

KING CARLOS DE BRAGANÇA, THE FATHER OF PORTUGUESE OCEANOGRAPHY

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Abstract: King Carlos de Bragança, Carlos I of Portugal (reigned 1889-1908) was a keen naturalist and a talented artist. From childhood he had a *passion de la mer*, and aboard his successive four yatches *Amélia* he carried out between 1896 and 1907 a series of oceanographic cruises along the Southern Portuguese coasts. His main interest was in fishes not only for their scientific aspects but also because knowledge of their biology and ecology could have important applications on fisheries, a very important economic activity for Portugal. For his achievements he can be considered the Father of Portuguese Oceanography. He was assassinated the 1st February 1908.

Introduction

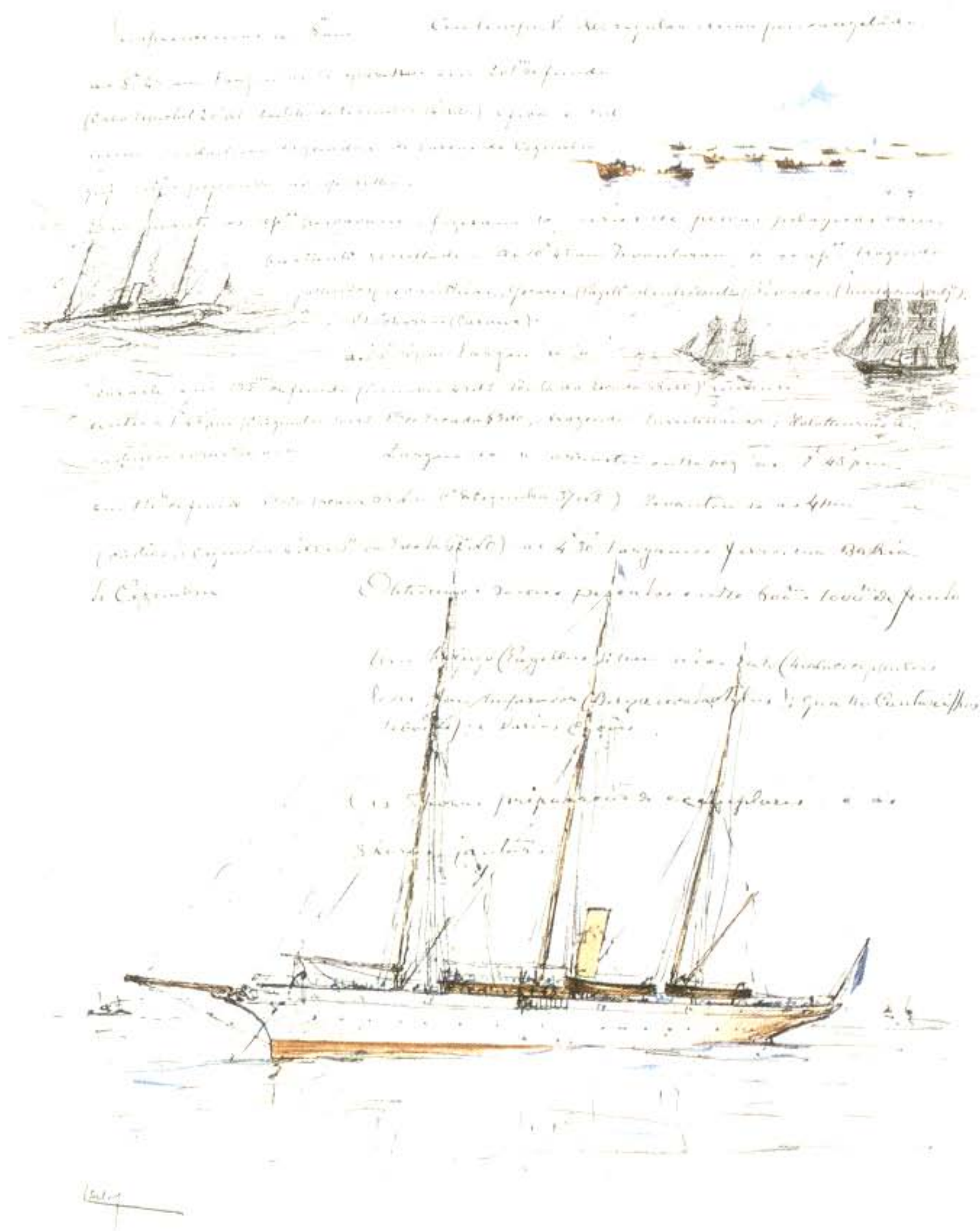
The numerous oceanographic researches that foreign countries carried out in recent times with such auspicious results, the importance of these studies for the fisheries industry, one of the most important in our country, and the exceptional variety of bathymetric conditions of the sea along and off our coasts, suggested to us last year the idea of the scientific exploration of our sea, and to make available, by regular work, not only a knowledge of the fauna of our continental shelf but also that of the abysses that are found in certain regions only a few miles off the coast, a situation almost unique in Europe.

With these words King Carlos began the publication (1897) of the preliminary results of his first cruise in September 1896, aboard the *Amélia*, named in honour of his Queen.

King Carlos de Bragança reigned from 1889 to 1908. Carlos I was a highly intelligent and sensitive person, much interested in humanism in all its aspects. He was a talented painter and also published a lavishly illustrated catalogue of the birds of Portugal. As he himself wrote, he had a *passion de la mer* from childhood, so it was natural that one of his fields of interest was the sea and all that dwelled therein.

He had been strongly influenced by the recent achievements in Portuguese waters by different foreign scientists and oceanographic vessels, like those of the *Porcupine*, *Challenger*, *Travailleur*, *Talisman*, *Hirondelle* and *Princesse-Alice* (Bragança, 1897, 1902; Ruivo, 1957; Saldanha, 1980, 1996; Deacon, this volume; Rice, this volume). Nevertheless his close association with Prince Albert of Monaco, one of the most brilliant oceanographers of the era of exploration, was certainly decisive (Carpine-Lancre & Saldanha, 1992). It is interesting to note that D. Carlos started his first cruise with preliminary experiments in the Bay of Cascais towards the end of August 1896. Nearly one month before, in July 1896, the *banc Princesse Alice* had been found accidentally by Prince Albert, south of the Azores. The importance of this discovery in Portuguese waters was certainly a crucial factor encouraging D. Carlos to conduct his own research at sea. The King stated that he actually had a very short time to prepare his yacht *Amélia* to carry out this first oceanographic cruise (letter to Prince Albert, Oct. 4th, 1896, cf. Carpine-Lancre & Saldanha, 1992). National pride was perhaps a strong argument to do something quickly. From this letter we can understand that he wanted to see Portuguese waters studied by Portuguese scientists aboard Portuguese oceanographic vessels. In 1897 he wrote: *On 1st September 1896 we had the pleasure of beginning the first national oceanographic cruise in the seas of Portugal* (Bragança, 1897). Actually all factors were favourable to him: he was a naturalist, artist and sailor, he could spend money and he had a yacht. Furthermore the waters near Cascais, Lisbon, Sesimbra and Setúbal offered a large field for exploration. Not only were there estuaries and shelves but also, and most interesting, deep canyons very near the coast.

Carta da Baía de Lagos, 1897



A page of D. Carlos personal log-book (1897)

In subsequent years D. Carlos expanded his observations to Algarve, the southernmost coast of Portugal, mainly to carry out tuna studies. He believed that a methodical study of the Portuguese waters was a necessity in order to gain a full understanding of them. This understanding would lead to the rational exploitation of fisheries, such an important economic activity for Portugal.

Yachts and crews

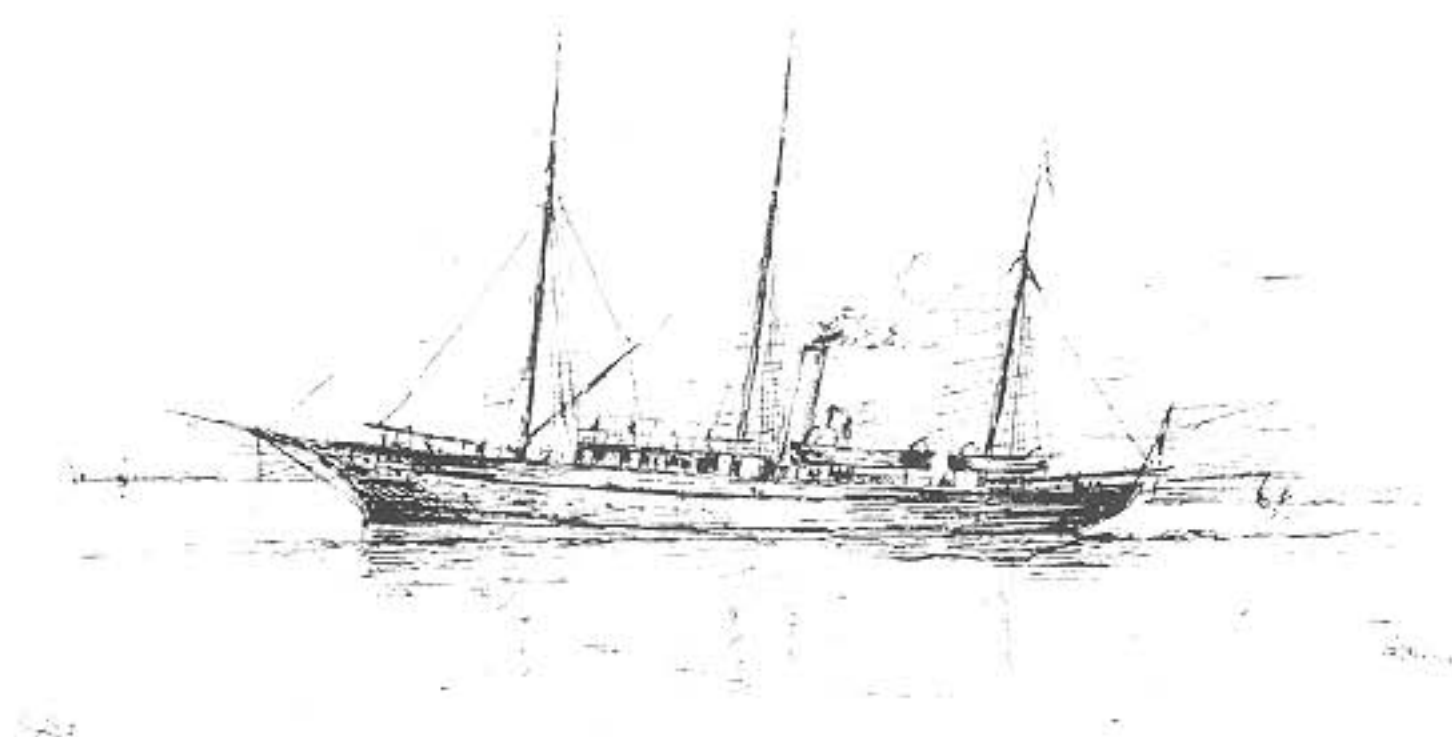
D. Carlos used four successive yachts between 1896 and 1907. The four *Amélia* were recreational yachts adapted to oceanographic work, and large enough to work along the Portuguese coast (Saldanha, 1980, 1996; Carpine-Lancre & Saldanha, 1992).

The first *Amélia* was 35 m long, being suitable for inshore work though she rolled terribly in the open sea making all scientific activity very difficult. Furthermore there was little room on the deck to work conveniently, no space for a laboratory and the anchor winch was not really sufficiently powerful for dredging or trawling. The *Amélia* was therefore used only for the cruise of 1896.

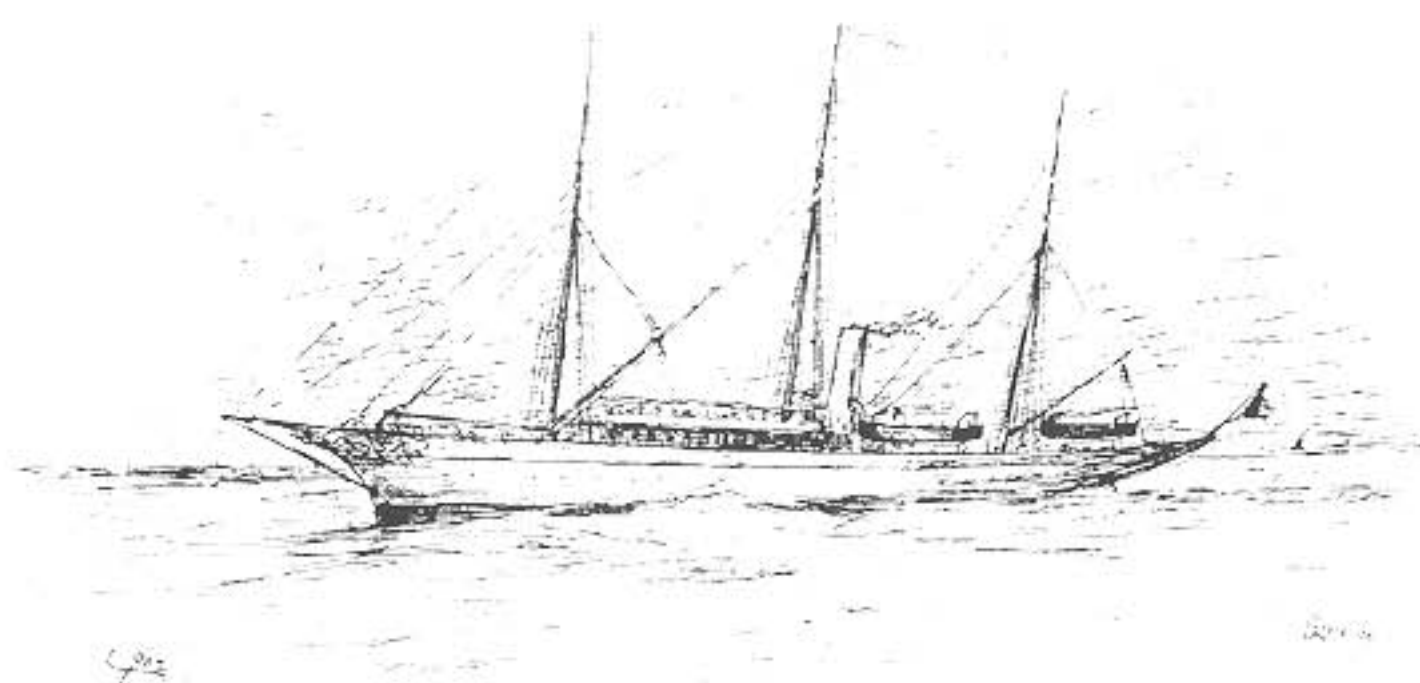
For these reasons D. Carlos acquired the 45 m long *Amélia II* which was used for the cruises of 1897 and 1898. However, she also lacked laboratory space as well as adequate quarters for the larger crew required for work further offshore. The King therefore purchased a third *Amélia*, this time 55 m in length. She was armed with a harpoon-gun for cetacean work but, more important, there was more space and the smoking room was transformed into a laboratory.

Despite all the improvements for efficient scientific work at sea on *Amélia III*, the King was still not satisfied and in 1901 he obtained a fourth *Amélia*, with a length of 70 m. She was used between 1902 and 1907 with a totally different outline from her predecessors (Carpine-Lancre & Saldanha, 1992; Saldanha, 1996).

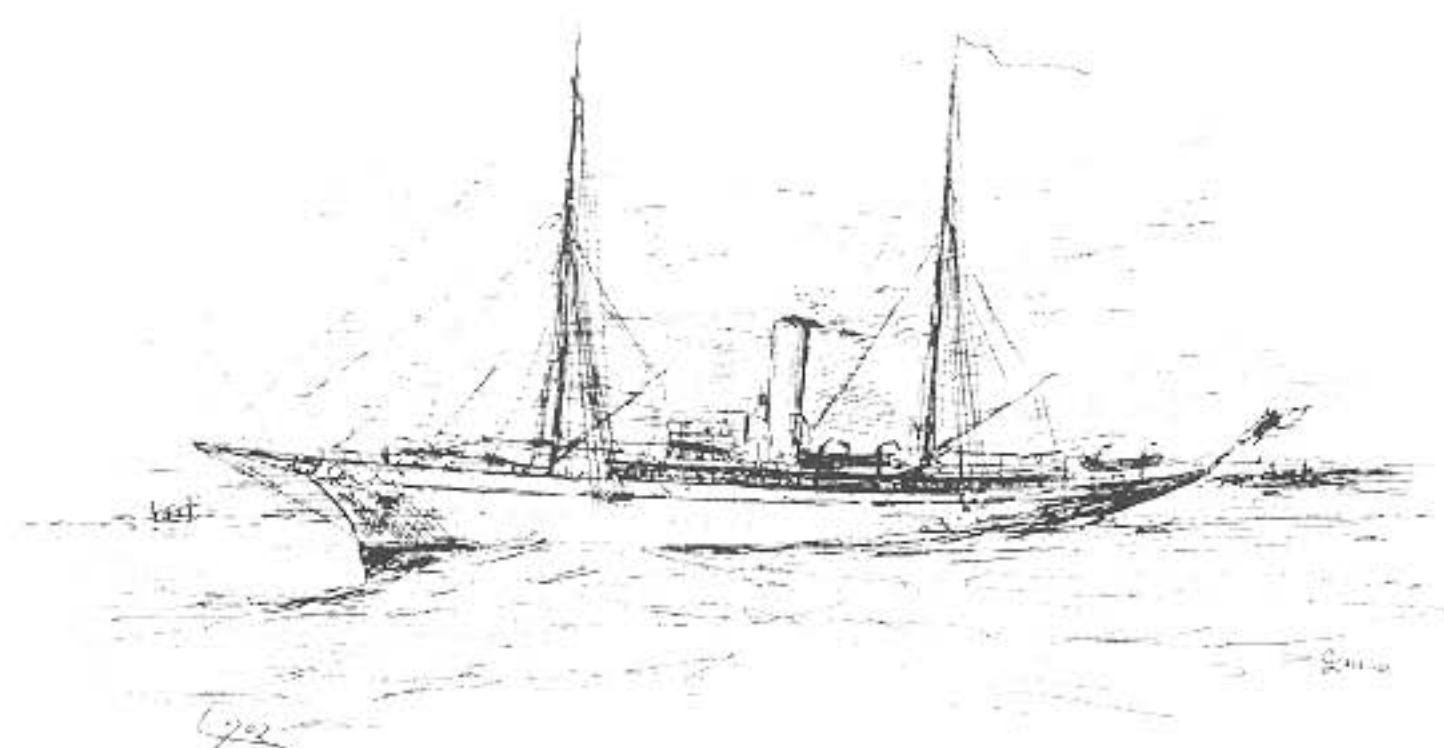
The three first *Amélia* still had sails, but there are practically no records on their use during the scientific cruises. The two first *Amélia* had compound engines while the *Amélia III* and *IV* were fitted with



1st «Amelia»



2^{me} «Amelia»



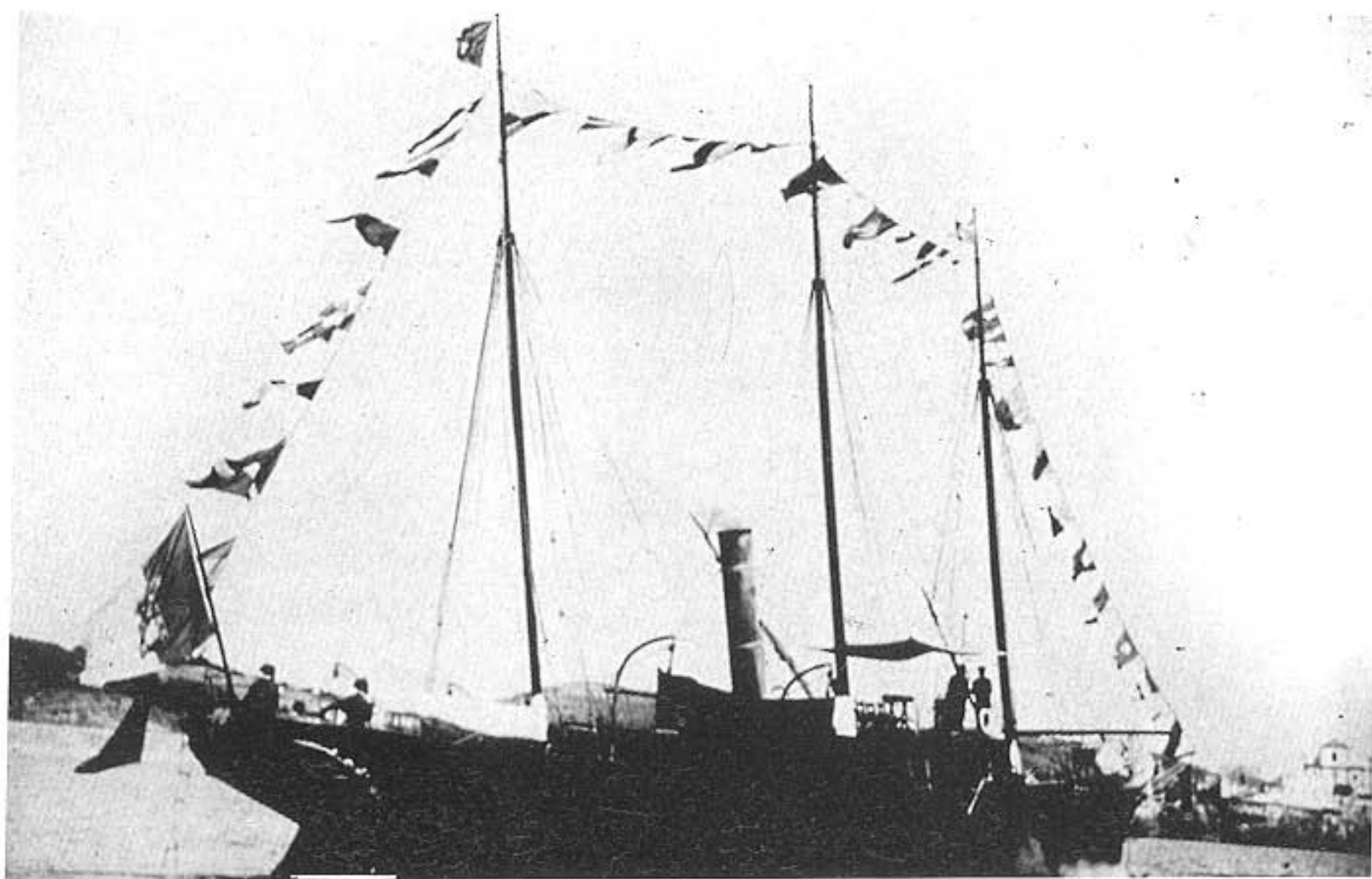
3^{me} «Amelia»

Drawings by King Carlos

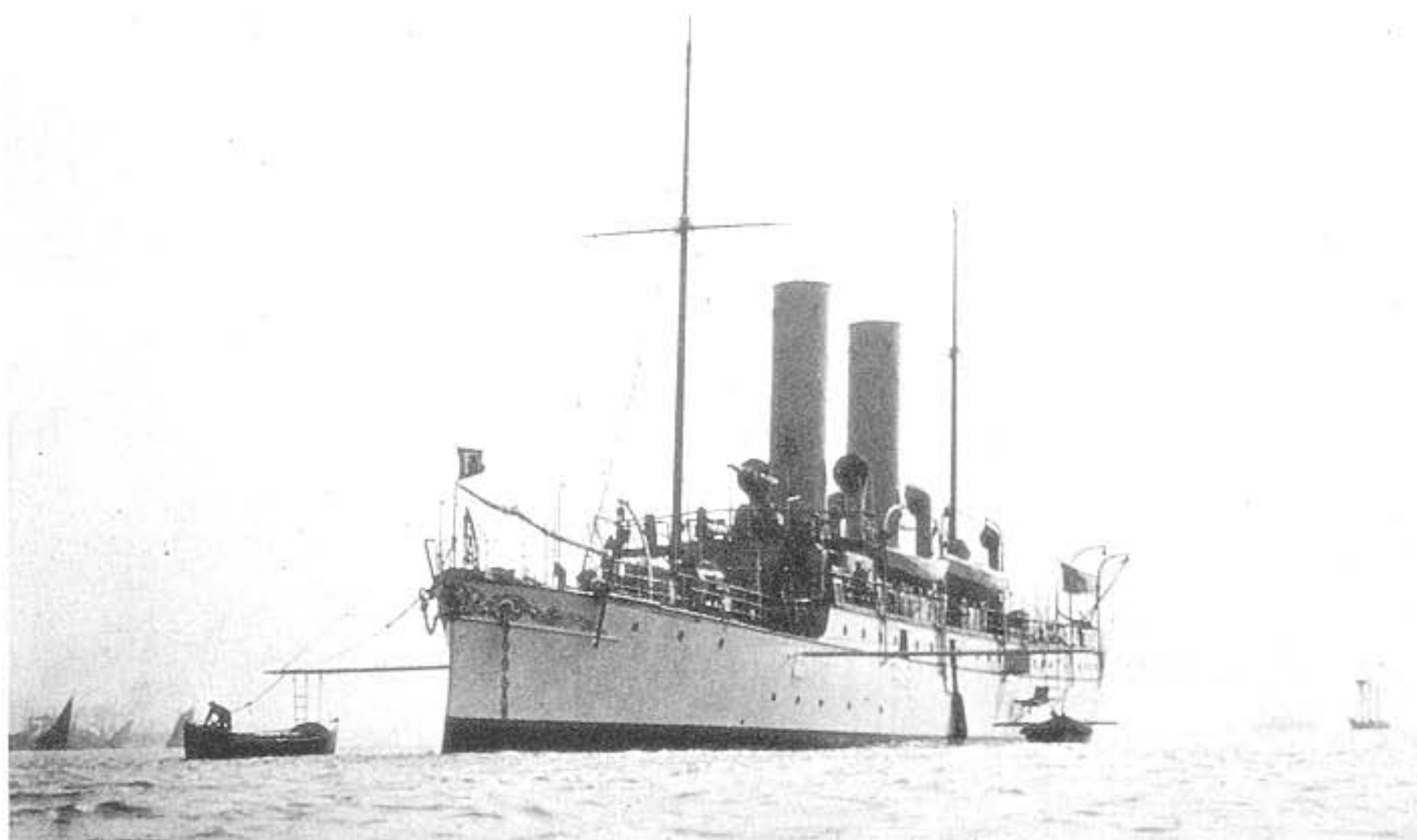
triple expansion engines in order to reduce coal consumption. Other devices on *Amélia IV* were suited for the same purpose.

The crews of all these yachts were composed of sailors from the Navy, chosen from among the best. Some of them stayed in the service of the King for many years. They had to be keen sailors, experts in oceanographic and fishing operations, and able to behave properly among the King's aristocratic entourage and officers. The latter belonged to the royal military staff and the first captain of the *Amélia* was Roberto Ivens, the well known African explorer.

Usually there was no doctor aboard, because the cruises were short and there was always the possibility to reach a harbour quickly in case of sickness or accident. In fact, there are few records of sicknesses and no personal accidents during the cruises. The King's doctor, D. Thomaz de Mello Breyner, participated in the longer cruises to Algarve. He kept an interesting diary (*cf.* Mello Breyner Andresen, 1996) where he notes, among other things, the seasickness that affected most of the passengers who sailed with the King. Humorously he wrote: "Very fortunately I am not seasick and I could lunch like a priest" (!).



Amélia II



Amélia IV

Scientists and laboratories ~

D. Carlos had the collaboration of only one scientist: Albert Arthur Alexandre Girard (Carpine-Lancre & Saldanha, 1992). From a French family, he was born in New York (1860) and came to Portugal as a child. He took a degree in engineering but his main love was natural history. He started his career at the Museum of Zoology of the Polytechnic School in Lisbon (now Museu Bocage). Later he was appointed a member of the Fisheries Commission and started his duties at the King's service, being the curator of the royal collections at the Necessidades Palace. He was always with the Monarch in all his work at sea. He studied the collected material, organized the collections and prepared the results for publication.

Furthermore he organized popular exhibitions in Portugal and abroad to show the results of the King's oceanographic cruises. He was, in fact, the King's scientific adviser. D. Carlos held Girard in high esteem and the feeling was reciprocated. On many occasions both wrote about each other in the most flattering terms. According to

Girard the King himself studied the collected specimens and wrote the publications, while at sea he didn't need the help of a naturalist to recognise the animal species due to "his extraordinary memory".

The scientific merit of Girard is evident from his scientific papers and the manuscript notes he left. For example, his draft "Notes for the scientific study of the coast of Algarve" includes a plan to study the mining pollution of the Guadiana estuary and its effect on adjacent sea biota. This plan is certainly the first one in Portugal concerning marine pollution (Saldanha, 1996).

A true symbiosis existed between D. Carlos and Girard that led to such considerable achievements.

Contrasting with the pool of renowned scientists who worked with Prince Albert of Monaco, D. Carlos scientific collaboration was limited to this single man. Nevertheless it is probable, based on a letter from Louis Joubin to D. Carlos, that the King through Afonso Chaves (Saldanha, 1996) had asked him to study the cephalopod collections.

As the two first yachts had no space for laboratories it is probable that fixing and preserving specimens took place on the deck. Since the cruises between 1896 and 1898 took place in the neighbouring seas of Cascais, D. Carlos established a laboratory at the Citadel of the same village, his summer home.

The advantage was that it was relatively easy to keep alive marine organisms in buckets of sea water between the collecting places and the laboratory at Cascais, at most three or four hours sailing. Once at Cascais all the procedures for preparing specimens for study were carried out at the laboratory, where several aquaria provided the possibility of keeping animals alive. Later this material was kept at the royal collections at the Necessidades Palace where a taxidermy workshop existed.

Aboard the *Amélia III* there was a well equipped laboratory that could be converted in a dark room for photographic work. There are no records of the existence of a laboratory on *Amélia IV*.

At sea

D. Carlos supervised personally all the oceanographic operations aboard his yachts. He preferred to study small areas of the Portuguese coastal seas in some detail, rather than trying to cover large areas less comprehensively. The seas off the mouths of the Tagus and Sado estuaries and the adjacent waters were his chosen field. *Grosso modo* the seas of Cascais, Cape Espichel and Sesimbra between the cape of Roca and Sines. As already pointed out, there is an extraordinary bathymetric variability in this region including deep canyons and a great variety of biotopes. The coast of Algarve was mainly studied for tuna observations. Each station was commenced with a sounding, not only to register the depth but also to determine the sediment nature and to decide which kind of biological gear to use. Water samples were collected and the temperature measured. These operations were followed by biological collecting: dredging, trawling, long-lining and plankton hauls. The deepest trawl was carried out in 1899 at a depth of 1856 m off Cape Espichel, and specimens of *Gnathophausia*, *Pasiphaea*, small molluscs and foraminifera were collected.

The first years of work at sea were the most productive in terms of number of stations worked, the number of operations and consequently the time spent cruising. Aboard *Amélia IV* during the later years of activity the work at sea was reduced drastically, due perhaps to the entangled political situation about which King Carlos was very much concerned (Carpine-Lancre & Saldanha, 1992; Saldanha, 1996).

Instruments and gear

All the manoeuvres were carried out on the forward deck. Collecting gear like dredges or trawls were put into the water with the help of a crane attached to the foremast and were therefore towed from the ship's side. At least in the first three *Amélia* there were no drums to store the cables. During the cruises carried out in these yachts. D. Carlos didn't use wire cables as was already common aboard other contemporary oceanographic vessels. He stored 2000 m of the main

cable of "agave" along either side of the deck and a further 6000m was stored in the hold. D. Carlos preferred these cables of 2,3 cm and 3,4 cm in diameter and they were so strong that some of them were used for four years.

Sounding was carried out from the foredeck and it was the first operation at each station. The soundings during the cruise of 1896 were carried out using a manual winch and a rope of 1500 m, 1 cm in diameter, and using the Thoulet's sounder. Later D. Carlos used piano wire, and different sounding machines on different occasions, including those of Belloc, Sir William Thomson, Lucas and a model similar to that used aboard the American vessel *Fish Hawk*. The latter could also be used to work with bottles for water samples and thermometers, over the shelf.

The sounders used by D. Carlos were those of Sir William Thomson and Lucas. There is a Buchanan sounder in the King's collection at the Aquário Vasco da Gama, in Lisbon, but there are no records of its utilisation during the cruises.

For surface waters, D. Carlos used the Chabaud thermometer and several others built in Lisbon. For deeper waters, reversing thermometers were used, such as those of Negretti & Zambra and Chabaud. According to the King, the precision of the measurements was very good, the error never being more than a fifth of a degree.

In the early cruises, water samples were collected using a brass tube with a small volume. Later came the Buchanan bottle together with a reversing thermometer.

A Secchi disk was used throughout the cruises to measure water transparency.

Currents were studied using Hautreux bottles, suspended in pairs on a vertical rope from the surface to the desired depth and the Mitchell floater (used by Sigsbee) also composed of two metallic cylindrical containers and deployed in the same way as the Hautreux bottles (Saldanha, 1996).

Currents and bathymetry

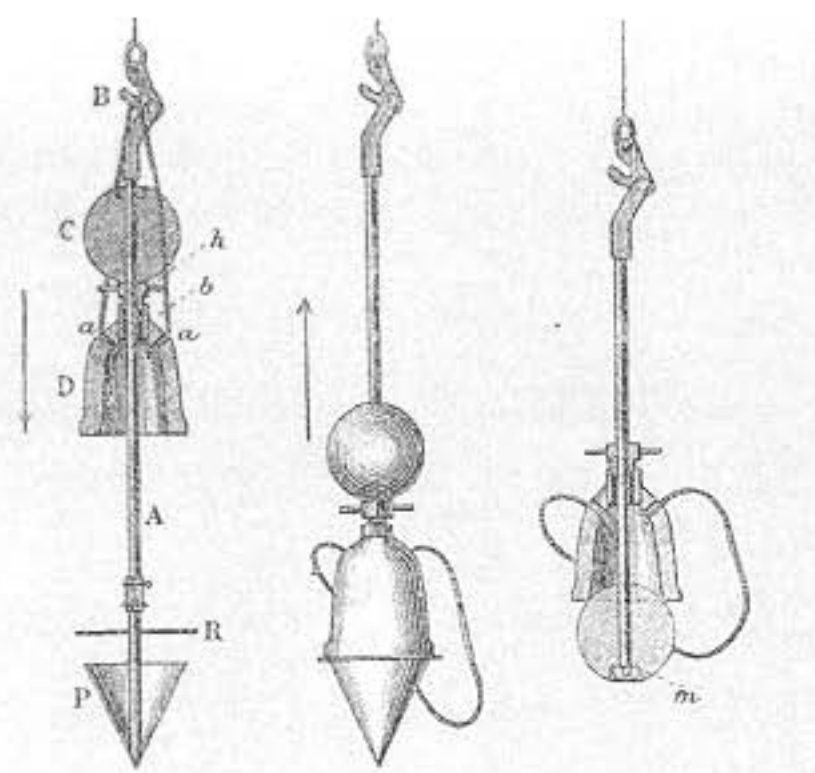
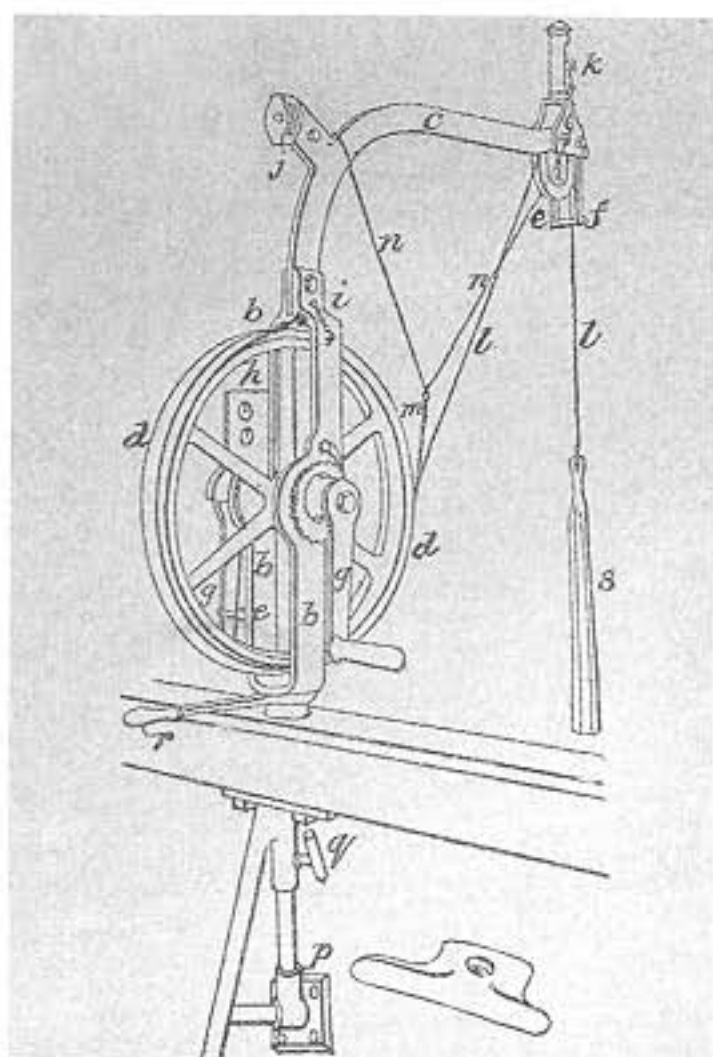
A few experiments were carried out in 1896 off Berlengas and Cape Espichel and from a navy vessel, the *Mandovi*, using Hautreux bottles. Some of these floaters were recovered and D. Carlos concluded that between November and December of that year a surface current flowed along the coast, to the north, between Cape Espichel and Aveiro.

D. Carlos also carried out in 1899 some experiments along the Algarve but the results, except for the recovery of one or two floaters, are not known.

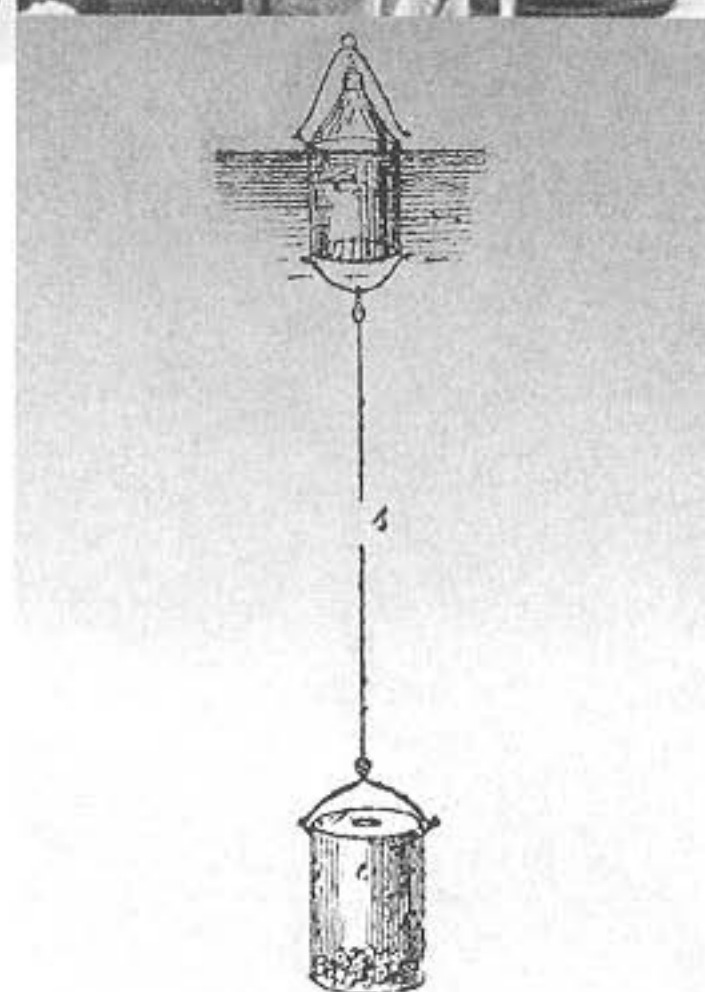
The preparation of a bathymetric chart of the Portuguese sea was also a concern for D. Carlos. Furthermore in 1905 Prince Albert of Monaco published the *Carte générale bathymétrique des océans* and this initiative was of the utmost importance for oceanographic studies. Up to this time, soundings had been obtained at each station worked but not co-ordinated. In 1905 the King decided to start drawing the bathymetric chart with all the soundings known to 60 miles off the coast and to be presented at a scale 1/10,000. Unfortunately, this chart was never published, being limited of a draft made by Girard with the soundings carried out from 1896 to 1907, existing at the Aquário Vasco da Gama (Carpine-Lancre & Saldanha, 1992; Saldanha, 1996).

Biological collecting

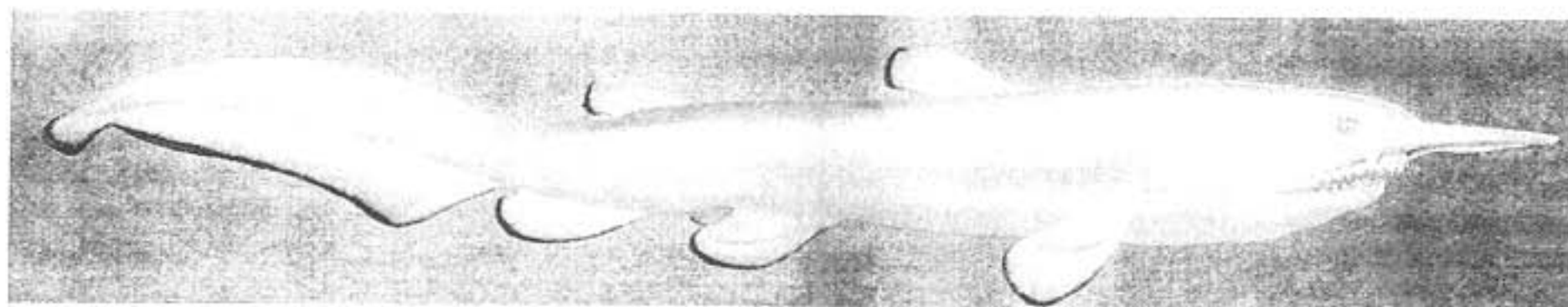
Like all biologists of his time, D. Carlos used the dredge. But he used beam-trawls much more extensively, like those used aboard the *Blake* and the *Hirondelle*, because they could collect much more material, particularly mobile animals like fishes and crustaceans. A rope tangle was attached to each of the four corners of the beam-trawl to collect small invertebrates. Sometimes a plankton net was also attached to the beam to collect small pelagic organisms. Several models of fish traps were used, including the triedric trap used by the Prince of Monaco, but results with this model proved unsatisfactory.



King Carlos (in white) aboard the *Amélia IV* and sounding gear



The Hautreux floaters



Para Alberto Girard

Dia 6 de Junho —

Dentro da Caixa de folha

- 1 *Aulopus filamentosus*
- 1 *Centrolophus lusitanicus*
- 1 *Dentex* (?)
- 2 *Cepola rubescens*

a linha a 460 metros a P.O. do Cabo
Espichel

- 1 — *Merluccius*
- 1 — *Caranx*
- 1 — *Merluccius* (?)
- 1 — *Solea quadrimaculata*
- 2 — *Ascidia* —

Alvaro Cardoso

(Luiz)



Odontaspis nasutus (= *Mitsukurina owstoni*).

A note from D. Carlos to A. Girard accompanying specimens.

D. Carlos and A. Girard.

Long-lines like those used by the fishermen of Setúbal and Sesimbra, for deep-sea shark fishing, were commonly used by King Carlos and good results were obtained. To deploy and recover these lines the King used traditional fishing vessels and the services of fishermen. These operations were carried out near the yachts, on station. Other smaller lines and more common fishing gear of different sizes were also used. No techniques for obtaining specimens from different biotopes were ignored. Pelagic organisms, from minute plankton to big medusae, were of course collected with near surface plankton nets. As a consequence, D. Carlos obtained for the first time in Portugal microscopic photographs of planktonic organisms.

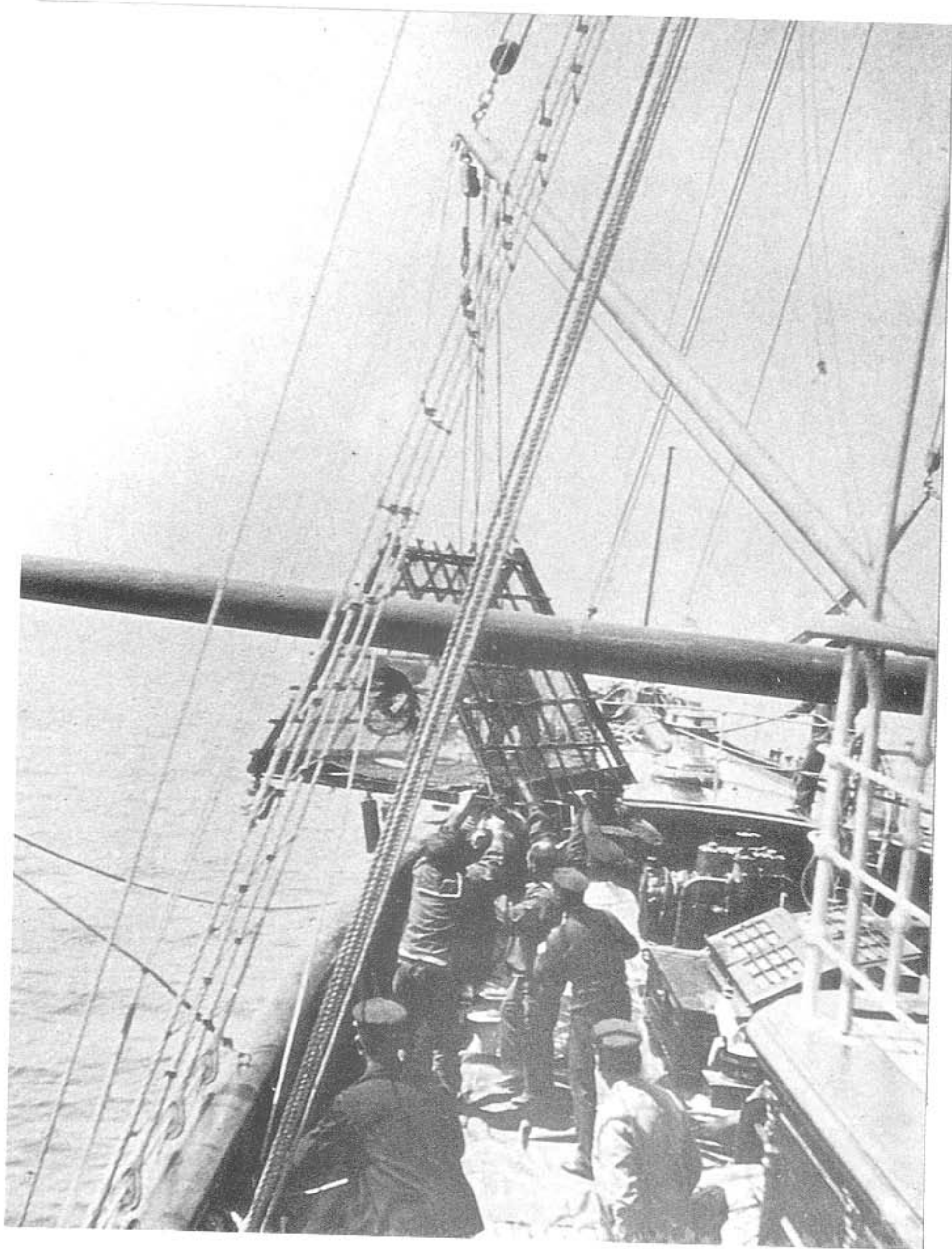
Littoral areas such as rocky and sandy shores were also prospected by the King and his team. Night and day the collecting activity never ceased. Birds and marine mammals were not forgotten, contributing to outstanding collections.

Specimens from fishermen and other collectors were also welcome in the collections and many interesting specimens were obtained in this way.

If the invertebrate collections had not been lost for various reasons over the years, the material collected by D. Carlos, would allow valuable studies of the benthic communities of the areas surveyed and from which the sediment characteristics were known. The collections existing now at the Aquário Vasco da Gama are a pale reflection of the superb material once available.

Fisheries

King Carlos was mainly interested in fishes, not only because of their scientific interest but also because the study of their biology could lead to a more rational exploitation of the resources they represented. He was in a good position to do so having Girard as an expert of the Fisheries Commission. By the time people realised that the steam trawlers that had just appeared would deplete the resources of the shelf, which in the case of Portuguese fishermen, had been exploited only with sailing boats.



The triedric trap (*Amélia III*)

To investigate the problem, in 1902 he hired a steam trawler the *Machado* that fished at different shelf depths off Sesimbra. Fish species, the number and body length of each fish species collected were recorded. This was not enough, of course, to study the possible fish depletion but, it was a basis for the work carried out several years later.

Also by 1902 a sardine crisis had begun on the French coasts of the Atlantic and Mediterranean. French public opinion was that the sardines had deserted the French coast to take refuge along the Portuguese coast! The Prince of Monaco and D. Carlos were interviewed about the subject by the *Petit Parisien* (February, 1903). D. Carlos said that no ichthyologist could tell anything about sardine depletion, and that the case was not the first one to be observed off the coasts of Brittany. Furthermore, a greater abundance has not been recorded in Portuguese waters. He said also that variations of temperature, lack of food, presence of cetaceans or the use of different kinds of fishing gear could be an explanation for such a dramatic stock shortage (Carpine-Lancre & Saldanha, 1992; Saldanha, 1996).

In studying the tuna fishery of the Algarve, he planned his cruises carefully, trying to relate oceanographic conditions with the fish movements and abundances. He distributed forms to be completed by the owners of the fixed nets, stating dates of tuna appearance, species, abundances, water conditions, etc. In a space of a year he got his first results and published them (Bragança, 1899). This publication included the systematics of the different species, feeding habits, sexual maturation, planktonic eggs, migrations, abundances and conclusions about the influence of oceanographic parameters on tuna biology. Finally, he express his opinion that the fishery owners should be equipped with thermometers and measure temperatures between the surface and 50 m deep, in order to forecast annually the appearance of the first specimens of tuna along the coast of the Algarve.

Ichthyology

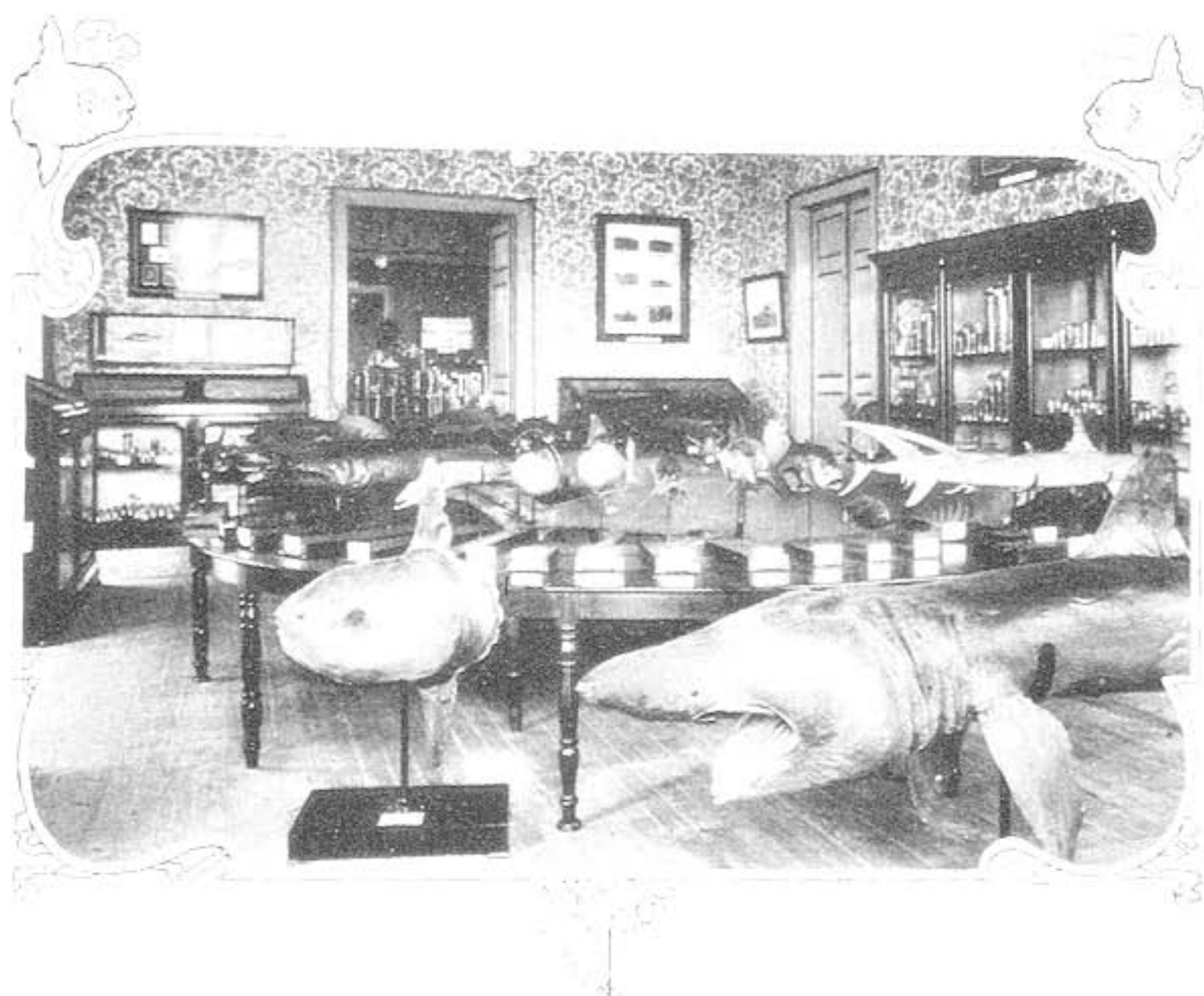
D. Carlos published in 1904 an extensive work on Portuguese sharks. He tried to complete with this paper the lack of existing knowledge for example on geographic and bathymetric distribution of the different species. He also included fishing techniques, systematics, synonymy, references, common names (in Portuguese and French), list of collected specimens, with the respective lengths, stomach contents, presence or absence of foetus, coloration, parasites and what part of the animal is economically useful. Keys for species identification and a schematic ecological classification of sharks were also given.

This work has also the merit of clarifying the abundance of several species such as *Centroscymnus coelolepis*. He also recorded for the first time in Portuguese waters *Chlamydoselachus anguineus* and *Mitsukurina owstoni* (under the name of *Odontaspis nasutus* n.sp.) (Bragança, 1904).

The King left many manuscript notes about other groups of fishes that he certainly intended to publish in the same format. For him the production of catalogues on the different fish groups was a goal to be attained, not only for their scientific merit but also for the interest it represented for fisheries. Actually D. Carlos produced only two scientific works: one about the Algarve tuna (Bragança, 1899) and a second on the sharks (Bragança, 1904). He also left two publications containing the general results of his cruises (1897, 1902).

Exhibitions

D. Carlos oceanographic activities were shown to the general public in several national and international exhibitions. Specimens, nets, instruments, and drawings, everything was carefully prepared by Girard to be shown during the exhibitions of 1887 at the Polytechnic School, 1898 at the Aquário Vasco da Gama, 1902 and 1903-1904 at Oporto, 1904 at the International oceanographic exhibition at the Society of Geography (Lisbon) and finally in 1906 in Milan. After the King's death many pieces were still exhibited in Rio de Janeiro.



Part of D. Carlos' collections

D. Carlos also sent some material from his cruises (fishes and invertebrates) to the collections of the Muséum National d'Histoire Naturelle in Paris and to the British Museum (Natural History). These specimens still exist.

King Carlos de Bragança's oceanographic activity opened the gates to a entirely new discipline in Portugal.

For a man always concerned with serious political problems it is remarkable that he could find the peace of mind to carry out scientific activities. These were for him *mon repos et ma récréation* as he wrote to Prince Albert.

Le monarque savant as Prince Albert of Monaco called him, was no doubt the Father of Portuguese Oceanography.

He was assassinated by political opponents in the streets of Lisbon on February 1, 1908, in his 45th year - a tragic loss to the field of endeavor he loved so much.

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