SCIENCE.—SUPPLEMENT.

FRIDAY, APRIL 1, 1887.

THE AMERICAN WHALE-FISHERY, 1877-1886.

THE American whale-fishery reached its flood-tide of prosperity about the middle of the present century. In 1846 the fleet numbered 722 vessels, valued, with outfits, at nearly $20,000,000. The most valuable catchings were in 1854, when the oil and bone secured were worth $10,766,521. The largest annual yield of sperm-oil was in 1837, 5,329,138 gallons, averaging $1.24¾ per gallon; of whale-oil, in 1851, 10,347,214 gallons, averaging $45\frac{5}{16}$ cents per gallon; and of whalebone, in 1853, 5,652,300 pounds, at 34½ cents (gold) per pound.

In 1877 the whaling-fleet numbered 163 vessels, hailing from the following ports: New Bedford, Mass., 118 vessels; Provincetown, Mass., 21; Boston, 6; Edgartown, Dartmouth, Fairhaven, Marion, and Westport, Mass., 12; New London, Conn., 3; San Francisco, 2.

In 1886 the fleet cruising in the North Pacific and Arctic had very largely transferred its headquarters and ownership from New Bedford to San Francisco. The hailing-ports of the fleet during this year, numbering 124 vessels in all, were as follows: New Bedford, 77 vessels; Provincetown, 12; Boston, 3; Edgartown and Marion, 4; New London and Stonington, 6; San Francisco, 22.

The distribution of the fleet in 1886 was as follows: 48 vessels, mostly schooners, cruising in the North and South Atlantic; 39 vessels, the largest and best in the fleet, cruising in the North Pacific, Bering Sea, the Arctic north of Bering Strait, and in the Japan and Okhotsk seas, pursuing the bowhead and the Pacific right whale; 2 vessels in Hudson Bay in search of the bowhead; 20 vessels cruising, chiefly for sperm whales, in the South Pacific and Indian oceans. Thirteen vessels were detained at home ports throughout the year, leaving the active fleet only 111 sail.

The business is carried on by forty-nine firms and general agents, with headquarters chiefly at New Bedford and San Francisco.

The following tables show the condition of the industry during the last decade. There has been a steady decrease in the number and tonnage of the vessels. The annual yield of sperm-oil has greatly decreased. The yield of whale-oil, which includes oil of walrus and of all cetaceans other than sperm whales, varied greatly from year to year. The value of sperm-oil from 1877 to 1886 averaged 92 cents per gallon; whale-oil, 47½ cents per gallon; and whalebone, $2.44 per pound.

Number and tonnage of vessels, and value of oil and bone.

Year.	Number of vessels.	Tonnage of vessels.	Value of catchings.
1877	163	40,593	$2,309,569
1878	179	39,700	2,232,029
1879	178	40,028	2,056,069
1880	173	38,408	2,659,725
1881	177	38,551	1,926,620
1882	161	36,802	1,861,779
1883	147	34,000	1,891,716
1884	144	33,119	2,542,614
1885	133	31,207	2,456,064
1886	124	29,118	1,792,657

Number of barrels of oil, and pounds of whalebone taken.

Year.	Whale-oil.	Sperm-oil.	Whalebone.
1877	27,191	41,119	160,220
1878	33,778	43,508	207,259
1879	23,334	41,308	286,280
1880	34,776	37,614	464,028
1881	31,650	30,600	368,000
1882	23,371	29,884	271,999
1883	24,170	24,595	254,037
1884	24,670	22,670	426,968
1885	41,586	24,203	463,990
1886	27,249	23,312	352,490

The two principal branches of the industry are the sperm-whale and the right-whale fisheries. Vessels engaged in sperm-whaling are sometimes employed 'between seasons' in the capture of humpback whales. The right-whalers take the bowhead or polar whale and the ordinary right whale of temperate waters. They also capture walrus for the oil and ivory.

About one half the tonnage of the fleet, including most of the smaller vessels, is employed in sperm-whaling, and the other half in right-whaling. More than fifty per cent of the sperm-oil is taken in the Atlantic Ocean, and about three-fourths of the whale-oil comes from the Arctic.

Sperm whales are very widely distributed in temperate and tropical waters. They have been taken as far south as the 50th parallel of latitude in the Atlantic and Pacific, and as far north as latitude 56° 12′ in the North Pacific. They are generally taken in deep water, though sometimes captured in the more shallow waters at the edge of the great ocean-banks. They are smaller within thirty degrees north and south of the equator than in higher latitudes. The fishing-grounds for sperm whales are widely separated. In the North Atlantic good sperm-whaling has been found in the Caribbean Sea, in the Gulf of Mexico, and in various places about the West Indies, the Bahamas, and the Azore Islands. Among the most important regions are the 'Charleston ground,' in latitude 29° to 32° north, and longitude 74° to 77° west; and the 'Hatteras ground,' along the edge of the Gulf Stream, in the latitude of Cape Hatteras. Other resorts are the 'Two forties' and 'Two thirty-sixes,' situated at the crossings of the 36th and 40th parallels and meridians. There have been important grounds from latitude 48° to 54° north, and longitude 23° to 32° west.

In the South Atlantic, sperm whales are now taken chiefly along the African coast and between the coast and St. Helena. Very profitable whaling was formerly found along the South American coast.

The South Pacific grounds for sperm whales are off the Chilian coast, extending from latitude 35° to 46° south, and from the coast 200 miles off shore. North of here are the 'Archer ground,' the 'Callao ground,' and other resorts. Throughout the South Pacific there were formerly many other extensive and profitable cruising-grounds; but they are now nearly all abandoned, not entirely because of the scarcity of whales, but because of the low price of sperm-oil and the great expense attendant upon the long voyages to distant seas. A few vessels still cruise in the vicinity of New Zealand and Australia, and in some seasons make good voyages.

In the North Pacific, also, sperm whales were formerly taken on various grounds along the coast of Lower California, and on the once famous 'Japan ground,' extending across the ocean along the 30th parallel, and especially between latitude 25° and 40° north, and longitude 140° to 180° east. For several years no vessels have been fitted for sperm-whaling in those waters; though Arctic vessels on their way north, after their spring cruising, have reported these whales in abundance.

The Indian Ocean was once the scene of an extensive fishery for sperm as well as right whales, but very few vessels have gone there during the last ten years. In 1880 there was no American whaling-vessel in that ocean; in 1886 two vessels went there, with fair success. Sperm whales were found principally off Port Dauphin, around Madagascar, about Mauritius, Bourbon, and Roderique islands, the Amirante group, off Zanzibar, and elsewhere along the African coast to the Red Sea.

Right whales (Eubalaena) are found as far north as latitude 61° 30′ at the mouth of Hudson Strait, and south to the Antarctic Ocean, though they are not common in tropical waters. These are also called 'black whales,' to distinguish them from the bowhead or polar whale (Balaena mysticetus), which by English whalers, and often by others, is confounded with the right whale. The bowhead is an ice whale, found only in Arctic regions, while the other species inhabit temperate waters.

The principal resorts of the right whale east of America are in the South Atlantic, while in the Pacific they are about equally abundant both north and south of the tropics. These whales were formerly taken along the New England coast, but they are now only occasionally captured in the North Atlantic. During the winter months whalers find them on the Hatteras ground and in the Gulf of Mexico and Caribbean Sea, and a few vessels have met with indifferent success in searching for them along the west coast of Africa between latitude 15° and 23° north.

In the South Atlantic they are sought for around the Tristan Islands and along the South American coast, where they were once very abundant.

The Indian Ocean was once an important right-whaling ground, but is now practically abandoned.

In the South Pacific, right whales are taken from September to January, off the coast of Chili, on the grounds from latitude 42° to 47° south, and longitude 75° to 80° west, and in the spring farther north and nearer the coast.

The North Pacific right-whale grounds were once famous, and were cruised over by upwards of two hundred American vessels. The principal resorts were the 'North-west coast' or 'Kadiak ground,' off the Alaska Peninsula, and in the Japan and Okhotsk seas. After the discovery of the whaling-grounds in the Arctic, the lower latitudes were gradually abandoned. A few vessels, however, have within a few years past again resorted to the Kadiak, the Okhotsk, and the Japan grounds.

Humpback whales are found within the parallels of 60° north and 70° south. They are taken chiefly in shallow water within certain bays and along the coast. The island of Trinidad and Gulf of Para, also the Cape Verde Islands, and the African coast from 3° to 7° south latitude, and about the West Indies, are the principal grounds in the Atlantic. Some years these whales are quite abundant along the New England coast and on the off-shore fishing-banks.

In the Pacific these whales are found along the South American coast, particularly in the Bay of Panama and in the Gulf of Guayaquil, and along the Californian coast. They are also found as far north as the Aleutian Islands, where the natives capture them.

The California gray whale, or devil-fish (Rhachianectes glaucus), is found only in the North Pacific, and is an object of pursuit by the shore stations established along that coast.

Finback and sulphur-bottom whales are quite universally distributed; but, their blubber yielding comparatively little oil, they are not often captured except by shore parties along the Californian coast, at Cape Cod in New England, on the northern coast of Norway, and at Iceland.

Bowhead whales, as stated above, are confined to icy waters. The Atlantic-Arctic fishing-grounds are in Davis Strait, Cumberland Inlet, and Hudson Bay. American vessels formerly cruised as far north as Pond's Bay, in about latitude 73°, but they now seldom go beyond latitude 65°. Scotch whaling-steamers, however, cruise as far north as 75°, their northern range being limited only by dangers from ice.

The Pacific-Arctic resorts of the bowhead are in Bering Sea and north of Bering Strait. About three-fourths of the whale-oil and nearly all the whalebone landed by American whaling-vessels is taken by the North Pacific fleet, so called, cruising north of Bering Strait and in the Okhotsk Sea. The vessels in this fishery are the largest and best equipped in the whaling-service. In 1879 or 1880, steamers were first used in this fishery, and now about one-fourth of the fleet are of this class. They can push their way with less danger than sailing-vessels amid the ice-floes, and, as a rule, thereby secure a greater catch. The Arctic vessels have their headquarters at San Francisco. They leave for the north about March 1, in season to meet the ice in Bering Sea, and to push gradually northward with it. Usually about May 1 to 10 a few whales are overtaken on their northward migrations, and as fast as the ice permits, the vessels crowd their way in pursuit. Until about June 1 the fleet cruises along the Siberian coast, capturing as many whales as possible. Those which are secured form only the 'fag-end' of the 'herd,' most of the whales having moved northward before the vessels could overtake them. As soon as the ice allows, the vessels push their way through the Strait, ever alert to catch the whales which are hurrying to the far north. From the middle of June till the latter part of July few whales are taken. During this time, while waiting for the return of the bowheads, the whalers devote their time to capturing walrus, which are valuable for both ivory and oil. About the beginning of August the fleet moves eastward and northward to Point Barrow and beyond, capturing whales wherever they can be found, though but very few are seen until the southward migration begins, in the latter part of the month. From this time till the latter part of September or early in October, when the season closes, there is great excitement and eagerness to secure as many whales as possible.

The early departure of the animals to inaccessible regions among the ice, and the anxious weeks spent in awaiting their return, make this ground one of the most exciting regions that whalemen can find, and the surroundings are of more than usual interest. Nothing can exceed the daring and pluck of the whalemen in their endeavors to search out and capture their prey. Forgetful of surrounding dangers, they pursue the spouting animal far up among the ice-floes; and many a vessel has been crushed to pieces by the ice as she was tracking out a whale. Anxious to secure full fares, they remain amid the freezing waters until early winter stares them in the face, when they plough their way homeward. Several disasters have overtaken the fleet in their zeal to catch the whale, as in 1871, when thirty-five noble craft were left at anchor in sight of certain destruction; the crews, after arduous labor, saving themselves with their boats.

Not always are the whalemen thus fortunate in escaping with their lives. In 1879 two vessels became separated from the fleet, and were never after heard from. Nearly every year one or more vessels are caught in the ice and ground to splinters. In Hudson Bay and Cumberland Inlet, also, the vessels are exposed to dangers from ice. From 1846 to 1880, eighteen vessels were wrecked in those waters. The fleet is not as large as that cruising north of Bering Strait, nor are the vessels generally so large and so well equipped. Several vessels have passed the winter 'locked in the ice,' in Hudson Bay or in Cumberland Inlet, and have thereby taken advantage of the early and late weeks of the whaling-season, besides securing bear, musk-ox, and seal-skins during the winter months.

Year.	Number of vessels.	Barrels of oil.	Pounds of whalebone.	Pounds of walrus ivory.
1877	19	17,530	153,800	74,000
1878	17	13,080	114,200	30,000
1879	21	18,800	200,500	32,900
1880	19	26,700	409,000	15,300
1881	23	24,740	387,000	15,400
1882	32	22,975	360,500	17,800
1883	38	10,155	159,400	23,100
1884	39	20,450	318,700	5,421
1885	40	24,844	451,068	6,564
1886	44	20,307	332,931	5,273

The foregoing table shows the extent of the Pacific-Arctic fishery from 1877 to 1886. The number of whales secured each year varies greatly. In 1880, 265 were caught; in 1885, 222; and in 1886, only 153. The 'whale' oil includes also oil of walrus.

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ICE AND ICEBERGS.

IN a paper read before the Royal society of Canada (May 27, 1886), 'On some points in reference to ice phenomena,' Dr. Robert Bell discusses various observations on the formation of ice and its action on the land. The rapid disappearance of icebergs after they have passed the banks of Newfoundland, he ascribes to the difference in temperature of the Gulf Stream and the interior of the berg, which is probably much colder than 0° C. He supposes that the rapid increase of the temperature of the water causes the ice to crack; and this process, once started, would rapidly continue as the colder parts of the interior come in contact with the water. An experiment made at Ottawa proved that ice, on coming in contact with warm water, really cracks. Though the difference in temperature may take an active part in fracturing icebergs, some other facts ought to be investigated before it is possible to decide on this question. The icebergs of the Labrador current show, even while in Baffin Bay, many signs of decay. The most remarkable ones are the deep grooves hollowed out by the waves breaking at the foot of the icy cliffs. The depth of these excavations and the amount of *débris* scattered around the berg prove the efficacy of the waves in breaking up the berg. However, the greater part of the year the bergs are embedded in pack-ice, and protected from the action of the swell. This continues as far as the Labrador coast. As soon as the berg reaches the southern end of the pack-ice, the breakers formed by the Atlantic swell will undermine its cliffs, the *débris* furthering their action. The history of icebergs may well be observed in Baffin Bay. The greater number are flat, and shaped like a table, having a flat top and vertical edges. They attain a size of from twenty-five to thirty square miles, and are about four hundred feet thick, their height above the water being fifty feet. These masses of ice, on striking a rock or a shoal, are broken up into small pieces, all of which have vertical edges. A very few of these are tilted, the horizontal top becoming inclined and partially submerged. Thus some parts of the berg attain a far greater height than they had before the tilting, and it is probably thus that the high and pointed icebergs originate. Flat bergs are very stable, while pointed ones show signs of frequent tilting and capsizing. Grooves which were excavated by the swell may be seen in all parts of the berg, some of them even running vertically. Sometimes many parallel grooves prove that large pieces of the unsubmerged part of the berg broke off, and that it gradually emerged from the ocean. Grooves diverging from one edge are of frequent occurrence, and were caused by the lifting of one side of the berg. It would be of great importance to know whether the tilting has any influence upon the direction of the cracks and fissures. These are always vertical while the bergs are in their original position. There are no observations which would enable us to decide whether the same direction is maintained after the tilting, which would be of eminent influence on the breaking-up of the iceberg. If, after the tilting has occurred, inclined faces would originate, this would materially contribute to a rapid destruction. As even small pieces of the large bergs have vertical edges, their direction is probably due to the structure of the ice, and will be maintained in any position the ice may have.

Bell remarks that the amount of rocky and earthy material carried from north to south by bergs is not very large. Field-ice, on the other hand, particularly such as is formed in shallow bays with high tides, and near the land, always carries great quantities of mud and stones, which are carried upon it by the wind or avalanches. We do not think that any amount of material is carried upon the ice by torrents formed by the melting of snow, as Bell supposes. The ice always contains some salt, and, as the melting-point of the fresh water coming from the land is higher than that of the ice, the latter is rapidly wasting at the mouths of the rivers.

In regard to the formation of Frazil (anchor) ice,