THE MATHEMATICAL AND THE NATURAL SCIENCES.—Will hold Council meeting at 10 A.M., December 27. Secretary, William A. Hedrick, Central High School, Washington, D. C.

AMERICAN PHYSICAL SOCIETY.—Will hold joint sessions with Section B, A. A. A. S., from December 26 to 28. President, H. A. Bumstead; secretary, Dayton C. Miller, Case School of Applied Science, Cleveland, Ohio.

OPTICAL SOCIETY OF AMERICA.—Will meet on Friday, December 27. President, F. E. Wright; secretary, P. G. Nutting, Westinghouse Research Laboratory, East Pittsburgh, Pa.

SOCIETY FOR PROMOTION OF ENGINEERING EDUCATION.—December 26–28. President, John F. Hayford; secretary, F. L. Bishop, University of Pittsburgh, Pittsburgh, Pa.

GEOLOGICAL SOCIETY OF AMERICA.—December 27 and 28. Joint meeting with Association of American Geographers, afternoon of December 28; joint meeting with Section E, A. A. A. S., on night of December 28. President, Whitman Cross, U. S. Geological Survey; secretary, E. O. Hovey, American Museum of Natural History, New York, N. Y.

über Fische das Java-Meeres), *Natuurkundig Tijdschrift voor Nederlandsch Indie*, 1908, deel 67, p. 124.