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Cetology and Cetologists

Cetology, the scientific study of whales, began in the fourth century BC, but in 2,300 years has progressed remarkably little.

The Greek philosopher Aristotle, whose lectures were collected into a one-man encyclopedia, was a careful and meticulous observer, fascinated by natural history. In *Historia Animalium* he dealt with over five hundred different kinds of animals, having dissected many of them to find out how they really worked. He was particularly interested in sea life, and wrote of the Common Dolphin:

'The dolphin is provided with a blowhole and lungs ... and has been seen asleep with his nose above the water, and when asleep he snores. No one is ever seen to be supplied with eggs, but directly with an embryo, just as in the case of mankind. Its period of gestation is ten months, and it brings forth its young in the summer. The dolphin is provided with milk, and suckles its young ... which accompany it for a considerable period. In fact, the creature is remarkable for the strength of its parental affection. The young grow rapidly, being full grown at ten years of age. It lives for many years; some are known to have lived for more than twenty-five, and some for thirty years; the fact is fishermen nick their tails sometimes and set them adrift again, and by this expedient their ages are ascertained.'

This is an astonishing piece of natural history, filled with accurate observations which directly refute those whose superficial reading of Aristotle leads them to dismiss or ridicule him for classifying dolphins as fish. His information was acquired as a direct result of observation and experiment with live animals in the field and his account of the Common Dolphin (*Delphinus delphis 75*) is so good that there is little we can add to it even now.

Following Aristotle, Gaius Plinius Secundus (Pliny the Elder) compiled a 37-volume *Historia Naturalis* which was published in Rome in AD 77 and included a whole book on dolphins and whales. His works are invaluable compendia but contain little or no original observation, drawing on and digesting two thousand other ancient books by almost five hundred writers. Pliny was certainly thorough, but he was also completely credulous and undiscriminating. It is nevertheless to him that we have to turn for the earliest surviving account of great whales, in which a distinction is drawn between the right whale (*balaena*) and the sperm whale (*physeter*), using terms which are still the accepted generic names for these cetaceans.

As far as cetology is concerned, nothing was added to Aristotle's contribution until the Renaissance, when original research was re-born. The impetus for this was provided largely by a rapid increase in exploration and by a flush of published reports on various 'Navigations, Voyages, Traffiques and Discoveries'. The earliest and best of these was *Speculum Regale (The Mirror of Royalty)*, an account of Iceland in the thirteenth century which concluded that few things in that country were worth talking about except whales. The author discusses whales in detail from direct observation and, amongst other things, describes the difference between the Great Right Whale (*Balaena glacialis 1*) and the Bowhead Whale (*Balaena mysticetus 2*), a distinction that continued to elude most zoologists for a further five hundred years.

Attempts to discover a northern passage to the Indies in the sixteenth century took explorers into the Arctic and revealed for the first time the rich feeding grounds in those high latitudes with their vast whale populations. In 1596 the Dutch navigator Willem Barents discovered Spitzbergen and, early in the seventeenth century, commercial whalers were sent there by Dutch and English companies.

These expeditions were concerned mainly with whale products and added little to knowledge of the living animals, but they also spawned a number of publications which at least produced reasonably accurate descriptions of the external appearance of the most common kinds of whale. The best of these were *Spitzbergische oder Gröenlandische Reise-Beschreibung* by Frederich Martens in 1675 and *Bloeyende Opkomst der Oloude en Hedendaagsche Groenlandsche Visschery* by C. G. Zorgdrager in 1720, both of which contained engravings which continued to be copied from book to book until the early nineteenth century.

In the eighteenth century, a young Swedish botanist Linné, better known as Linnaeus, changed the face of biology by making it truly systematic. His system of classification, published for the first time in 1735 and refined in the tenth edition of *Systema Naturae* in 1758, not only imposed a new order on natural history, but exerted a profound effect on the way we still see and think about the world around us.

The sheer physical difficulty of working with animals that live in the open ocean has meant that cetology has had to rely almost entirely on the whaling industry. As a result most of the last two hundred years has been devoted to little more than imposing taxonomic order, from a distance. This endeavour began with a small group of European museum men, who systematized the existing knowledge of cetaceans. Their material came from all over the world and found its way into a handful of institutions in France, England and the United States. The centre of the French web was the Musée Nationale d'Histoire Naturelle in Paris; in London it was the Royal College of Surgeons and later the British Museum (Natural History); and in the United States it was either the American Museum of Natural History in New York or the United States National Museum at the Smithsonian Institution in Washington.

In France the process began with Georges Louis Leclerc (later Comte de Buffon), a naturalist with legal training, who became Keeper of the Jardin du Roi in 1739 and was charged by King Louis XV with the task of cataloguing the collection in the royal museum. He turned this relatively simple task into an account of the whole of nature, which became his life's work. Buffon wrote clearly and simply but thought nothing of

doing violence to factual details when it suited his purpose. The first part of *Histoire Naturelle – Générale et Particulière* was published in 1749, but the last of the forty-four beautifully illustrated volumes did not appear until sixteen years after his death in 1788. While Buffon was alive he was assisted by Louis Daubenton, a meticulous naturalist-physician, who performed and illustrated most of the dissections. The last eight volumes, including the one on cetaceans, were completed by Bernard La Cépède (later Comte de Lacépède).

Lacépède was a naturalist (and a musician) who did a thorough job of completing his master's work, but like Buffon he relied largely on compilation from other sources and most of the illustrations in his volume on whales (later published separately as *Histoire Naturelle des Cetacées*) were copied from previous publications. Lacépède acknowledged that, not having seen whales, he had taken everything from research.

Daubenton went on to become Professor of Natural History at the Collège de France. His assistant, and eventual successor, was the legendary Georges Leopold Dagobert, later Baron Cuvier. Cuvier added a new dimension to the study of taxonomy by taking internal as well as external characteristics into account. He obtained a post at the Musée Nationale in Paris and went on to build up the natural history collection into the largest of its kind anywhere in the world. He not only founded the science of comparative anatomy, but extended it to include the comparable study and classification of fossils, thereby giving birth also to the science of palaeontology. In cetology he made several fundamental advances. His *La Regne Animal* and *Recherches sur les Ossements Fossiles* are basic texts much in use today. They contain the original, and still the best, descriptions and illustrations of the three species of cetacean which now bear his name.

The Paris museum was kept supplied during this period by a constant stream of material from travelling naturalists such as Baron Louis Bougainville, Antoine Delalande, the Verreaux brothers and Jean Dussumier.

In Britain the pioneer of cetology was a Scot called John Hunter who studied medicine in London and served as a surgeon at St George's Hospital. He was particularly interested in cetaceans, and not only described all those stranded locally, but even went to the expense of sending someone on a whaling expedition to the Arctic to collect further material for him. After his death in 1793 his vast collection of comparative material was purchased by the government and housed in the Royal College of Surgeons.

Hunter's secretary, William Clift, became the first Curator of the Hunterian collections at the Royal College, where his assistant, who eventually became both Hunterian Professor at the College and his son-in-law, was Sir Richard Owen. During the first half of the nineteenth century, cetacean studies in England were dominated by Owen at the Royal College and by John Edward Gray at the British Museum. No two men could have been less alike.

Gray started working at sixteen as a casual assistant at the British Museum helping to arrange the collections. He was a dedicated, single-minded man who, in more than fifty years at the museum, never published less than thirty papers a year. Indeed, when partly paralysed by a stroke at the age of sixty-nine, he learned to write with his left hand and increased his output to over sixty papers a year. The quality of his work was erratic. He had a tendency to rush into print, creating new species and genera on the basis of single skulls, or even the drawing of a skull, later altering these when new and contradictory evidence came to light, but he was nevertheless a first-class museum man. When he became Keeper of the Zoology Department in 1840, the British Museum was way behind those of Berlin, Leiden and Paris; but by the time he died, still hard at work in 1875, the collection held more than a million specimens and was the largest, best known and most meticulously catalogued in the world.

Owen, on the other hand, was a total extrovert, a brilliant lecturer and an outstanding public figure, often to be seen at Court. He began his career as an assistant to the Conservator of the Museum at the Royal College of Surgeons. He was a physician but became a brilliant zoologist, writing a large treatise on the comparative structure of teeth. He studied with Cuvier in Paris and returned to the Royal College to build up its anatomical collection and to serve as Hunterian Professor. He was autocratic and irascible, quick to take offence and slow to give credit to others; but he was highly ambitious and succeeded finally in winning the long-standing feud with Gray by being appointed, over Gray's head, as Superintendent of the entire British Museum (Natural History).

Gray's greatest contribution, and the strength of the British Museum during this period, was the string of contacts he built up with other museums and with amateur naturalists throughout the Empire who sent material back to London, secure in the knowledge that it was welcome and that it would be described in a way which gave due credit to the finder. Notable amongst these field naturalists were John Anderson and Sir Walter Elliot in India, Sir Julius von Haast and Sir James Hector in New Zealand, and Robert Swinhoe in China.

In Germany during the same period Carl Rudolphi founded and built up the Zoological Museum in Berlin; and in Holland Herman Schlegel became Director of the Rijksmuseum in Amsterdam. Both contributed pioneer studies on whales, but the main work on cetacean taxonomy continued in Paris and in London, where Gray and Owen were succeeded by Sir William Flower, one of the great pioneers of museum display, who published several influential papers on the marine mammal collections.

In America the foundations of New World natural history were being laid down by talented immigrants such as the Swiss naturalist Jean Louis Agassiz, who started the Museum of Comparative Zoology at Harvard, and the Norwegian Leonhard Stejneger, who became Curator of the United States National Museum. These institutions were well served by hardy young native American naturalists such as Edward Cope, who collected fossils amongst hostile Indians, spade in one hand and rifle in the other; Spencer Baird, who founded the Woods Hole Oceanographic Institute; William Dall, who sailed to the Arctic and Alaska; and Roy Chapman Andrews, who took the *Albatross* to the Far East and returned to become Director of the American Museum of Natural History.

With the arrival of the twentieth century, the ascendancy of

the European collections was challenged by these new American institutions, and it was Gerrit Miller at the Smithsonian in Washington and Frederick True at the American Museum of Natural History in New York who did most during this period to bring the discipline of cetology to maturity.

Meanwhile the whaling industries of several countries were making their contribution to cetology. Only at sea are we still primaeval hunters and gatherers, involved in the old pursuit of wild creatures in their natural habitat, but with the assistance of new weapons. The success of our endeavours now depends not so much on our ability to locate and capture the prey, but on our willingness to control the harvest in ways which will ensure its continued productivity. The successful imposition of restraints depends on the acquisition of knowledge about the natural history of the species involved. Most maritime countries therefore have fisheries research projects and all the major whaling nations have, to a greater or lesser degree, sponsored cetacean investigations.

The literature on whaling is immense, most of it devoted to the history and technology of the hunt or to the economics of its product; but a few live whales do somehow manage to surface through the prevailing gore. That they do is largely thanks to enlightened whaling captains such as William Scoresby and Charles Scammon, who depended for their livelihood on knowing something of the ways of the prey, and who made their own observations in the field or collected those of their colleagues. Scoresby in 1820 published *An Account of the Arctic Regions*, which still constitutes most of what we know today about the northern form of the Great Right Whale. Scammon's book *The Marine Mammals of the North-western Coast of North America* was published in 1874 and has become a classic, particularly valued for its description of the natural history of the Grey Whale (*Eschrichtius robustus 4*) in California.

It was however the shore stations used in more modern whaling that provided the material for recent and more intensive research. That at St Johns in Newfoundland was a field site for Frederick True of the New York Museum, who worked there while compiling his 1904 monograph *The Whalebone Whales of the Western North Atlantic.* His associate, Roy Chapman Andrews, took similar advantage of the Californian stations to produce his valuable 1906 monograph on the Sei Whale (*Balaenoptera borealis 8*) in the Pacific.

The intensive study of southern whales was pioneered by Major Barrett-Hamilton at the British whaling station on South Georgia in 1913. This was extended by a series of *Discovery* expeditions on which two other British scientists, N. A. Mackintosh and J. F. G. Wheeler, examined 1,600 carcasses in order to produce their report on Blue (*Balaenoptera musculus 6*) and Fin (*Balaenoptera physalus 5*) whales in 1929. Leonard Harrison-Matthews continued with similar reports on the Humpback Whale (*Megaptera novaeangliae 10*), Sperm Whale (*Physeter macrocephalus 36*) and the southern form of the Great Right Whale (*Balaena glacialis 1*) in 1938.

The skill and experience of the old whalers have today been replaced by sonar, explosives and high-speed diesel engines. Little knowledge of whales is now needed to kill them. Yet it has been this very facility, together with a mindless mass slaughter that threatens to destroy the industry itself, which has given rise to a good part of the current boom in cetacean studies. Those pioneer investigations in the Antarctic were made specifically in order to gather information on the basic biology of whales as a necessary prerequisite to framing protective legislation. They led to the formation, after the Second World War, of the International Whaling Commission which still encourages similar research.

As far as cetology is concerned, the existence of a profitable whaling industry has been invaluable. It has provided the motivation, the machinery and the money for a growing group of biologists to extend their studies into the field. We now know a fair amount about the gross anatomy and general physiology of whales and we have some information on their pregnancy, growth, maturation and longevity, but such knowledge is restricted to the few species of commercial interest and is biased towards those measurements that are likely to be useful in the construction of models that help predict population dynamics.

Only in the last decade has there been a change. It began with the aqualung, with a number of Bottlenose Dolphins in captivity and with the haunting recordings of Humpback Whales at sea. In 1967 Roger Payne of the Rockefeller University turned from a study of the ability of owls to hear and locate their prey in total darkness to the equally mysterious underwater vocalizations of Humpback Whales. Every spring until 1971 he and his wife Katherine floated in the waters of the whales' breeding ground near Bermuda, recording their long, repeating patterns of sound. These 'song cycles' are now believed to be the most elaborate single display known in any animal species, and their impact on scientists and laymen alike has been immense. The sheer range and evocative power of the songs have brought the world of the great whales into everyday consciousness, creating a new concern for their survival; and the Paynes' continuing analysis of the way in which the songs grow and change is providing science with a unique window on to the mysteries of whale social behaviour and mentality.

The Paynes have now extended their studies to the winter breeding ground of Pacific Humpbacks around the islands of Hawaii and added their weight to a growing community of researchers based on Lahaina in Maui, who monitor the whales there each January, February and March. Their information and recordings, and the magical deep-blue photographs now coming out of Hawaii, are at last putting us close enough to these giant animals to begin to appreciate what their lives must be like.

In Alaska Charles Jurasz and his family have been watching the eastern Pacific Humpback Whales at the other end of their annual migration and, apart from turning up fascinating new information about their feeding behaviour (see *Megaptera novaeangliae 10*), have proved after twelve years of observation that the whales which turn up each summer are the same ones which winter off Hawaii. On the other side of the continent, Stephen Katona and his associates at the College of the Atlantic are getting to know the individual whales which

come to feed off Newfoundland and Maine and are forging similar links in the spring mating grounds off Bermuda.

Roger Payne has also made what may be the single most important contribution to cetology since Aristotle's. Until recently there has been no way of measuring the condition or requirements of whale herds without destroying some individuals. All the traditional scientific methods of assessing population size and breeding potential depend on measurements made on corpses provided by the whaling industry. Payne, in his study of the southern form of the Great Right Whale (*Balaena glacialis 1*), has shown that it is possible to identify all the whale individuals by their conspicuous markings, and that their fortunes can be followed from year to year. By aerial photography and new techniques of measuring live whales and recording their movements and feeding behaviour, Payne is already providing information on age, sex and growth without killing, touching, marking or molesting a single whale. For the first time we know something of the true nature of a whale herd, which may be spread out over hundreds of miles, and can begin to understand what really constitutes a whale population. The success of this study is now providing an important incentive for others working with whales in the wild.

Next to the Humpback and the Great Right Whale, the best-known large cetacean is certainly the Great Killer Whale (*Orcinus orca 51*). The existence of a number in captivity and the presence of a resident wild population in Puget Sound have stimulated tremendous enthusiasm amongst those who have seen them, and led to intensive studies based in Seattle and in British Columbia.

We believe that it is non-intrusive field studies such as these which will continue to provide the best insights into cetacean life histories, but we concede that a great deal has been learned from animals kept in captivity.

Thirty years ago there were very few cetaceans in captivity anywhere, but a series of photogenic Bottlenose Dolphins changed that. There was a demand for dolphin shows, which burgeoned until there were over 300 Bottlenose Dolphins in captivity in the United States alone. The vast majority of the dolphinaria were, and still are, devoted to simple repetitive public performances which do little either to stretch the dolphins' abilities or to increase our knowledge about them. The dolphinaria all, however, employ trainers who continue to be amazed by the speed at which dolphins learn. As the store of anecdotal material grows some trainers are turning to more methodical investigation and academics are being recruited to help pose the right questions. In 1959 John Lilly, an experimental neurologist, founded the Communication Research Institute at St Thomas in the Virgin Islands in order to explore the potential of the dolphin's big brain. During the following ten years, he and his small team demonstrated that dolphins could produce sounds in air which seemed to be direct and relevant imitations of human speech patterns, and a long experiment with Margaret Howe and a Bottlenose Dolphin called Peter showed that it was possible for a human and a dolphin to live together constantly for several months and learn a great deal from each other.

In 1968 Lilly closed his Institute, saying: 'I no longer want to run a concentration camp for my friends', but in 1978 he returned to cetology. He believes that humans and dolphins have the capacity to communicate with each other despite their physical differences, and he proposes to lower the barriers between the species by means of new techniques using modern sophisticated programming and minicomputer technology. His supporters and detractors alike wait with fascination to see what comes of the project Lilly is calling JANUS (for Joint Analog Numerical Understanding System).

Lilly's results are still the subject of debate, but there is little doubt that he has had a dramatic influence on a whole generation of students now starting work with cetaceans. There is amongst them a new determination to deal with whales and dolphins in an open-minded way, to concede that they have large and complex brains and to admit, when the evidence makes such a conclusion appropriate, that they could be conscious creatures.

Time chart of prominent cetologists