CHAPTER I

HISTORICAL SKETCH OF THE EXPLORATIONS IN THE GULF OF MEXICO

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The brief historical sketch of discoveries and explorations in the Gulf of Mexico presented in this paper is based on published materials available in this country. Fortunately, the large collection of books and maps in the Library of Congress, Harvard University, American Geographical Society, and the Public Library of New York York City provided abundant material from which the progress of scientific knowledge of the Gulf of Mexico could be traced with reasonable completeness. A wealth of data about the earlier discoveries in the Gulf can be found in the classical works of Winsor (1884–89), Thacher (1896), Lelewel (1852), in 20 volumes of history of voyages by Prévost (1746–89), Harrisse (1900), and Fiske (1892).

A student of history of explorations in the New World finds in the writing of Alexander von Humboldt, especially his Examen Critique . . . (1836–39) a rich source of critical information. A catalog of maps of the Spanish possessions published by the Library of Congress under the title, The Lowery Collection (Lowery 1912) not only gives detailed descriptions of maps printed from 1502 to 1820 but also contains a great amount of information about the explorations and cartography of the Gulf. A brief but comprehensive review of the explorations between 1492 and 1543 is given by Kohl (1863).

Many other publications and maps in various institutions in the United States were consulted. The more important of them are the catalog of maps, British Museum (1884, 1885), the catalog of geographical documents in the national library in Paris (Paris, Bibliothqèue nationale, 1892), Phillips' list of maps of America, list of geographical atlases (U. S. Library of Congress, 1901, 1909–20), and the description of Mexican maps by Torres Lanzas (1900). The publications of Phillips are listed in some libraries under his name, while in others they appear only under his titles (see Bibliography); the work of Torres Lanzas may be found under "Spain," "Torres," and "Lanzas." Other references not discussed in the text are listed in the bibliography.

Reports, letters, and other documents written by the earlier explorers show clearly that adventure, military conquest, and search for fabulous riches were the principal impelling forces that lured thousands of men of the sixteenth and seventeenth centuries to embark on the daring voyages beyond the unknown western ocean. Science played only a minor part in these risky undertakings, and scientific observations made in the course of these explorations, which so greatly enhanced the knowledge of the inhabitable world, were merely incidental byproducts of mercenary or military ventures.

History of the discovery and colonization of the New World is beyond the scope of this chapter. The following pages contain, therefore, only a brief summary of scientific achievements of the many explorations in the Gulf of Mexico from the time of its discovery to the present days. The author hopes that the picture of the scientific progress in the studies of the Gulf which he presents here has not been distorted by errors or omissions.

PRE-COLUMBIAN ERA

Written history of the explorations in the Gulf of Mexico naturally begins with the discovery of the New World by Columbus in 1492, but long before the white man set foot on the shores of the islands of America the existence of a large, landlocked body of water now called the Gulf of Mexico was known to the tribes that inhabited its coastal plains and sailed and fished in its waters. Indians living along the west coast of Florida did not venture beyond a narrow coastal zone in which they fished from small dugout canoes. This conclusion is well substantiated by archaeological research in Florida and especially by the study of the contents of numerous shell heaps (Walker 1880, 1885; Wiley 1949), which contain the rem-

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nants of birds, fishes, and mollusks found only in coastal waters.

The Aztecs, who developed their own system of navigation, were fairly well acquainted with certain parts of the Gulf. This is probably true also of the Mexican and Yucatec Indians, who sailed over considerable distances off shore. Evidence for this is given in the report of the fourth voyage of Columbus, who on July 2,1502, sighted a large Indian ship of the size of a Spanish galley about 80 miles east of the Yucatán coast (Kohl 1863).

The art of map making practiced by Aztecs had reached a high degree of perfection as can be judged from the incident described by Bernal Díaz de Castillo (Hakluyt Society Works, 2d ser., No. 24, p. 129, quoted from W. Lowery, 1912, p. 27). During the Cortés invasion of Mexico, he writes, "The great Montezuma gave our Captain a henequen cloth on which were painted and marked very true to nature, all the rivers and bays on the northern coast from Pánuco to Tabasco, that is, for a matter of one hundred and forty leagues, and the river of Coatzacoalcos was marked on it."

For more than 1,400 years of the Christian era the geography of the western world was under the influence of the writings of Claudius Ptolemy, an Egyptian who lived in Alexandria about the middle of the second century (the dates of his life are usually given as between 90 and 168 A. D.), and spent 40 years in making astronomical observations. For many centuries Ptolemy's data on the locations of many places on earth with reference to the parallel of Alexandria were the principal source of information for map makers. No existing Ptolemy maps are known earlier than that of the thirteenth century, the first printed edition of which was executed in 1475 in Vicenza (Thacher 1896).

Some idea of the type of maps available to navigators at the end of the fifteenth and the beginning of the sixteenth century can be gained from examining figure 1 representing the map of the world by Johannes Ruysch, copied from Ptolemy's geography of 1507–08. The discovery of the New World has been already incorporated in it, and the name "Mundus novus" appears for the first time on the engraved map.

During the last 40 years of the fifteenth century the Portuguese seamen made persistent and almost continuous efforts to search for new Atlantic islands beyond the Azores. So far, no documentary proof has been found of the pre-Columbian discovery of western lands by Portuguese, but, as stated by the Portuguese historian, Antonio Baião, " . . . there are numerous indications that the existence of other islands beyond the Azores was known or suspected in Portugal. It was in the wake of these indications that Columbus sailed. His voyage is integrated with cycle of Portuguese explorations of the Western Ocean." (Quoted from Morison, 1940, p. 75.)

Because of the secrecy attached by the Portuguese Government to the discoveries of new lands and their location, the findings of Portuguese seamen were lost, and only inconclusive traces of their efforts remain on certain documents originated in Lisbon. One of these is the famous map by Alberto Cantino which is discussed in the next section of this article (p. 8).

DISCOVERY OF THE GULF OF MEXICO

The discoverer of the New World came almost to the very entrance of the Gulf of Mexico but failed to enter it. On his second voyage, June 1494, Columbus followed the southern shores of Cuba as far as Isla de Pinos, where he stopped. Disregarding the information received from the Indians that the end of the land was not far, he changed his course and sailed eastward. The decision was influenced by his strong belief that Cuba represented the end of the new continent. As it is generally known, he asked his companions to sign a statement to this effect. The declaration, however, was not universally accepted since the earliest maps of the New World by Cosa, 1500 (fig. 3, p. 9), and Waldseemüller, 1507 (fig. 2), show Cuba (Isabella) as an island.

The question who was the first European explorer to sail along the coast of the American continent is by no means settled. The credit is usually given to the man whose name is forever associated with the New World. Amerigo Vespucci, the third son of a Florentine notary, was born on March 9, 1451. He studied diligently and became proficient in astronomy and in the use of the astrolabe, but his principal interest was in a commercial career. After establishing himself as an agent for the House of Cadiz, Vespucci undertook to settle the claims left after the death

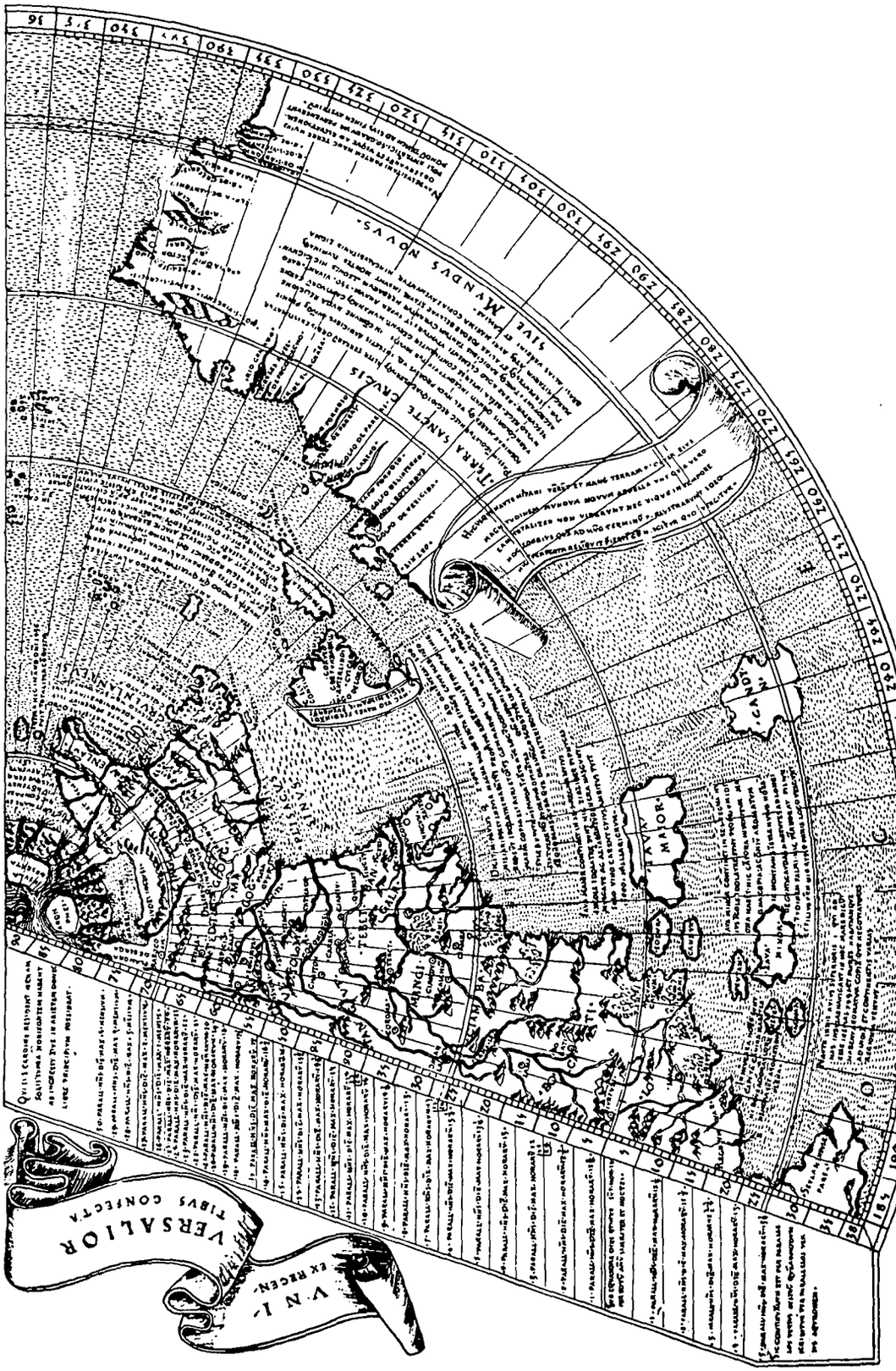

FIGURE 1.—Portion of the world map by Johannes Ruysch from Ptolemy's geography of 1507–08.

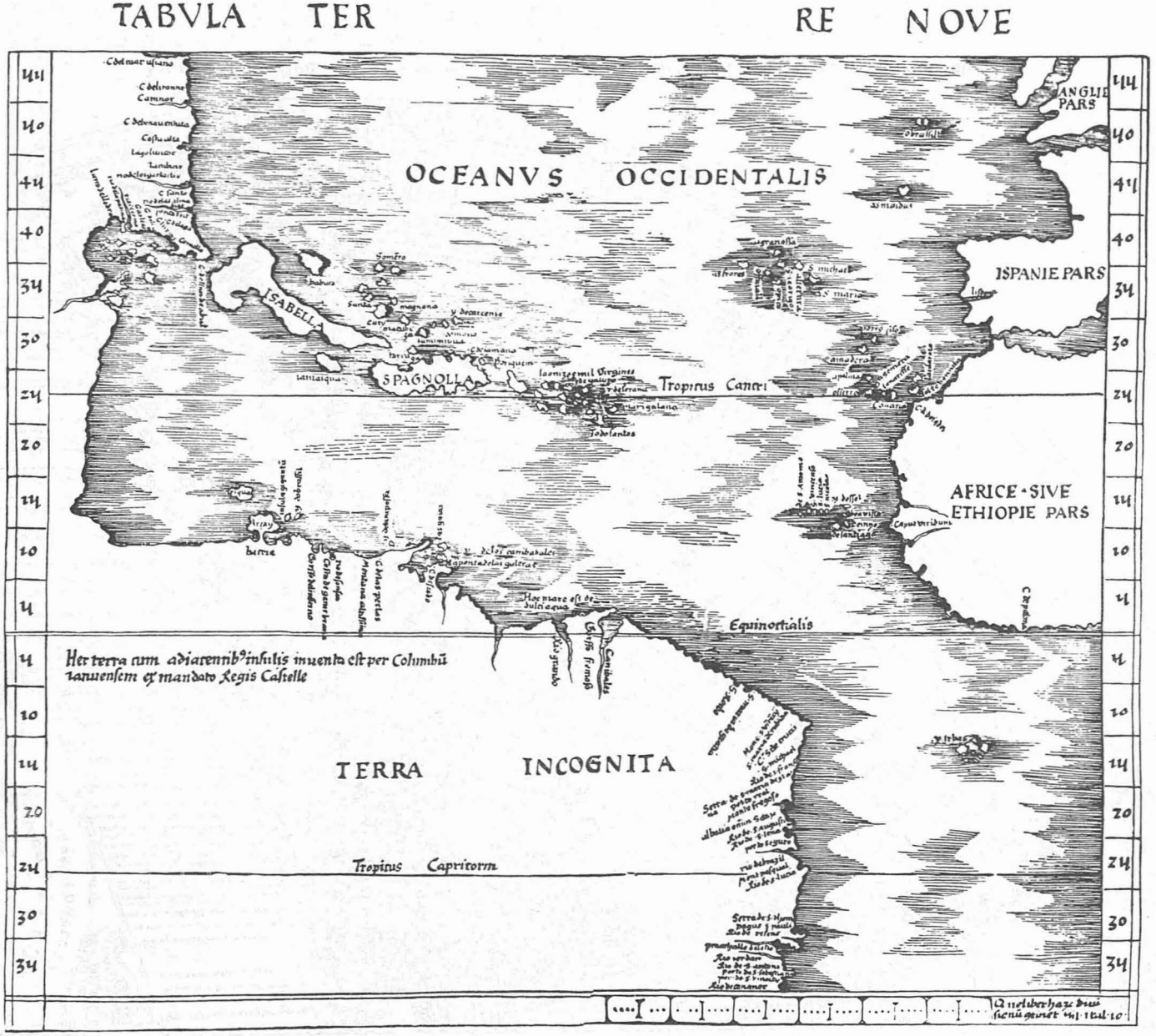

FIGURE 2.—Waldseemüller map about 1507 showing the discoveries of Vespucci, from the Ptolemy geography printed in Strassburg in 1513, known also as the Admiral's map. Reproduction from a copy in the Library of Congress.

of his friend, Juanito Berardi, who contracted to supply and equip 12 vessels of 900 tons each for the Spanish Crown. In 1497, at the request of the king, Vespucci joined the expedition to the New World. In his own words, "the King, Don Fernando of Castile, being about to dispatch four ships to discover new lands toward the west, I was chosen to aid in making discovery" (Thacher 1896, p. 69). He never explained his exact duties aboard the ship, but judging from his previous experience in commercial methods he probably went as a sort of supercargo to supervise the distribution of food, to weigh the gold, and to keep accurate tally of the Crown's share which, according to the royal decree of 1495, was one-third of the total gold obtained by the expeditions.

Vespucci started from Cadiz on May 10, 1497. After reaching the Canary Islands in about 10 days, the fleet sailed west and quarter-southwest for 37 days (27 days according to the Latin text of Vespucci's letter) until land was sighted a thousand leagues from the Canaries. Making allowance for an error of 1° latitude and about 8° longitude, Thacher (1896) estimated that the landfall would be off the coast of Honduras in the vicinity of Cabo Gracias a Dios. It is interesting to note that the ships passed between the islands of the Caribbean without noticing them. A safe harbor was found after 2 more days of sailing northward. Vespucci describes how, skirting the coast, he saw villages one of which, consisting of 40 houses, was built, like Venice—upon the water. It was near this village that a fierce encounter with Indians took place in which 15 or 20 natives were killed. The place is probably on the shores of Campeche Bay, north of Tabasco.

Continuing for 80 leagues farther along the coast, the expedition came to a place inhabited by different people. It was called the Province of Lariab, a name which later on caused a great deal of confusion and argument since in the Latin edition of Vespucci's letter the name was translated "Parias," a mistake that led many to believe that the explorer referred to the Gulf of Paria off the Venezuelan coast discovered by Columbus in 1498 during his third voyage. According to Thacher, the word "Lariab" is a compound word of Quiche dialect which means "there are many." It is assumed that the expression was used by the natives, who misunderstood the question addressed to them by Spaniards about the name of their province and answered that there were many people in the land. Vespucci states that this land, which is probably near Tampico in Mexico, is "within the torrid zone, close or just under the parallel described by the Tropic of Cancer where the pole of the horizon has an elevation of 23° at the extremity of the second climata." (Quoted from Thacher, 1896.) The term "clima" (plural "climata") of ancient Greek cartographers denotes parallel zone or belt, the width of which, according to Hipparchus, is determined by astronomical observations on the basis of the longest day of the year.

The rest of the letter (Vespucci, 1926 edition) caused endless arguments among geographers. Vespucci states that from Lariab they navigated in sight of land and covered 870 leagues, still going in the direction of the "maestrale." This course, corresponding to northwest, would have brought the expedition over the continent nearly to the coast of California. Harrisse (1900) ignores the western component of the direction of "maestrale" and considers only its northerly meaning. He states that plotting 870 leagues along the American coast would bring Vespucci's ships as far north as Cape Hatteras. According to Vespucci's narrative, the expedition turned east toward Bermuda from this place and returned to Cadiz on October 15, 1498.

Humboldt (1836–39) expresses doubt whether Vespucci ever made this voyage and denies him the credit of discovery of the new continent. According to Humboldt, at the time of his supposed voyage Vespucci was engaged in equipping the third expedition of Columbus and could not possibly have taken part in the explorations he describes. Obvious inconsistencies in the text of Vespucci's informal letters are unfortunately augmented by errors in translation. The accusations that Vespucci was a fake (see Winsor 1886, v. 2, pp. 129–136; Harrisse 1895) are answered, however, by pro-Vespuccian writers (Varnhagen, 1865, 1869a, 1869b, 1870), and final settlement of the question awaits further historical research.

Bremer (1940) advances an entirely new theory that the honor of the discovery of the Gulf of Mexico belongs to a Portuguese by the name of Gaspar Corte Viall who, shortly before 1500, sailed to the west and upon returning to Portugal spread the news of the existence of a new continent and islands in the western ocean. In support of his

hypothesis, Bremer mentions a place on the northern coast of the Gulf of Mexico known by tradition as Portuguese Field, which he considers may be a landing place of Portuguese sailors. The evidence, however, is not convincing.

SIXTEENTH AND SEVENTEENTH CENTURIES

The progress of early discoveries in the Gulf may best be followed by studying the maps of this period. Since the data concerning the location of new lands were considered by the Spanish Government a state secret, maps and reports which the captains of the ships were requested to submit to the government immediately upon their return to Spain were carefully guarded, and all means were taken to prevent them from falling into the hands of other European powers. As a consequence of this policy of secrecy the first maps of the New World were engraved and published outside Spain (in Italy, France, and Germany), using data which were often surreptitiously obtained or smuggled out of the country. Many of the original documents, usually drawn on parchment or oxhide, were lost or destroyed in war and by accidents; only a few of these valuable documents were recovered in more recent years after many vicissitudes.

The first map of the world summarizing the discoveries in the western ocean and showing the Gulf of Mexico was drawn by Juan de la Cosa, the companion and pilot of Columbus and owner of the caravel, *Santa Maria*, which bore the admiral's flag and was the first ship to reach the New World. The map embodies the results of seven important voyages: the three voyages of Columbus in 1492, 1493, and 1498; the first and second voyages of Vespucci in 1497 and 1498; and the first and second voyages of Cabot in 1497 and 1498. The date of the execution of the map is established by the inscription which reads, "Juan de la Cosa el fiso en el porto de *Santa Maria* en año de: 1500."

The history of this unique historical document is interesting. After being lost for three centuries, the map was found in 1832 in a Paris bric-a-brac shop where it was purchased for a small sum by Baron de Walckenaer. Its great significance was pointed out by Humboldt (1836) when in 1832 he drew public attention to its importance. After the death of Walckenaer the map was offered for sale at public auction and was purchased for 420 francs by the Hydrographic Department of the Spanish Government. Today it hangs in the Naval Museum of Madrid, listed in the museum guide book as number 553, with a detailed description and a brief history of this remarkable document (Madrid, Museo Naval, 1945).

The original map is drawn on oxhide, 5 feet 9 inches long, cut square at the tail of the hide where its width is 3 feet 2 inches. The Tropic of Cancer runs vertically through the middle; the top corresponds to the extreme west and includes the Caribbean Sea and the Gulf of Mexico. The latter area, instead of geographical details, is occupied by a rectangular drawing representing St. Christopher bearing the Christ child, a rather crude imitation of the famous woodcut engraving of 1423. Originally the map was rich in blue and gold and illuminated after the fashion of medieval manuscripts, but today it is torn and faded. Peter Martyr, who saw it in 1514 in the house of the Bishop of Burgos, head of the Maritime Department of the Casa de Contratación, remarked on its highly colored beauty.

The photographic reproduction of the Cosa map available in the Library of Congress is too blurred and cannot be clearly copied in the text. The part of the map referring to the Gulf of Mexico can be seen in figure 3, representing a copy found in volume 4 of Humboldt's Examen Critique (1836–39); this part of the map was redrawn and oriented by Humboldt in the conventional manner.

One of the earliest documents showing certain details of the New World and a part of the Gulf of Mexico is Cantino's map of the world. It represents for the first time what appears to be the west coast of Florida and the adjacent part of the Gulf (fig. 4). It was drawn as a large planisphere on parchment in gold and various colors. The map derives its name from Alberto Cantino, Ambassador of the Duke of Ferrara to the King of Portugal. The original, located in Biblioteca Estense in Modena, was obtained by Cantino for 12 ducats and was sent by him with a letter to Señor "Duca Hercole" in Lisbon. In later years the map was used as a screen and finally was recovered in a damaged condition from the shop of a pork butcher in Modena and deposited in the library.

Some cartographers (see Lowery 1912, pp. 5–6)

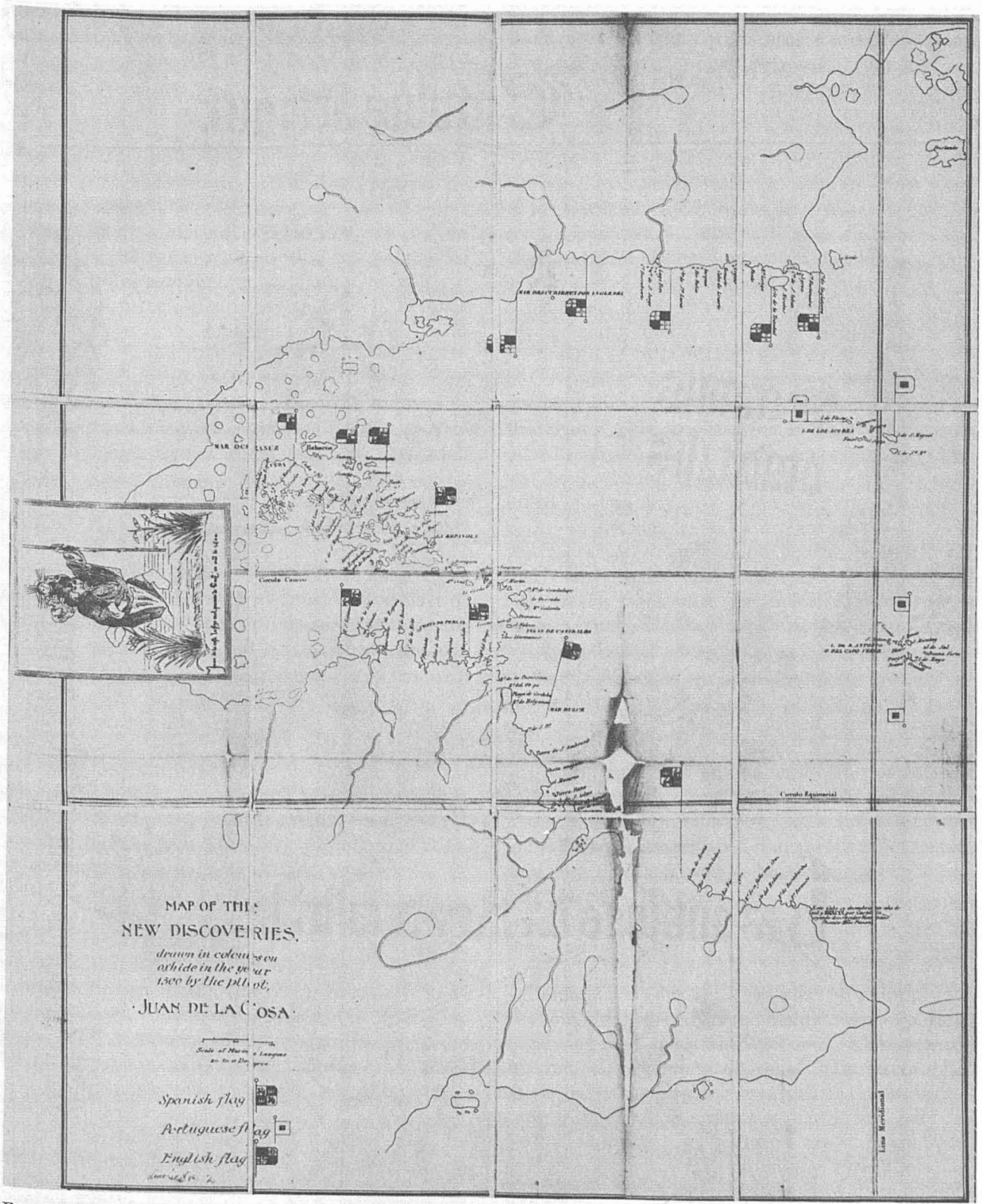

FIGURE 3.—Western part of the map of the new discoveries drawn by Juan de la Cosa. Reproduced from a copy in Humboldt's Examen Critique (1836).

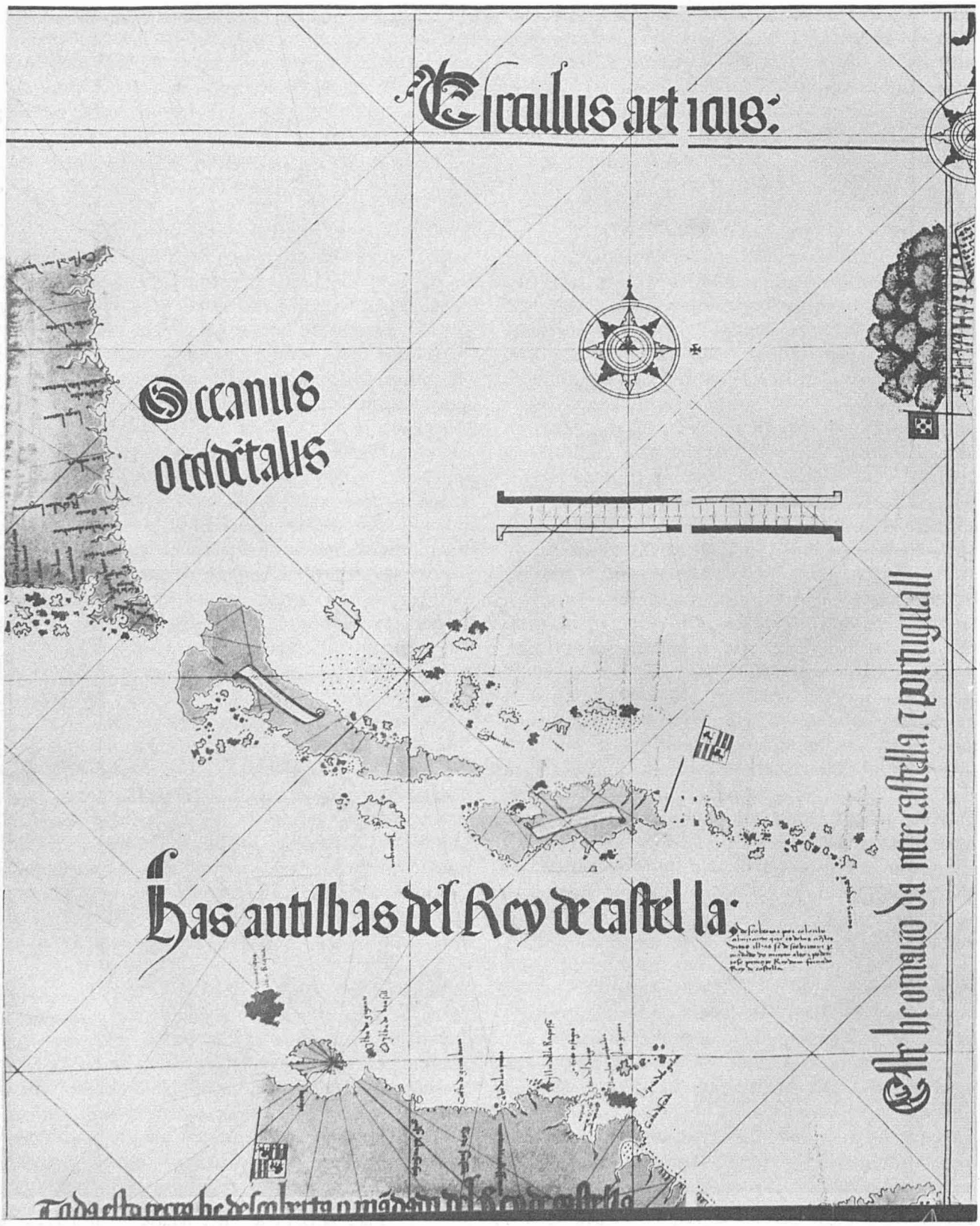

FIGURE 4.—Western portion of the Cantino map of the world, 1502. Original without name, date, or title. Reproduced from a copy in Harrisse's Les Corte-Real 1883.

consider that Cantino was familiar with the Portuguese voyages to the New World and incorporated their discoveries in his drawing. This subject, as well as the questions whether "Ilha Ysabella" on the map represents the island of Cuba or the Crooked Islands group called "Isabella" by Columbus, and whether the peninsula west of it is Florida, are critically discussed by Morison (1940).

The Gulf of Mexico is very crudely shown on the map of the world made by the German cartographer, Waldseemüller, and printed in 1507 in St. Dié, Lorraine. This map is famous because for the first time the continent of the New World is shown with the name "America" attached to it in honor of the Florentine explorer. The original is owned by Franz Joseph II of Liechtenstein.[1]

Of the many expeditions that sailed to the New World during the first decade of the sixteenth century, the more important ones were those headed by Hojeda, 1499; Niño and Guerra, 1500; Pinzón, 1499–1500; Lepe, 1500; Bastidas, 1500–02; Hojeda and Vergara, 1502–03; and Cosa, 1504–05. Results of these ventures materially enlarged the knowledge of the geography of the eastern part of the Caribbean area, but its western section, including the Gulf of Mexico, remained unexplored.

In 1513 the expedition headed by Ponce de León made a formal discovery of Florida, the existence of which was probably known to Spanish and Portuguese adventurers who visited the land north of Cuba but left no records of their findings. On Easter Sunday, March 27 of that year, Ponce de León with his three ships was in sight of land not far from the present city of Jacksonville. To commemorate the holiday the land was named la Florida. Failing in his attempt to circumnavigate the "island" Ponce de León turned south and on May 12 of the same year found a chain of islands which he named las Islas de los Mártires (present Florida Keys), and about a month later he discovered the Tortugas. In the following year, 1514, the King of Spain incorporated the newly discovered land in an administrative region known as Adelantado de la Isla Bimini e la Florida.

Ponce de León was the first explorer who recorded the existence of a strong current along the east coast of Florida. He reported that his ships' while crossing the stream near Cape Canaveral, frequently were swept by strong current. He obviously was referring to that part of the Gulf Stream which at present is known as the Florida Current (Herrera 1601, 1728; Stommel 1950).

In 1516 Diego Miruelo undertook another expedition to Florida, and in the following year, 1517, Fernando de Córdoba and Antonio de Alaminos explored the northern and western coasts of Yucatán. Driven for several days by a severe storm they finally saw land with a large Indian town, near Cabo Catoche. The expedition recorded many points, bays, and harbors along the west coast of the Gulf and safely reached the Bay of Campeche, giving it its present name. Trouble started, however, near the place called Champoton where Córdoba and his landing party were attacked by Indians. In this encounter, Córdoba was badly wounded and many of his soldiers were killed. Alaminos, the principal pilot of the expedition, decided to take advantage of the prevailing easterly winds and sailed north to Florida and then turned south toward Cuba. His decision was a right one. In a few days the ships crossed the Gulf and returned to Cuba, where Córdoba died of his wounds.

Scientific results of the expedition were significant. More than 500 miles of the Gulf coast were mapped; proof was obtained of the existence of an open channel between the Florida and Yucatán Peninsulas; and valuable information was accumulated regarding the prevailing winds, currents, and depth of water. Alaminos was still under the impression that Yucatán was an island. The name Yucatán was taken from the expression "Uyucatan" which the Spaniards frequently received from Indians in reply to their questions, the meaning of which was "we don't understand you."

Before his death, Córdoba appointed his nephew, Juan de Grijalva, commander of a force consisting of 4 ships and 250 men. Experienced Antonio de Alaminos was again the senior pilot of the expedition which on April 20, 1518, sailed from the harbor of Matanzas (Cuba) and followed Córdoba's former route toward the Cape of Yucatán. Stormy weather drove the expedition farther south along the eastern coast of the peninsula toward an island called by the Spaniards la Isla de Santa Cruz but known at present as Isla de

[1] In May 1960 the map was offered for sale at an auction in New York City with the condition that bids should exceed $50,000, but in the last minute was withdrawn by the owner.

Cozumel. From this point the ships turned north around the Yucatán Peninsula and on May 26 passed the point reached by the previous expedition and entered a large bay which was called Boca de Términos (Laguna de Términos on modern charts). Grijalva thought that he had reached the end of the Yucatán island which he named La Isla de Santa María de Remedios, the name which appeared on maps of that time. The expedition continued along the unknown coast for nearly a thousand statute miles to a point a short distance south of the present location of Tampico.

Grijalva's expedition substantially contributed to our knowledge of Gulf geography. The names of many familiar places such as Grijalva River, the bay and river of Tonola, Coatzacoalcos River, Alvarado River, and many others were established and their positions indicated on maps. Alaminos made many astronomical observations between Yucatán and Tampico. Some of his determinations of latitude—for instance, that of a small island where the present town of Veracruz is located—were accurate within 1°. He also observed and recorded the currents along the coast and made soundings and other hydrographical observations.

When the expedition entered the mouth of the Grijalva River the Spaniards were encountered by many Indians having gold in their possession. When asked for the name of the land the metal came from, the Indians replied, "Mexico." In this way the Spaniards heard for the first time the name of the country which played such an important role in the expansion of Spanish power in America.

Upon reaching his farthermost point at Pánuco, Grijalva became convinced that he was exploring the coast of a large continent and not of an island as he had first believed. Realizing the importance of this discovery, he dispatched Pedro de Alvarado on a fast ship to inform Governor Velásquez of Cuba of his important finding and sailed back following the same route the expedition took from Cuba.

A new expedition organized by Velasquez in 1519 was in command of Hernando Cortés with Antonio de Alaminos again serving as chief pilot. In May of the same year the expedition sailed around Cape Catoche, following in general the route taken previously by Grijalva. This time the Laguna de Términos was explored more carefully by Captain Escobar who established its true nature as a shallow, landlocked body of water not suitable for establishing a colony on its banks. Antonio de Alaminos, who was sent northward to Cabo Rojo south of Tampico, discovered a large river emptying into the Gulf and named it Rio Grande de Pánuco.

Besides the surveys of the coast from Cape Catoche to Tampico, Alaminos' principal contribution to the exploration of the Gulf was the discovery of a free passage between Florida and Cuba which represented the shortest route for Spanish vessels carrying silver from Mexico to Europe.

In 1519 Francisco de Garay, Governor of Jamaica, sponsored an expedition of Don Alonzo Álvarez de Pineda to explore the northern coast of the Gulf. Four ships provided by Garay sailed from Jamaica toward Florida. Believing that Florida was an island, Pineda followed the west coast looking for a passage and, not finding it, turned west along the northern coast of the Gulf. In the course of his exploration he discovered the mouth of the Mississippi River which he called "Rio del Espiritu Santu" and described the body of water east of the delta as "Mar Pequeña" or a small sea, the name of the present Mississippi Sound which persisted on many charts for nearly two centuries. Pineda noted the physiographical character of the shoreline, recorded the positions of dunes, low-lying sandspits, bays, knolls, marshes, and oyster banks (*ostiales*) which abounded in the Mississippi Sound and in the delta of the Mississippi River. He realized that the majestic freshwater stream which he ascended for several miles must originate on a large land area, and other observations convinced him that he was exploring the coast of a great continent.

Although the majority of writers agree with Harrisse (1900) that the river Pineda named Rio del Espiritu Santu is the present Mississippi River, there are others who think that the description of the country given in his reports does not agree with that of the mouth of the Mississippi and that Pineda's expedition actually was in Mobile Bay (Scaife 1892). This question probably never will be answered with complete certainty. As a result of his explorations Pineda produced several new maps showing, with approximate accuracy, the outlines of the Gulf coast. Only one of them, bearing the title "Traza

de Costas de Tierra Firme y las Tierras Nuevas," was published. The original, dated 1521, is in the Archivo General de Indias, in Seville, and its reproduction is given by Navarrette (1837) and Winsor (1884, v. 2, p. 218).

In 1521 the west coast of Florida was revisited by Ponce de León, who landed probably in Charlotte Harbor where he was seriously wounded in a battle with Indians. He died within a few days, after being taken back to Cuba. This expedition added nothing to the progress of geographical knowledge of the Gulf.

The next attempt to conquer Florida and explore the northern part of the Gulf was made by Pánfilo de Narváez, who had distinguished himself in the conquest of Cuba under Velásquez and was at the head of an expedition sent by the Spanish Government to compel Cortés to relinquish his command in Mexico. His defeat and imprisonment by Cortés did not reflect on his reputation, and upon returning to Spain he obtained from Charles I a grant to colonize a vast expanse of land from Florida proper as far west as Rio Pánuco.

On June 17, 1527, five ships under the command of Narváez sailed from San Lucas, Spain, with 600 men and officers aboard. One of his companions was Cabeza de Vaca, the treasurer of the fleet. After leaving the south shore of Cuba in March 1528, the ships, driven north by strong winds, found shelter in a large bay which the Spaniards called Bahia de Santa Cruz. According to the description given by Cabeza de Vaca, the bay extended from 7 to 8 leagues inland, had many islands, and presented an excellent anchorage with a depth of water of about 6 fathoms. There is no doubt that it was the present Tampa Bay.

Misinformed by Indians that the land north of the bay, known as Apalachee, was rich in gold, Narváez marched overland with 300 officers and men while his ships under the command of Miruelo followed the northern direction along the coast. The rendezvous was supposed to be in a bay north of the point of their departure.

In about 2 months, Narváez's column reached the village of Apalachee where with great difficulty the men found only a few bushels of corn. Trying to establish contact with the ships, Narváez turned south and discovered a river, Rio de Magdalena, as the Spaniards called it, which probably corresponds to the present Apalachicola River. The party suffered many hardships in the swamps of this region, and many men perished of exhaustion and disease.

Failing to contact the ships, Narváez decided to march west rather than to return to Tampa Bay. On the shores of a bay, which probably corresponds to the present St. George Sound and which was named Bahia de los Caballos, the Spaniards were compelled to slaughter their last horses to make crude boats of their skins, and sailed westward. They followed the shoreline, entering different lagoons (Pensacola, Santa Rosa, and others). In November they reached a bay with many islands (probably Chandeleur Sound in the Mississippi Sound). Since the water was fresh they realized that they were near the mouth of a great river which they attempted to enter, but strong wind and current drove them into the sea where Narváez perished in the storm. His companion, Cabeza de Vaca, found refuge on a small island 5 leagues long and 2 leagues wide which he named Isla de Malhado. The place may be Ship Island, Horn Island, or some other island in the Mississippi Sound.

Scattered by the storm, most of Narváez's men perished. With a few men, Cabeza de Vaca succeeded in landing on the mainland, where for 6 years he lived among the Indians. In 1533 he gave up hope that any European ship would visit the coast and with Lope Oviedo decided to march westward. Encountering a few small streams they came to the banks of a very large river which they considered to be Rio del Espiritu Santu (Mississippi River), and after crossing it marched for a long time through Texas until they reached the Bay of California.

In 1536 Cabeza de Vaca returned to Europe where the results of the unfortunate expedition became known. Its principal scientific achievements can be briefly summarized as follows: The Mississippi River was seen for a second time; Tampa Bay was more fully explored, and new names, such as Apalachee Bay, were added to geography.

After waiting in vain for Narváez at the place of rendezvous, Miruelo returned with his ships to Tampa Bay. It is interesting to note that, although he failed to reach the bay at the north coast of the Gulf where he was supposed to meet Narváez, the name of Bahia de Miruelo

appeared for many years on the charts in the place of the present Apalachee Bay.

Shortly after the tragic end of the Narváez expedition, Fernando de Soto, a Spanish captain and explorer, was preparing for a new adventure. De Soto acquired a large fortune from the conquest of the Inca Empire in Peru in which he played a prominent role. He obtained from Charles V a commission as "Adelantado" of the lands of Florida and Governor of Cuba and invested his large fortune in a new adventure.

On May 18, 1539, seven ships comprising De Soto's flotilla carrying 700 soldiers, 200 horses, mules, supplies, and materials, sailed from Havana. On May 25 they reached Tampa Bay, known as Bahia de Espiritu Santu. From Tampa Bay, De Soto with a large detachment of horsemen and foot soldiers went by land to Apalache. One of his companions, Juan de Añasco, a prominent seaman, cosmographer, and astronomer was engaged in making scientific observations during this military expedition. After reaching the land north of Apalachee, De Soto despatched Añasco south to find a harbor. During this travel the party discovered the bones and other remains of Narváez's men, and coming finally to the shores of the sea discovered a large bay which they called Bahia de Aute (present Apalachee Bay).

In January 1540, De Soto ordered Captain Diego Maldenado to sail for 100 leagues along the coast to take records of all the bays, harbors, and rivers and to return in 2 months. In the course of this survey Maldenado found a bay 60 leagues west of the Bay Aute which he described as the most beautiful harbor in the world ("un hermosissimo puerto"), protected against all winds. He named it Achusi. The entire harbor was sounded with great detail, for De Soto wanted to use it as a rendezvous and a base for his operations. Detailed descriptions made by Maldenado leave no doubt that Achusi corresponds in every respect to the present Pensacola Bay.

After exploring the east coast of the American continent as far north as the Savannah River, De Soto returned to the Gulf and in October 1540 investigated the place called Mavill or Mauvill which is the present Mobile. His further explorations lead him inland and westward to the banks of the Mississippi which he crossed at Chickasaw Bluffs near the present location of Memphis, Tennessee.

In 1542 he died and was buried at the bottom of the Mississippi River. Before his death he appointed Luis de Moscozo de Alvarado as his successor.

After many vicissitudes the Spaniards, under the leadership of their new chief, constructed several boats in which they sailed down the river, successfully evading the pursuit of Indians. Upon reaching Gulf waters they turned westward with the hope of landing somewhere on the Mexican coast. All navigation instruments were lost when the Indians burned the Spanish camp at Mobile, but one astrolabe was saved by Añasco. Being a careful and resourceful man, he managed to make a sea chart from a parchment of deerskin, and with a forestaff, made from a ruler, and an astrolabe salvaged from the fire at Mobile, attempted to guide the course of the flotilla. His worthwhile efforts were so much ridiculed by the other seamen because Añasco had never before embarked on any other maritime expeditions, that in disgust he threw his instruments, except the astrolabe, into the sea.

One day, because of bad weather, the ships sought refuge in a small cove. While some of the Spaniards were gathering shellfish along the shore they found some slabs of black bitumen almost like tar which the ocean had cast upon the beach. Garcilaso, who tells this story (Garcilaso de la Vega, Varner's translation, 1951, p. 601), says, "This substance must come from some spring which flows into the sea or which is born in the sea itself. The slabs weighed 8, 10, 12, and 14 pounds; and they were found in quantity." The tar-like substance was successfully used by the Spaniards to repair the leaky vessels, and after spending a few days on the shore they continued westward. This is probably the earliest reference to the finding of asphalt along the Gulf coast. After many days of sailing along the coast line Moscozo entered the mouth of the Pánuco River and landed in Mexico.[2]

The discovery of Pensacola Bay, exploration of the delta of the Mississippi River and of the northern coast of the Gulf, and the convincing evidence that the Mississippi was a mighty stream draining from a large continent, were the principal scientific contributions of the De Soto expedition.

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[2] Detailed account of De Soto's expedition can be found in the report of the U. S. De Soto Commission (1939).

Its unhappy completion marked the end of the period of the earliest explorations in the Gulf.

Sixteen years after the return of Moscozo a Spanish conquistador, Don Tristan de Luna, organized a new expedition to the Gulf. This expedition contributed little to the science of geography. By this time Spain's interest in the new land across the ocean and the enthusiasm of her rulers for new explorations and colonization of the New World somewhat slackened.

Although the great advantages derived from the possession and colonization of the newly discovered territories were fully appreciated by the Spanish Government and by the educated class of the Spanish nation, the country lacked ability and resources to develop them. At the same time, the Spanish Government jealously watched the efforts of other nations to establish themselves in the New World. It tried by every means to prevent French colonization of the country surrounding the Gulf of Mexico and did not hesitate to send military expeditions to destroy French colonies.

The results of many expeditions in the Gulf conducted during the first half of the sixteenth century provided the cartographers with new, reliable material for the construction of new maps, and consequently, the outlines of the Gulf shown by them in their drawings began to assume more or less correct configuration. This can be noticed, for instance, by examining figure 5, representing Mercator's map of 1538, in which for the first time the name America was applied to the entire western continent.

It may be of interest at this point to make a brief survey of the geographical names which were given to the Gulf of Mexico. No special name for the Gulf is found on the map of Juan de la Cosa of 1500 or the Waldseemüller map of 1507, although in both of them the location of the Gulf is clearly shown. Cortés, in his despatches, referred to the Gulf as Mar del Norte, while the names Golfo de Florida and Golfo de Cortés are found in the writings of other explorers. The name Sinus Magnus Antilliarum appears on an old Portuguese map made in 1558 by Diego Homen (original in British Museum). Probably the most remarkable name is that of Mare Cathaynum (Chinese Sea) which is found on one chart of the middle of the sixteenth century (copy reproduced in the Mémoirs de la Societé de Nancy, 1832). In 1550 the name Golfo de Mexico appears for the first time on the world map the original of which, according to Kohl, is in the Bodleian Library in Oxford. Earlier Spanish geographers used, also, the name of Golfo de Nueva España. Herrera (1728) called it Ensenada Mexicana and Seño Mexicano, the names which persisted in Spanish admiralty charts until the eighteenth century. The present name, the Gulf of Mexico, and the corresponding names, Golphe du Mexique in French and Golfo Mexicano in Spanish, appear to have been in use since the middle of the seventeenth century.

During the latter half of the sixteenth century the French Huguenots, trying to escape religious persecution in Europe, made many attempts to establish colonies in Florida. Their efforts were primarily directed to the east coast of Florida where the French penetration lead to many bloody encounters with the Spaniards. Probably the most significant French contribution to geographical knowledge of this time was Le Moyne's map of Florida. Jacques Le Moyne de Morgues was an artist who accompanied a French expedition to Florida under Laudonnière in 1564. His map shows only a part of the Gulf of Mexico east of the Mississippi River. Since it is known that French observations were limited to the east coast of America between the point south of St. Augustine and Rio Jordedan (Charleston Harbor) in the north, the rest of the map was obviously borrowed from Spanish sources. The names of many places are corrupted as, for instance, Apalache Bay is indicated as Sinus Morquel, corrupted from the Bay of Miruelo, and the Bay of Ponce de Leon (Tampa Bay) is called Sinus Joannis Ponce. This map, published by De Bry in 1591 after the death of the artist, was for 50 years copied by Dutch and French cartographers but was completely ignored by the Spaniards.

Le Moyne produced, also, a series of extraordinarily interesting drawings depicting the home life, habits, methods of hunting, and ceremonies of the Timucua Indians. Excellent reproductions of these illustrations together with a translation of the Latin text of De Bry were published in English (Le Moyne, 1564, ed. 1875) and some of the drawings are reproduced by Swanton (1946, tables 51, 53–57, 81, 82, 85, 87, and 106). Examination of these illustrations gives an insight into the tribal life of Florida

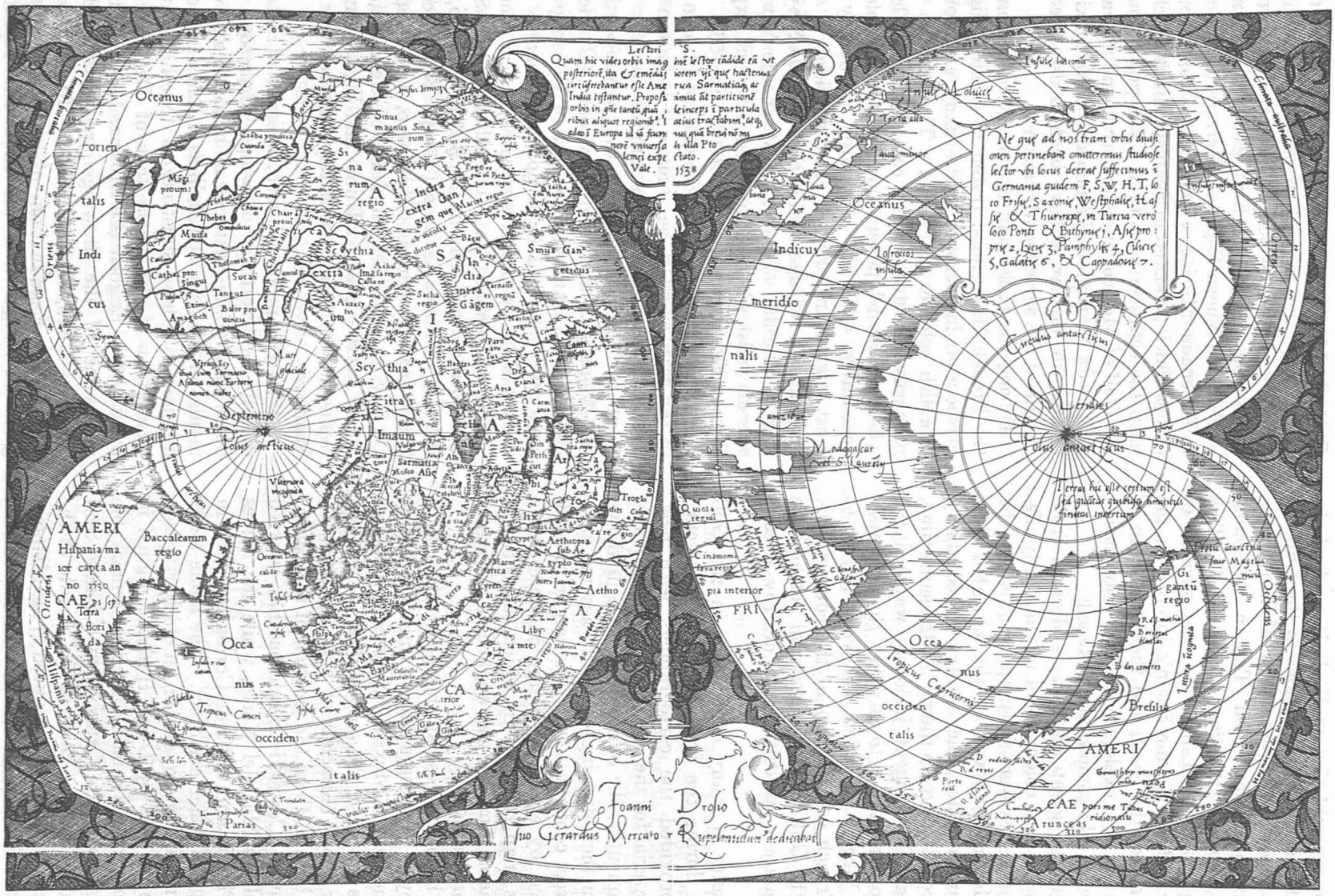

FIGURE 5.—The Mercator map of 1538. Reproduced from a copy in the Library of Congress.

Indians as it was interpreted by a French artist. Particularly amusing are the scenes of alligator hunting in which the beast exceeds many times its normal size and the peaceful scene of the Timucua Indian women sowing their fields, the latter drawing conveying a bucolic atmosphere in conformity with the prevailing artistic taste of that time.

No significant advance in geographical knowledge of the Gulf was made during the latter part of the sixteenth and the first half of the seventeenth century. In this period Spanish ships loaded with gold and silver continued to sail from Mexico to Havana following the northern coast of the Gulf and passing the delta of the Mississippi River which was called Cabo de Lodo, or Mud Cape. The names of the earlier discoverers, such as Pineda, Narváez, Ponce de León, De Soto, and others whose exploits made possible the relatively safe sailings of these ships, were almost forgotten.

During the last quarter of the seventeenth century a new era of explorations was initiated by French adventurers who attempted to reach the Gulf coast from the north in order to establish there new colonies. In 1673 two French explorers, Louis Joliet and Father Marquette, descended the Mississippi River from Lake Michigan and voyaged south to the mouth of the Arkansas River.

In 1682 La Salle entered the Mississippi by way of the Illinois route, explored the river to its mouth, and in the name of France took possession of its entire drainage basin. Seeing great political and economic advantages in establishing a colony at the mouth of the Mississippi River, he obtained support of the French Government and in 1684 sailed from Europe with four ships, one of which was shortly captured by Spaniards. La Salle missed the mouth of the Mississippi River and landed farther west in Matagorda Bay, Texas, where he established his colony. Misfortunes, disease, and death so devastated the ranks of the colonists that in a few years only 45 survivors remained from several hundred who comprised the original party. In desperation, La Salle decided to reach Canada by land and during this journey was assassinated by his men.

One of the results of La Salle's exploration, which is of definite interest to the geography of the Gulf, is the sketch map of the location of his camp on the shores of Matagorda Bay with the soundings shown in feet. The reproduction of this map, in the form of a tracing from a photograph of the original, is given by Dunn (1917, p. 33).

Rumors of the French penetration in the land bordering the Gulf aroused the half-dormant rivalry between Spain and France and induced the Spanish Government to send several military expeditions with orders to destroy French colonies. As one of the official documents of that time stated, it was necessary to "desarraygar esta espina que se a yntroducido en el corazon del cuerpo de la America" which means to uproot the thorn that had been thrust into the heart of America (Dunn, p. 42).

In 1686 Martin de Echegaray, a naval captain of the presidio of St. Augustine, Florida, attempted to interest the Spanish Government in strengthening Spanish influence in the domain of Florida by transporting 50 Spanish families from the Canary Islands and 25 Indian families from Campeche. In support of his plan, Echegaray submitted a map, which is a good example of the defects of the geographical knowledge of that time, of the interior of the American continent. The Echegaray map shows the large "river Canada," or St. Lawrence River emptying into a lake from which two rivers lead southward to the Gulf of Mexico, both emptying into Espiritu Santu Bay (Mississippi River). Echegaray's scheme was not accepted, but the Spanish Government took other measures to counteract the French penetration into the new continent and to destroy La Salle's colony of which they were afraid. An interesting account of these attempts is given by Dunn (1917). It is sufficient to mention here that not less than four maritime expeditions were sent by the Spanish Government, and the whole Gulf of Mexico was examined with great diligence. One of the important results of this search for French colonies was the rediscovery of Pensacola Bay which the Spaniards decided to occupy. Admiral Pez was placed in command of an expedition organized for this purpose in 1693. One of his principal companions was Dr. Carlos de Siguenza y Gongora, professor of mathematics in the Royal University of Mexico and chief cosmographer of the kingdom. Siguenza kept a detailed journal of the journey in which he recorded his observations. The vessels of the expedition reached Pensacola Bay on St. Mary's

Day, August 14, 1693, and following their custom, the Spaniards immediately renamed it "Bahia de Santa María de Galve," the last name being added to the holy name of the Virgin in honor of the viceroy of the territory. Siguenza made a detailed survey of Pensacola Bay and described its configuration, depth, islands, and rivers. The expedition proceeded farther east and after some difficulty entered Mobile Bay, made soundings in the channel, and found that the depth was only 20 "palmas." As a result of Siguenza's observations strong recommendations were made to occupy Pensacola, but a final order for this action was not issued until 1698.

Rivalry among the western European powers in establishing a foothold on the shores of the Gulf of Mexico greatly enhanced the geographical knowledge of the region. As a military necessity the whole northern coast of the Gulf, with harbors, rivers, and lagoons, was surveyed; fairly accurate navigational charts were prepared; and information was accumulated regarding the prevailing winds and currents. In this way marked progress was attained in the cartography of the Gulf and adjacent coastal lands.

EIGHTEENTH CENTURY

At the beginning of the eighteenth century sailing vessels of European powers engaged in trade or in pursuit of military designs continued to traverse the waters of the Gulf in ever increasing numbers, but the era of ambitious expeditions and daring adventures, which in the past fired public enthusiasm, was over. As a matter of routine the ships made astronomical observations and determined the longitude and latitude of the places already known, surveyed the harbors and passes, made numerous soundings, and recorded the direction and velocities of winds and currents. These navigational data were eagerly sought by the cartographers to be incorporated in new maps, numbers of which appeared in various European countries and in Mexico. Examples given below, which illustrate this progress, have been selected from a large array of the cartographic material issued during this period.

French interest in the Mississippi River and the surrounding country is clearly expressed in the work of the famous French geographer, Guillaume Delisle (in the French publications the name is spelled "de L'Isle" and "Del'Isle") whose chart of Louisiana and of the course of the Mississippi was composed in 1719. The inscription reads that it was drawn after consulting many memoirs of Le Maire and others. The map shows the routes of De Soto and of other explorers and depicts the course of the principal rivers. The name Texas (Los Teijas) for the first time appears in cartography. According to Kohl (1857, No. 238), the Delisle map is "the mother and main source of all the later maps of the Mississippi and of the whole West of the United States."

The entrances to the Mississippi River, being of great importance to the French mariners, were surveyed with great persistency. Among the many persons who contributed to our knowledge of the physiography of the river, Lemoyne de Sérigny occupies a prominent position. In 1719 he participated in military operations in Florida and Louisiana and led a successful attack from the sea against Pensacola. His observations along the northern part of the Gulf coast are incorporated in a map drawn by an anonymous French cartographer and entitled "Carte de la côte de la Louisiane depuis l'Embouchure du Mississippi jusqu' à la Baie de St. Joseph, etc." The Library of Congress has a photographic reproduction of this document. The original is in Paris in Depôt de la Marine. Sérigny produced, also, a detailed map in colors of the approaches to Pensacola Bay. The notation on the body of the latter map contains reference to a strong surface current and the rise and fall of tides approximating 3 feet during a 24-hour period.

In connection with the construction of fortifications around the recently founded city of New Orleans, the French Government detailed many engineers to Louisiana. Among them Bernard de la Harpe distinguished himself by numerous observations which were incorporated in the de Beauvilliers map of 1720. The map shows many streams, mountains, towns, and Indian villages along the Gulf of Mexico and many islands off the coast of Yucatán. The chart of the Louisiana coast drawn about the same time (1719–20) by Devin was also made on the basis of the reports of De la Harpe and other French army officers. It shows many soundings and the positions of shallows and reefs in St. Louis Bay and adjacent waters.

The necessity of having accurate maps for safe

navigation along the coasts of America was fully recognized in England. Among the many charts published there during the first half of the eighteenth century that of Henry Popple, issued in 1733 on 20 sheets with an index, is of particular interest. This large chart, measuring 232 by 239 centimeters has the following title: "A Map of the British Empire in America with the French and Spanish Settlements adjacent thereto." A prospectus attached to the first impression contains a detailed description of the map. The Library of Congress has three impressions, one of which is imperfect.

About the middle of the eighteenth century the Spanish Government, feeling the need for more accurate information regarding the extent of its dominions in the New World, demanded by the royal decree of 1741 the submission by local authorities of detailed suveys of their administrative districts. Data thus obtained were summarized by Don José Antonio de Villaseñor y Sanchez, Auditor General of the Department of Quicksilver, who enjoyed a reputation as a "distinguished mathematician, accurate historian, and a good citizen" (Bancroft, 1883–86, v. 3, p. 510). The entire undertaking resulted in the map issued in 1746 under the title, "Icomismo hidroterro ó Mapa Geographico de la America Septentrional" (original in Arch. Gen. de Indias, Seville; copy in Library of Congress). In the same year the Spanish Government detailed Fernando Consag to explore the upper part of the Gulf coast. A reproduction of his map is given by Bancroft (1883–86, v. 1, p. 463).

Jacques Nicolas Bellin, an engineer of the French navy, was probably the most outstanding cartographer of the second half of the eighteenth century. In carrying out official orders of the French Government he made a detailed survey of the coast of Louisiana and of the course of the Mississippi River, drew a plan of Pensacola Bay (1742), published marine atlases and many maps (Bellin 1749, 1755, 1764). His map of the Gulf of Mexico and of the islands of America, issued in 1754 and published in volume 12 of Prévost's Histoire générale des voyages (1746–89, pp. 8–9), illustrates the state of geographical knowledge of that time. One can see from this map (fig. 6) that the configuration of the Gulf, especially along its west coast, is still incorrect, and the shape of the Florida Peninsula is far from being true. In this respect, as well as in the manner of drawing and the angularity of the coastal line, Bellin's map resembles the one prepared by his predecessor, Royal Cartographer D'Anville, in 1731 (fig. 7). Although the outlines of Florida are almost identical in the two maps, it is interesting to note that Bellin does not show such a fantastic array of bays and sounds as are indicated in the southernmost part of Florida by D'Anville.

One of the most notable documents of the second half of the eighteenth century is a map of the British and French dominions in North America published in London by John Mitchell in 1775 in accordance with the Act of Parliament (Mitchell 1755, 1757). The original of one of the earlier issues, identified by only one insert (Hudson Bay) instead of four in the later editions, can be found in the library of Harvard University. A copy of a French edition of 1756 is in the Library of Congress.

Mitchell's map was first used by American and British diplomats at the Paris peace conference of 1782–83 after the surrender of Cornwallis at Yorktown. Since that time it had been referred to and quoted as an authentic document in many boundary disputes between the United States and European countries.

The Harvard University copy has an interesting quotation from John Adams attached to the map which reads as follows: "We had before us . . . a variety of maps but it was the Mitchell's map upon which was marked out the whole boundary lines of the United States." The map shows only a small section of the northern part of the Gulf of Mexico between longitudes 83°4′ and 97° W. and latitudes 28°20′ and 30°20′ N. Tampa Bay is still called Baia del Espiritu Santo, and there are interesting notations regarding the depth of the water "20 feet water over the Bar of Pensacola the Chief Harbour hereabout" and the depth of "Y^{e} Missisipi" stated to be "18 feet water into Balise, 12 feet over the Bar, 45 feet within, 50, 60, and 100 afterwards."

In 1764–71 George Gauld ordered by the British Admiralty to make a survey of the coast of the provinces of West Florida and Louisiana, produced a map known as "Admiralty Chart." He also gave accounts of his surveys of Florida and sailing directions in the West Indies and Florida Keys (Gauld 1790, 1796). Several editions of Gauld's maps were issued in the United

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FIGURE 6.—French chart of the Gulf of Mexico and of the islands of America by Bellin, 1754.

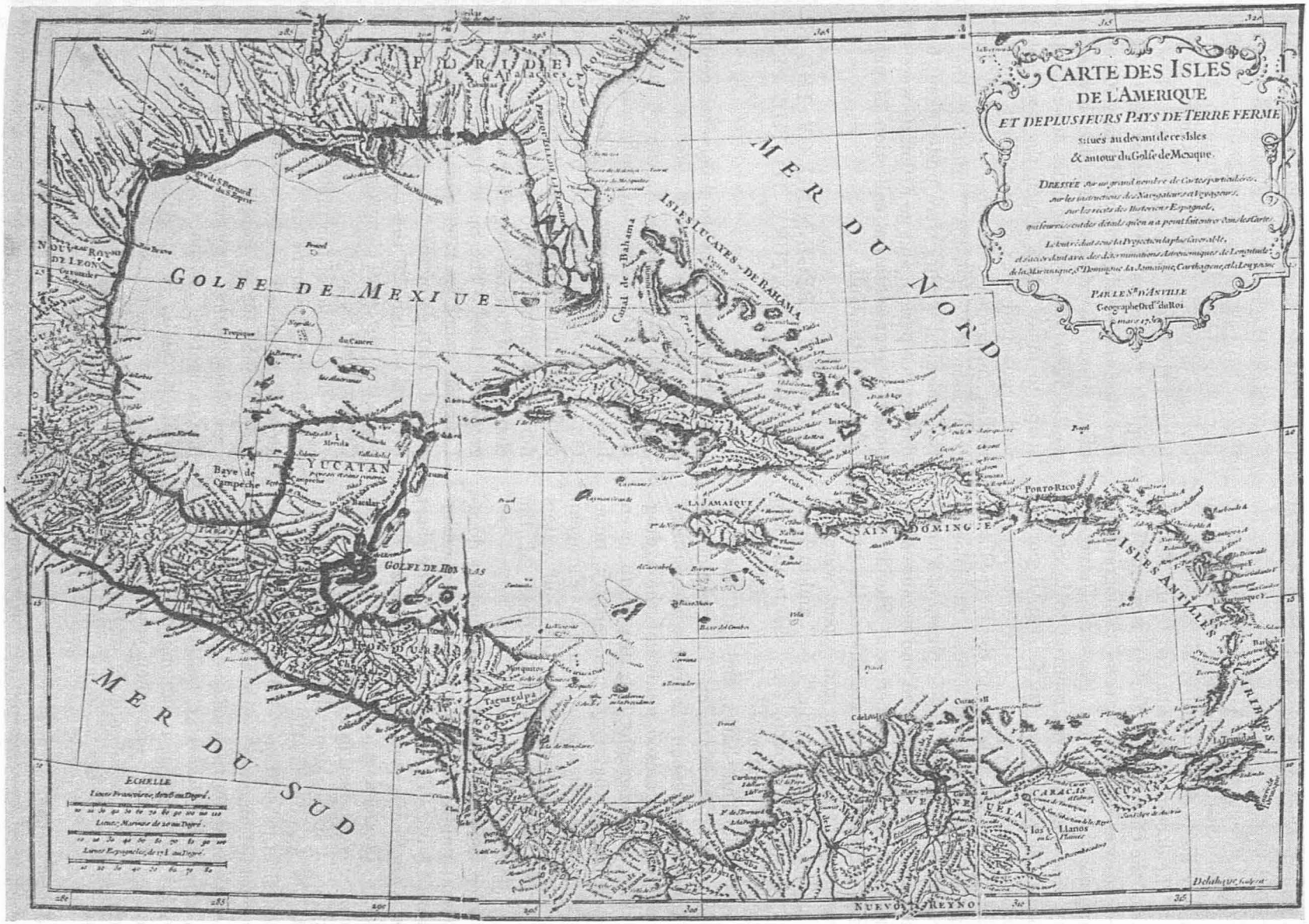

FIGURE 7.—French chart of the islands of America and adjacent countries by D'Anville, 1731.

States and in England and can be found in the Library of Congress.

In 1774 Captain Bernard Romans published a chart of the coast of East and West Florida to accompany his book on natural history (Romans 1776). The document is dedicated to the Marine Society of the City of New York; it is so rare that its existence was doubted by some bibliographers. The original is now in the Harvard University Library, and the map was referred to in Senate Document, 30th Congress, 1st Session, Report of Committee No. 242, August 12, 1848, to accompany Bill S. No. 338, relating to the Ever Glades. Romans' observations are of interest to biologists on account of the list of higher plants of Florida collected and identified by him and because of his remarks concerning the fisheries of Florida and Georgia. According to his statement, the principal fishes caught for trade and export were red drum (called in East Florida "bass" and in West Florida "carp"), pompano, sole, sea trout, and mullet. Oil was extracted from the livers of "nurses" (sic) and sharks, and glue was made from sea trout by drying them. The product was, using Romans' expression, "a perfect ichtyocalla."

Although no organized studies of the hydrography and oceanography of the Gulf were conducted during the eighteenth century, information received by the admiralties of the European countries from captains sailing the Gulf waters provided material for the corrections of the existing maps.

An interesting translation of a Spanish document was published about 1740 in London (Carranza 1740). The manuscript and the chart of the West Indies were given Carranza by a prisoner in Havana as a token of friendship. The book contains interesting data on tidal currents, description of shoals along the coasts of Yucatán and Florida, and depicts the channels that should be followed in navigation. Chapter 5 deals, in a rather detailed manner, with the currents and gives information on the variation of the compass which, as stated in the text, "is easterly, that is to say, in that part of it, among the shoals of Campeche it is 3°20′, and when you are out of soundings, 4°30′; in the middle of the bay 5½° to 6° and on the coast of La Vera Cruz, it amounts to 7°."

Incidental biological observations were occasionally reported by seafaring captains. Captain Uring (1726, new ed., 1928) mentions, for instance, many sea turtles his crew found on the shore when his ship was aground in Campeche Bay. He states that from June to August they lay eggs of which he counted as many as 150 in a litter. He found, also, in the same bay a large herd of "sea cows, or manatees, from 12 to 14 feet long and weighing from 800 to 1,000 pounds," about which he writes, "the flesh of it was as white as the finest veal. Their hides are cut into small strips to make whips which the poor slaves are well acquainted with all over West Indies." He makes numerous references to sand flies and troublesome "muchetos" infesting the woods. No biological studies were undertaken, however, during this period, and no attempts were made to obtain a representative collection of plants and animals of the Gulf.

FROM THE BEGINNING OF THE NINETEENTH CENTURY TO THE PRESENT TIME

At the beginning of the nineteenth century the geographical knowledge of the Gulf of Mexico made marked progress. As can be judged from the charts of that period the configuration of shoreline including the coasts of Florida and the Yucatán Peninsula appeared to be almost correctly outlined; many shoals and banks were shown with numerous soundings and notations regarding the character of bottom together with other hydrographical data. The Spanish map of Don Juan Langára, issued in 1799 and revised in 1805, is a good example of the best type of cartographic material available at this time (issues of this map are in the Library of Congress and in the American Geographical Society).

By the middle of the nineteenth century gross inaccuracies apparent in the older issues were almost eliminated as can be seen by examining Laurie's map (fig. 8) published in 1856 in London or a chart which appeared in a French manual for navigation in the Caribbean Sea and the Gulf (Kerhallet 1853). The latter map shows a general picture of the movement of surface waters, depicts the ingress of the Antillean Current, and indicates the existence of a large eddy in the central part of the Gulf (fig. 9).

In the United States the act of Congress of February 10, 1807, inaugurated a new era of ma-

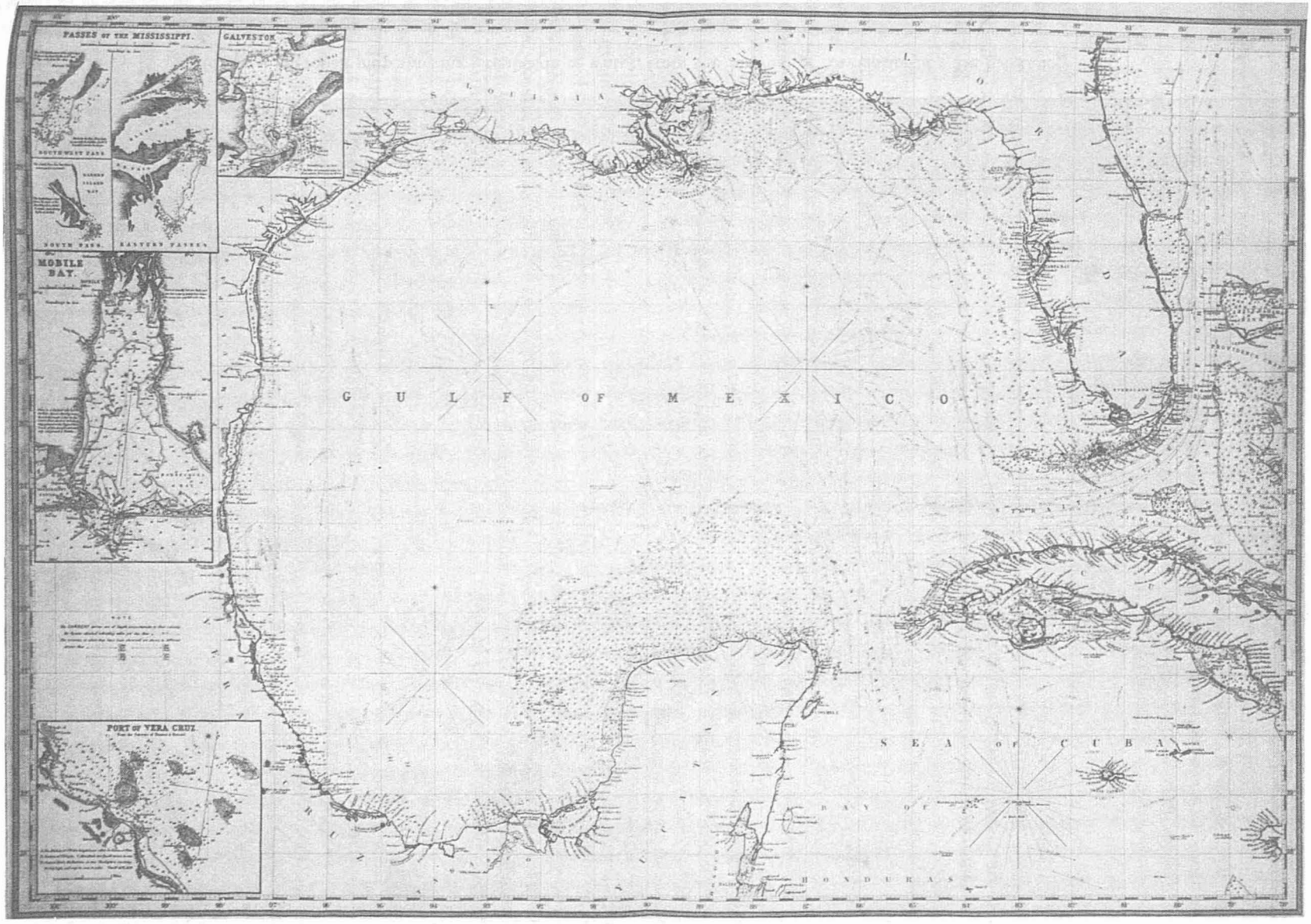

FIGURE 8.—English map of the Gulf of Mexico by Laurie, 1856.

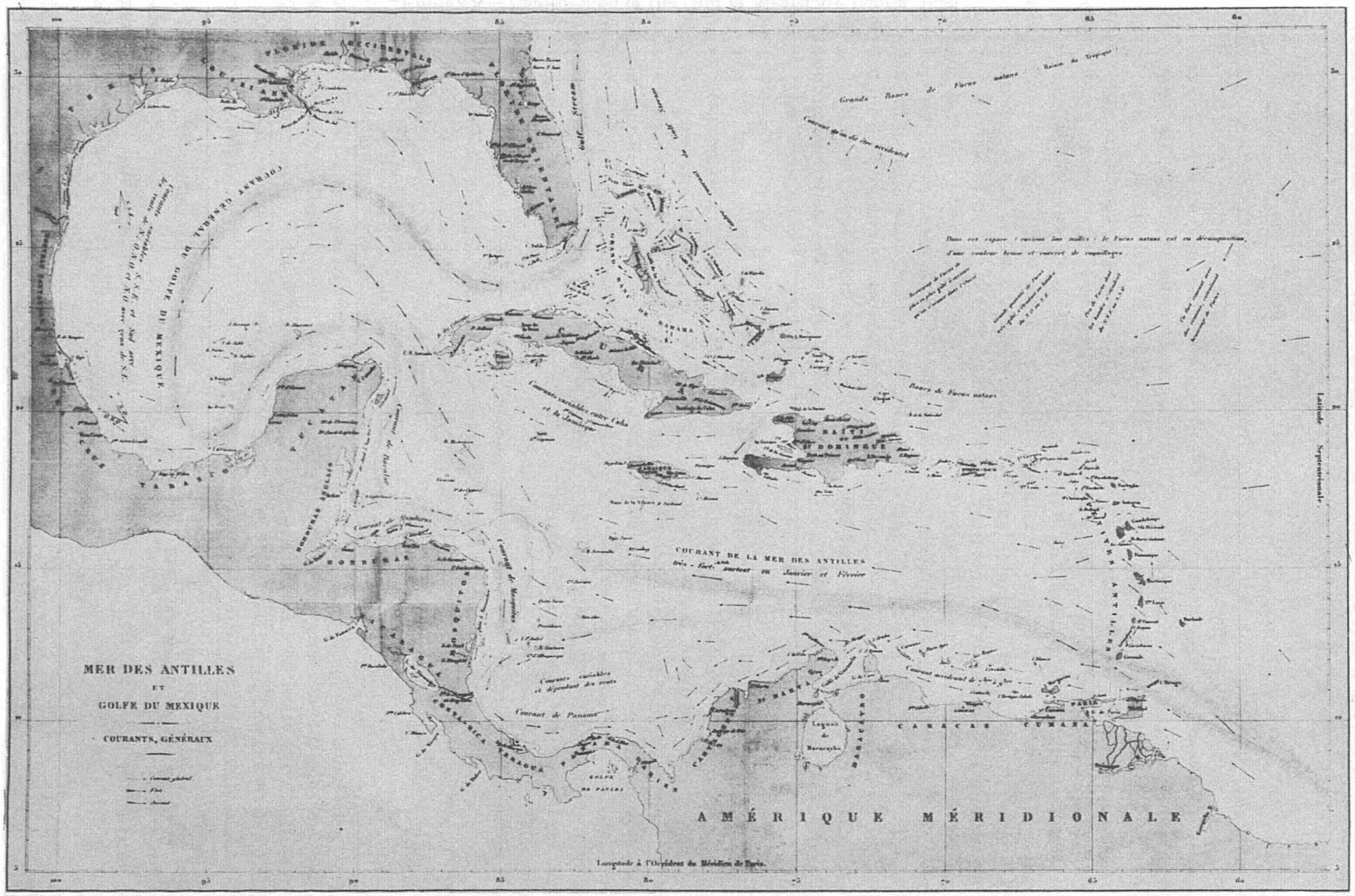

FIGURE 9.—French map showing circulation of water, from the Manual of Navigation, by De Kerhallet, 1853.

rine explorations by authorizing the President to "cause a survey of the coast of the United States and to employ proper persons in accomplishing the purpose prescribed in the act," for which a sum not exceeding $50,000 was appropriated. From 1816 to 1843 the reports of the Superintendent of the United States Coast Survey, made in compliance with this act, contained no references to the work in the Gulf of Mexico. Some explorations in the Gulf were conducted, however, by the United States Navy. In 1839 the U. S. S. *Vandalia*, under the command of Uriah B. Levy, was engaged, from February 4 to August 3, in the hydrographic exploration between Galveston and the southwestern pass of the Mississippi River.[3]

The reconnaissance survey of the Gulf coast was commenced by the United States Coast Survey in January 1845 (Report of the Superintendent for the year ending November 1846), and since that time the work of the organization, renamed in 1878 United States Coast and Geodetic Survey, is being continued at the present time. A large number of hydrographic and topographic charts issued during this time show the high degree of perfection achieved by this agency during more than a century of continuous work. The years of different surveys made in various sections of the Gulf can be found in the Hydrographic Index Charts, Nos. 80–91, and Topographic Index Charts, Nos. 20–32, issued by the United States Coast and Geodetic Survey.

The main features of the Gulf—the configuration of its bottom and the circulation of water and its emergence as the Gulf Stream—were the objects of many investigations. The exploration of the Gulf Stream was commenced in 1844 by Davis (Report of the Superintendent, U. S. Coast Survey, year ending November 1846) and was continued by Bache in 1846, who inaugurated a series of deep-sea investigations of the physical problems connected with the Gulf Stream (Bache 1852, 1859). This work was expanded by his successors in the United States Coast Survey, Benjamin Price, Carlile P. Patterson, and Julius E. Hilgard. The results of the Gulf Stream explorations, including observations of distribution of water temperatures in the Florida Channel and Straits, were discussed by Bache in several articles (Bache 1854, 1860).

In 1850, at the request of the United States Coast Survey, Professor Louis Agassiz undertook an extended biological survey of Florida reefs and obtained valuable information concerning the topography of Florida, the mode of formation of reefs by cementation, and the origin of the Florida Keys (L. Agassiz 1880).

Occasional references to bottom animals of the Gulf are found in French publications of Folin and Perier (1867–72), in which are described several new species of mollusks and ostracods from the bottom deposits collected near Veracruz and in Laguna de Términos.

Maury's (1858) classical book on the physical geography of the sea contains no specific reference to the Gulf of Mexico except a brief note concerning the corrosive action of Gulf waters, which were observed to be more destructive to copper sheeting of ships than the water from any other part of the world.

Systematic deep-sea explorations carried out in 1867 and 1868 by Pourtalès and Mitchel on the United States Coast Survey ships *Corwin* and *Bibb* consisted in dredging between Florida and Cuba, at some places at a depth of 850 fathoms. Many new types discovered in these collections and the finding of species of corals and echinoderms which were considered related to an antique fauna of the Cretaceous period, proved that a study of bottom organisms thriving along the course of the Gulf Stream is of great scientific interest (Pourtalès 1867; L. Agassiz 1852; A. Agassiz 1888, v. 1, p. 49; Peirce and Patterson 1881).

Explorations along the west coast of Florida undertaken in 1872 by Commander Howell were continued in 1875–78 in other parts of the Gulf under the direction of Lieutenant Commander Sigsbee aboard the United States Coast Survey steamer *Blake*. In the following years the operations were extended, under the command of Commander Bartlett, through the Caribbean Sea and the Straits of Florida. Alexander Agassiz, in charge of dredging operations of the *Blake* expedition, made a geological study of Florida reefs which had already attracted the attention of his father, Louis Agassiz, Le Conte, and Hunt (A. Agassiz 1888, v. 1, pp. 52–92).[4]

[3] Copy of the chart of the cruise of the *Vandalia* is in the Library of the American Geographical Society of New York.

[4] The geology of the Gulf of Mexico is discussed in an article by S. A. Lynch in this book, pp. 67–86.

Three cruises of the *Blake*, from 1877 to 1880, represent an outstanding event in the history of scientific explorations of the Gulf of Mexico. The expeditions obtained a wealth of information regarding the oceanography and biology of the Gulf, and the two volumes describing the work of the *Blake* written by A. Agassiz (1888) until the present day remain an important source of reference concerning the bottom fauna, the structure and origin of coral reefs, and the distribution of invertebrates and fishes at depths extending to 2,000 fathoms.

Collections obtained by the *Blake* served as material for many important publications on corals, antipatharians, crinoids, and Crustacea (Pourtalès 1870, 1880); echinoderms (A. Agassiz 1863, 1869, 1878, 1883); hydroids (Clarke 1879); annelids (Ehlers 1879); mollusks (Dall 1880, 1886, 1889), and many others. Numerous papers dealing with various taxonomic groups gathered by the expeditions can be found in the first 19 volumes of the Bulletin of the Museum of Comparative Zoology at Harvard College. A discussion of the deep-water fauna of the Gulf Stream was given by Pourtalès (1863–69).

The establishment, in 1871, of the United States Commission of Fish and Fisheries marked the beginning of the study of the important coastal and marine fisheries of the Gulf. With the building of the 1,000-ton steamer *Albatross* in 1883, the first Commissioner of Fisheries, Spencer F. Baird, initiated worldwide explorations of the sea fisheries. At the time of her completion, the *Albatross* was the best equipped dredger for deep-sea work in existence. One of her first details was to explore the bottoms of the Gulf of Mexico. The instructions given in 1883 by Spencer F. Baird to the commanding officer, Lieutenant Commander Z. L. Tanner, read in part as follows: "In returning (from the Caribbean) by way of Cape San Antonio it will be well to make a run into the Gulf of Mexico and spend a short time in making soundings and dredging therein, for the purpose of obtaining a general idea of the natural history and the fisheries of the Gulf, preliminary to a more lengthened visit to be made hereafter" (Tanner 1886). The instructions specified that in addition to the purely physical work, soundings, temperature, and observation of currents, the *Albatross* should secure "a fair representation of the shore fauna of the Caribbean Sea and its surroundings including shallow water, to collect parasites of the larger fish, birds, reptiles, freshwater fish, and the various species of mammals as well as to obtain aboriginal relics in the way of articles of stone, pottery, etc." Large collections made by the *Albatross* and deposited in the Smithsonian Institution testify that the instructions were faithfully carried out.

During the first visit to the Gulf in 1884 the *Albatross* explored the bottoms around the western tip of Cuba (fig. 10, open squares) but returning in the following year made more detailed explorations around Cozumel Island, along the eastern edge of Campeche Bank, on red-snapper banks off Cape San Blas in the northeastern part of the Gulf, and occupied a few stations along the west coast of Florida and at Key West (fig. 10, black double circles).

A brief but interesting account of the history of the *Albatross* is given by Hedgpeth (1945, 1947).

Simultaneously with the oceanographical studies the United States Fish Commission conducted an exploration of the fishery resources of the Gulf of Mexico. Accounts of this work with reference to red snappers, shore seine fishery, oysters, and sponges are given by Stearns (1884, 1887), Collins (1887), and Stearns and Jordan (1887).

In 1880 the United States Commission of Fish and Fisheries built a steamer, *Fish Hawk*, for the purpose of assisting in fish-hatching operations and conducting surveys of fishing grounds. From November 1895 to 1896, under the command of Lieutenant Franklin Swift, the *Fish Hawk* surveyed oyster regions of St. Vincent Sound, Apalachicola Bay, and St. George Sound, Fla. (Swift, 1897), the work which 20 years later was repeated with the same ship by Danglade (1917). In 1898 the *Fish Hawk* was used by the United States Coast and Geodetic Survey in hydrographic investigations of the inshore waters of Alabama. In 1901 and 1902 the ship was engaged in sponge investigations along the west coast of Florida. The exploration in 1901 covered the grounds between Anclote Anchorage, St. Marks, and Tampa Bay. In the following year the operations extended along the western coast of Florida, to the depth of 10 fathoms, from Cedar Keys to Key West. In 1905 the *Fish Hawk* was detailed to survey the oyster bottoms and make hydrographic investigations in Matagorda Bay, Tex. (Moore 1907), in 1911 made a similar investiga-

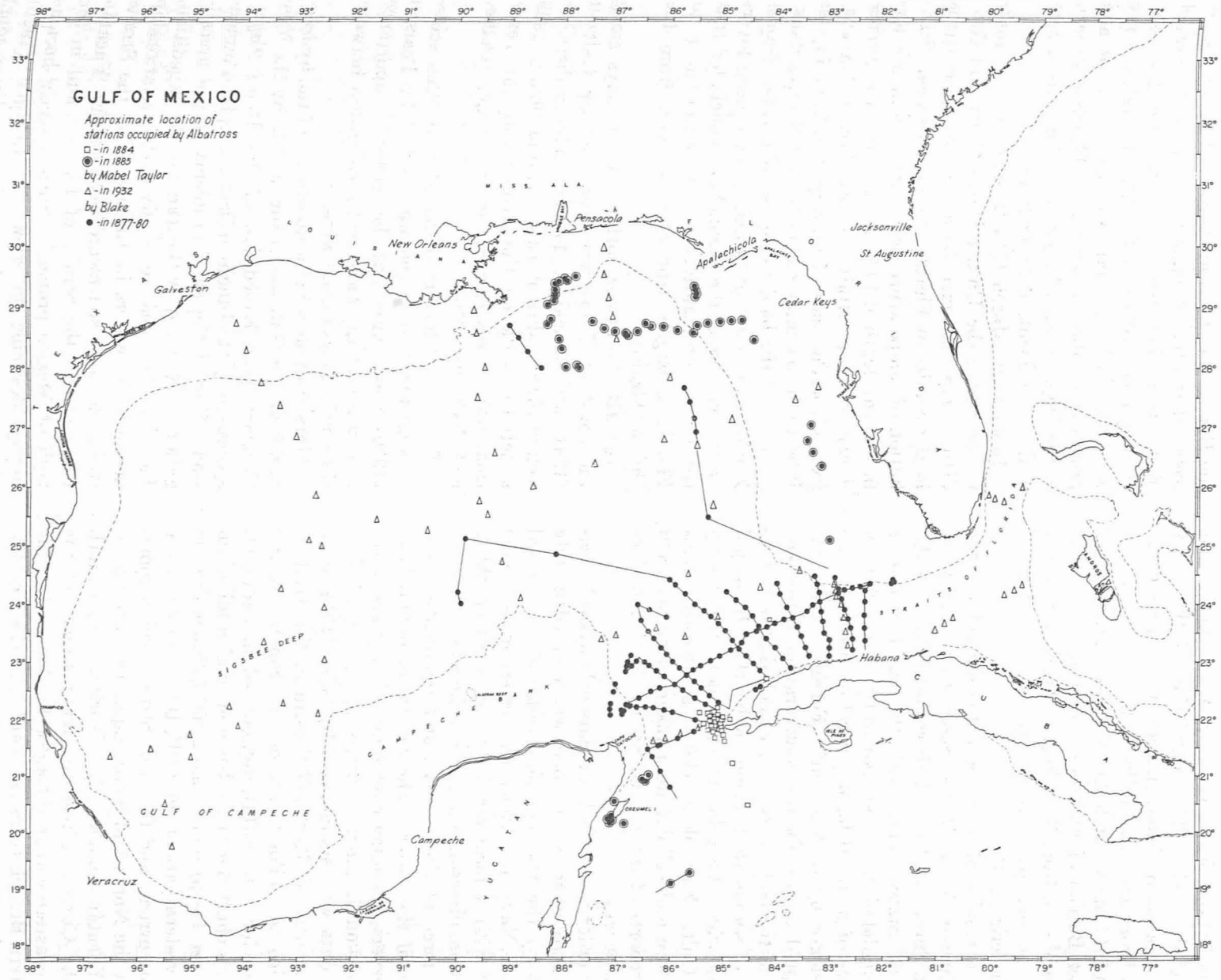

FIGURE 10.—Approximate location of stations occupied by the *Blake*, 1877–80, (black circles); the *Albatross*, 1884, (open squares), 1885, (black double circles); and the *Mabel Taylor*, 1932, (triangles).

tion in Mississippi Sound (Moore 1913a, 1913b), and in 1913 was used as the base for a survey of oyster bottoms in Lavaca Bay, Texas (Moore and Danglade 1915). The completion of the latter investigation by Moore marked the ending of the *Fish Hawk* activities in the Gulf.

In 1917 the research ship *Grampus* of the United States Bureau of Fisheries cruised over the continental shelf from Key West to Aransas Pass in a study of shrimp and fishery grounds (U. S. Bureau of Fisheries, 1919).

The results of systematic hydrographic work conducted by the United States Coast and Geodetic Survey and the Hydrographic Office of the United States Navy with the additional data accumulated by other explorations served as a source of material for a general discussion of the physiography of the Gulf. Forshey (1878) attempted to describe the configuration of the bottom of the Gulf, stressing particularly the deposition of sediments brought in by the Mississippi River which he believed eventually will fill up the Gulf. Lindenkohl (1896) summarized temperature and salinity data taken primarily from the reports of the United States Coast and Geodetic Survey.

In order to obtain basic data on physical oceanography of the Gulf a plan was adopted in July 1905 by the Hydrographic Office of the United States Navy to supply all vessels crossing the Gulf with a form for daily use in giving ship's position, direction and force of the wind, direction and force of the current, and temperature and color of the water. The reports of hundreds of observers extending over a period of years, when plotted on the monthly charts, agreed remarkably. The data were summarized by Soley (1914) on a chart entitled, The Gulf Stream in the Gulf of Mexico (see Pilot Chart of the North Atlantic Ocean for June 1914), reproduced in figure 11. Soley's chart shows the basin of tidal equilibrium (Sigsbee Deep) more than 2,000 fathoms deep in the western part of the Gulf, the direction of the main current, and the Gulf Stream which comes from the North and South Equatorial Current in the Yucatán Channel. The Northwestern Branch of the Current leaves the main stream at the northeastern corner of Campeche Bank, while the Eastern Branch turns eastward from the Yucatán Channel. The chart shows, also, the two countercurrents, the Cuban and the Western, and the position of the Central Sea, a circular body of dead water about 80 miles in diameter. From the time of the first publication of Soley's chart basic information given in it is being incorporated in monthly pilot charts regularly issued by the Hydrographic Office of the United States Navy with the additional data supplied by ships and provided by the United States Weather Bureau of the Department of Commerce (formerly a part of the U. S. Dept. of Agriculture).

In January–March 1914 Bigelow (1915), working on board the United States Coast and Geodetic Survey steamer *Bache*, made observations in the Straits of Florida studying vertical distribution of temperature and salinity from the surface to the depth of 1,800 meters along the profiles drawn across the Straits from Key West to Havana, from Cape Florida to Gun Bay, and from Jupiter Inlet to the northern end of Little Bahamas Bank. He noticed the banking up of cold water against Florida as a result of upwelling from deep layers on the left side of the channel and concluded that the cold, comparatively fresh water next to Florida is largely true abyssal water from the Gulf of Mexico.

In 1926 the oyster bottoms in the bays along the coast of Texas were surveyed by Galtsoff (1931) with special emphasis on salinity distribution in these bodies of water. From 1936 to 1939 a detailed work on the hydrography of Texas tidal waters was carried out by Collier (Collier and Hedgpeth 1950).

The natural history of redfish and other sciaenids on the Texas coast was studied by Pearson (1929) who pointed out the scientific importance in a study of the biological relationship between the Gulf and its inland waters.

Marked advance in the knowledge of the hydrography of the Gulf was made in 1932 by the Yale Oceanographic Expedition of the *Mabel Taylor* sponsored by the Bingham Oceanographic Foundation. One of the chief problems of the investigation, formulated by the leader of the expedition, Parr (1935), was to study "the relationship between the waters in the region of the Straits (*i. e.*, the area southward between the Yucatán Channel and the Straits of Florida) and in the Gulf of Mexico proper." Such a study became highly desirable in view of Nielsen's (1925) objections against the purely two-dimensional picture of surface movements of water in the Gulf

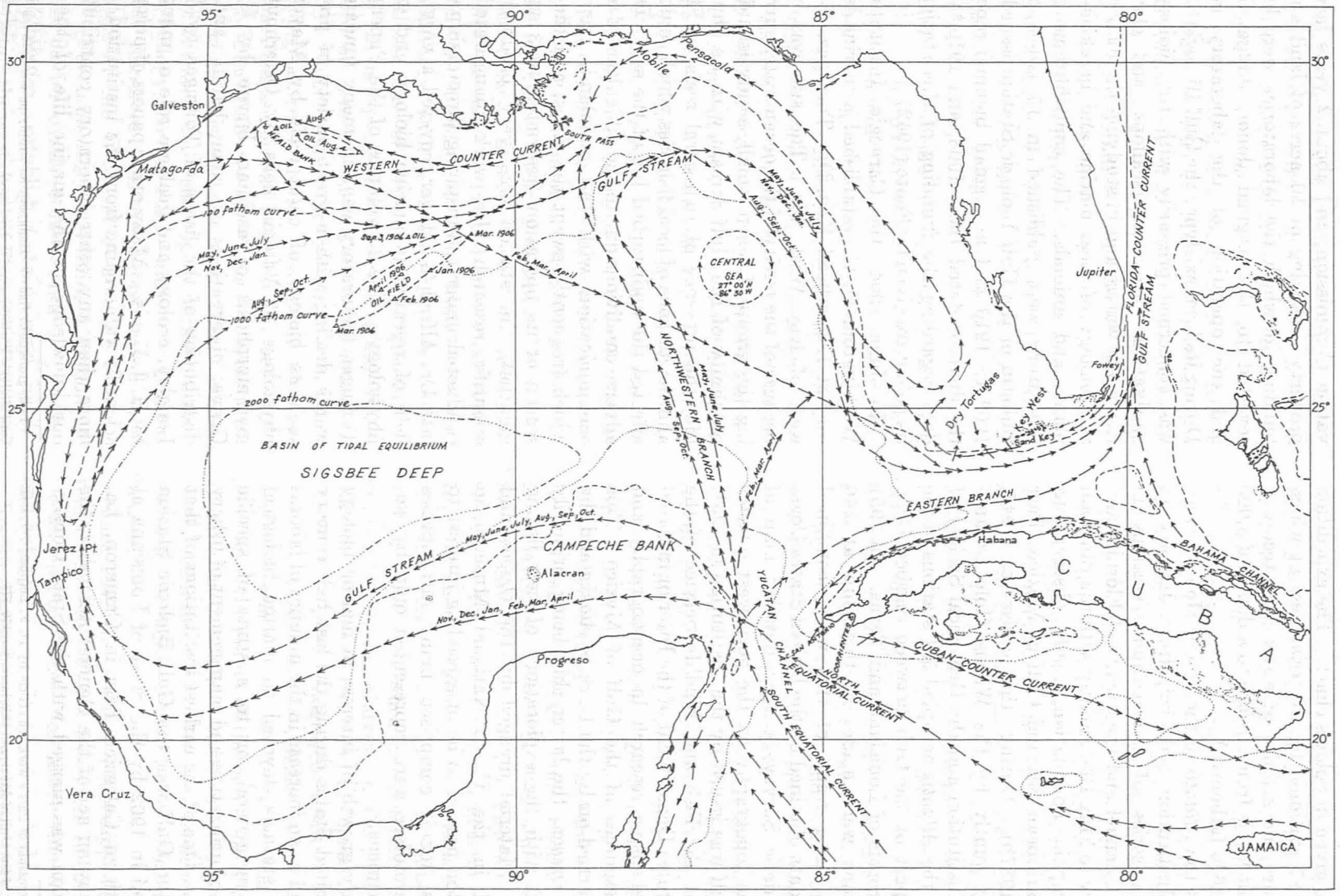

FIGURE 11.—Gulf Stream in the Gulf of Mexico shown by Soley's chart, 1914. The currents as they exist during the different seasons.

of Mexico given in Soley's chart. The expedition occupied 87 stations (fig. 10, triangles) at which temperature and salinity of water were recorded at different levels from surface to a depth of 3,000 meters (1,640 fathoms).[5]

In 1934 the *Atlantis* of the Woods Hole Oceanographic Institution occupied, from January to March, a series of hydrographic stations in Yucatán Channel and the Straits of Florida, and in January to May 1937, jointly with the Bingham Oceanographic Foundation, made observations in the Caribbean Sea and Gulf of Mexico (Parr 1937a, 1937b). During the cruise of 1947, sponsored jointly by the Woods Hole Oceanographic Institution and the Geological Society of America, the *Atlantis* occupied 551 stations in the western part of the Gulf between Sigsbee Deep and the coasts of Louisiana and Texas. In 1951 observations were made by this ship at 240 stations. As a result of this work, combined with the data obtained by the United States Coast and Geodetic Survey, a very detailed map of submarine topography on the northwest quarter of the Gulf was issued by the Institution in 1951.

In 1951 the Fish and Wildlife Service of the United States Department of the Interior initiated a comprehensive research in oceanography and fishery resources of the Gulf of Mexico. This work is carried on by the U. S. S. *Alaska* and the U. S. S. *Oregon*, the latter ship being primarily concerned with the explorations of new fishing grounds. Material dredged by the *Oregon* and deposited in the U. S. National Museum in Washington proved to be of exceeding interest to zoologists, for it comprised many rare species which heretofore were represented only by isolated specimens.

A steady growth of interest in marine biology in the United States during the last half century is reflected in an increase in the number of laboratories or stations devoted to marine biological research in general, or to a study of specific problems of utilization and management of fishery resources. One of the earliest institutions of that type in the Gulf was the Gulf Biologic Station established in 1902 by the State of Louisiana at the mouth of Calcasieu Pass in Cameron, La. In 1910, by an act of the General Assembly, the Gulf station was merged with the State Conservation Commission, and about 2 years later the property consisting of 10 acres of land and the building in which the laboratories were located reverted to the original donor, Judge Henry, and the operation of the laboratory ceased. During its brief existence the Gulf Biologic Station was concerned primarily with the biology and cultivation of oysters, scallops, and clams in Louisiana waters and in studying the distribution and biology of local marine and brackish-water plants and animals. The contributions of the laboratory were published in 15 issues of the Bulletin of the Gulf Biologic Station issued from 1902 to 1910 and in 3 small biennial reports of the director dated 1906, 1908, and 1910.[6] Brief data regarding the founding of this station and its policy are given by Foote (1942).

In June 1904, the Carnegie Institution of Washington, D. C., established a marine laboratory at Loggerhead Key, Dry Tortugas, 68 miles west of Key West, Fla. The site was chosen because of the purity of the ocean water surrounding the group of seven, small, sandy islands, the proximity of the Gulf Stream with its abundant life, the presence of rich coral reefs in Florida, and the absence of local fisheries which could have affected the undisturbed life of the sea. Despite adverse conditions due to the difficulties of regular communication with the mainland, hurricanes which frequently swept the Keys, and the short season of its operation (restricted to 3 summer months), the station was very productive in scientific research. Its work inaugurated and conducted under the inspiring directorship of the late Dr. Alfred G. Mayer, covered a very broad field of research in marine biology and general physiology. The 33 volumes of the Papers from Tortugas Laboratory contain many fundamental works dealing with a great variety of problems such as biology of coral reefs by Mayer, the physiology of Valonia cells by Osterhout, the metamorphosis of ascidian larvae by Caswell Grave, observations on color, habits, and local distribution of the fishes of Tortugas by W. H. Longley, ecology and geologic role of mangroves by H. J. Davis. Many other papers of permanent scientific value came from the institution, which more than any other laboratory contributed to our knowledge of the marine life of the Gulf.

[5] For the discussion of Parr's work see article by D. F. Leipper, Physical Oceanography of the Gulf of Mexico in this book, pp. 119-137.

[6] I am grateful to Joel W. Hedgpeth for supplying the data regarding the Gulf Biologic Station.

American scientists interested in marine research were grieved to learn from the report of the director of the Carnegie Institution for 1939 of the discontinuance of the laboratory due to the "relatively high cost of its maintenance." At the time of this action the Laboratory was receiving a modest annual grant of $12,000 which constituted about 0.8 percent of the total budget of the Carnegie Institution of Washington for that year.

Brief mention should be made of the attempt of the United States Bureau of Fisheries to establish a fishery laboratory at Key West in 1917. Owing to the lack of funds for salaries and equipment the station never became functional and was abandoned in 1928.

A small laboratory is maintained by Louisiana State University on Grand Isle. The laboratory is used every summer from June to July for teaching. Despite modest equipment and lack of modern research facilities a number of valuable scientific papers resulted from its operations which have enhanced our knowledge of the Gulf fauna.

From 1935 to 1937 the United States Bureau of Fisheries maintained a temporary laboratory at Indian Pass in Apalachicola Bay, Florida, for the purpose of studying the biology of the oyster leech (*Stylochus inimicus*) and other enemies of the oyster. Upon completion of this work (Pearse and Wharton 1938) the laboratory was abandoned in 1937 and the equipment transferred to the fisheries laboratory near Pensacola, Fla. The latter laboratory, established in 1937 primarily for shellfish research, is located on a small island in Santa Rosa Sound about 7 miles from Pensacola. The laboratory, with several auxiliary buildings, occupies the site of the abandoned quarantine station. It is equipped with running sea water and outdoor cement tanks for experiments on shellfish. The current work consists in ecological and biological research on oysters in Florida, Alabama, Mississippi, and Louisiana waters.

The Marine Laboratory of the University of Miami was established in 1942 at Coral Gables, Fla., for research and teaching in oceanography, marine biology, conservation, and management of fishery resources. Its operations extend over the waters of the West Indies and the Gulf of Mexico. The laboratory maintains a station at Apalachicola for oyster studies and, as circumstances require, establishes temporary headquarters along the west coast of Florida. Principal research projects, some of which are sponsored by the United States Navy, deal with the circulation of water in the Gulf (Smith, et al., 1951), seasonal changes in the composition of plankton of Biscayne Bay and adjacent oceanic waters, red tide, sponge disease and sponge culture, physiology of fouling organisms, and many others. Several of the articles by the members of the laboratory staff appeared in the newly established Bulletin of Marine Science of the Gulf and Caribbean and in the Proceedings of the Gulf and Caribbean Fisheries Institute founded by the laboratory. The Gulf and Caribbean Fisheries Institute represents an effort to integrate the work of oceanographers, biologists, economists, fishermen, and administrators. It seems appropriate to point out here that the idea of preparing a digest of the existing literature on the biology and oceanography of the Gulf of Mexico originated at the Second Annual Session of the Institute and has materialized through the efforts of several members of this organization (Walford 1950).

Several other institutions devoted primarily to the study of Gulf problems, were established in recent years. The Institute of Marine Science of the University of Texas in Port Aransas was founded in 1948 with a grant from the General Education Board and with funds provided by the Texas Agricultural and Mechanical Research Foundation. The Texas Game, Fish, and Oyster Commission established, in 1949, a marine laboratory at Rockport, Tex. The Fish and Wildlife Service of the United States Department of the Interior has maintained, since 1949, a temporary laboratory for red-tide studies at Sarasota, Fla., and in 1950 established headquarters with laboratory facilities at Galveston, Tex., for the conduct of oceanographical and biological studies of the Gulf. The Oceanographic Institute of Florida State University was established in 1949 with two seaside stations, one at Alligator Harbor and another at the mouth of the St. Johns River about 12 miles east of Jacksonville at Mayport, Fla., on the Atlantic coast. Research facilities of these stations, engaged primarily in teaching, are limited.

Since 1947 the State of Mississippi has maintained the Gulf Coast Research Laboratory at Ocean Springs, Miss., for instruction in zoology and botany.

Recent oil-development activities in the coastal

area of the Gulf provided an opportunity to make continuous observations from fixed platforms erected several miles off shore. Analyzing these records, Geyer (1950) discovered that the salinity of water of the Louisiana coast at a distance from 5 to 6 miles from the shore undergoes seasonal variations ranging from 15 to 35 parts per thousand at 10 feet below the surface. Extensive investigations of the hydrography of the inshore waters and the effect of crude oil and brine on aquatic life have been recently sponsored by the oil companies. Unfortunately, the results of these studies are not available to the public.

The outlook for scientific investigations of Gulf problems appears to be bright. There are at present many laboratory and field facilities available at various scientific institutions located along the Gulf coast. Furthermore, Federal and State organizations show great interest in the research problems and are in a position to conduct or sponsor various oceanographic and biological projects. It is therefore reasonable to expect that the progress in our knowledge of the Gulf of Mexico will be rapid and productive.

BIBLIOGRAPHY

AGASSIZ, ALEXANDER.

1863–69. Preliminary report on the echini and starfishes dredged in deep water between Cuba and the Florida Reef by L. F. de Pourtalès. Bull. Mus. Comp. Zool. Harvard Coll. 1: 253–308.

1878. II. Report on the echini by A. Agassiz, crinoids and corals by L. F. de Pourtalès, and ophiurans by Theodore Lyman preceded by a bibliographical notice of the publications relating to the deep-sea investigations carried out by the U. S. Coast Survey. In: Reports on the results of dredging . . . Bull. Mus. Comp. Zool. Harvard Coll. 5 (9): 181–252, 10 pls.

1883. I. Report on the echini. In: Reports on the results of dredging . . . by the U. S. Coast Survey Steamer *Blake*. Mem. Mus. Comp. Zool. Harvard Coll. 10: 94 pp., 32 pls.

1888. A contribution to American thalassography. Three cruises of the United States Coast and Geodetic Survey steamer *Blake* . . . from 1877 to 1880. Houghton, Mifflin and Co. and Bull. Mus. Comp. Zool. Harvard Coll., vol. 14 and 15.

AGASSIZ, LOUIS.

1852. Extracts from the report of Professor Agassiz to the Superintendent of the Coast Survey on the examination of the Florida reefs, keys, and coast. In: Report of the Superintendent of the Coast Survey . . . ending November 1851. 32d Cong., 1st Sess., Senate, Ex. Doc. No. 3, pp. 145–160. Washington.

1880. Report on the Florida reefs. Mem. Mus. Comp. Zool. Harvard Coll. 7 (1): 61 pp., 23 pls.

BACHE, A. D.

1852. Annual report of the Superintendent of the Coast Survey showing the progress of that work during the year ending November 1851. 32d Cong., 1st Sess., Ex. Doc. No. 26, 559 pp. Washington.

1854. Notes on the Gulf Stream. Reprinted from Blunt's American Coast Pilot, 1854, pp. 47–53, fold. chart, 5 curves. 17th edition.

1860. . . . Gulf Stream explorations. Third memoir. Distribution of temperature in the water of the Florida Channel and Straits. Am. Jour. Sci. and Arts, 29: 7 pp., March.

BANCROFT, HUBERT HOWE.

1883–89a. History of Mexico, 1516–1887. Vols. 1–4. The History Co., San Francisco.

1883–89b. North Mexican States. Vol. 1. A. L. Bancroft & Co., San Francisco.

BELLIN, JACQUES NICOLAS.

1749. Observations sur la carte du golphe du Mexique, et des isles de l'Amerique, dressées au dépôt des cartes, plans, et journaux de la marine, en 1749. 17 pp. Paris.

1755. Remarques sur la carte de l'Amerique Septentrionale, comprise entre le 28e et le 72e dégré de latitude, avec une description géographique de ces parties. Paris.

1764. Le petit atlas maritime; recueil de cartes et plans des quatre parties du monde. 5 vols. Paris.

BIGELOW, HENRY B.

1915. Explorations of the United States Coast and Geodetic Survey steamer *Bache* in the western Atlantic, January–March 1914, under the direction of the United States Bureau of Fisheries.—Oceanography. Rep. U. S. Comm. Fish. 1915, App. 5, 62 pp., 53 text figs., 1 chart. (Doc. 833, issued May 9, 1917).

BREMER, LAVILLE.

1940. Amichel. A narrative history of the Gulf coast. Gulf coast history and guide. Book one. To the closing of the French period. (Lithographed at the plant of the Photo-Lith Co., New Orleans.) 93 pp., illus., 6 maps.

BRITISH MUSEUM.

1884. Catalogue of maps: Accessions. W. Clowes and Sons, London.

1885. Catalogue of the printed maps, plans, and charts in the British Museum. 2 vols. London.

BROWER, J. W.

1893. The Mississippi River and its source. Minnesota Hist. Coll., vol. 7, 360 pp.

BRY, THEODORE DE.

1591. Brevis narratio eorumquas in Florida Americae Provincia Gallis acciderunt. Frankfurt a. Main.

CARRANZA, GONZALES DOMINGO.

1740. A geographical description of the coasts, harbours, and sea ports of the Spanish West Indies . . . London. (Printed for the editor, Caleb Smith, inventor of the new sea quadrant.)

CLARKE, S. F.
1879. Report on the Hydroida collected during the exploration of the Gulf Stream and the Gulf of Mexico by Alexander Agassiz, 1877–78. Bull. Mus. Comp. Zool. Harvard Coll. 5 (10): 239–252.

COLLIER, ALBERT, and JOEL HEDGPETH.
1950. An introduction to the hydrography of tidal waters of Texas. Pub. Inst. Mar. Sci. 1 (2): 125–194.

COLLINS, J. W.
1887. Report on the discovery and investigations of fishing grounds made by the Fish Commission steamer *Albatross* . . . with notes on the Gulf fisheries. U. S. Comm. Fish and Fisheries, Rept. of the Commissioner for 1885, App. B, 89 pp., 10 pls. Washington.

DALL, W. H.
1880. General conclusions from a preliminary examination of the mollusks. In: Reports on the results of dredging . . . by the U. S. Coast Survey steamer *Blake*. Bull. Mus. Comp. Zool. Harvard Coll. 6 (3): 85–92.
1886. Report on the Mollusca. Part I. Brachiopoda and Pelecypoda. In: Reports on the results of dredging . . . by the U. S. Coast Survey steamer *Blake*. Bull. Mus. Comp. Zool. Harvard Coll. 12: 171–318, 9 pls.
1889. Report on the Mollusca. Part II. Gastropoda and Scaphopoda. In: Reports on the results of dredging . . . by the U. S. Coast Survey steamer *Blake*. Bull. Mus. Comp. Zool. Harvard Coll. 18: 1–492, 40 pls.

DANGLADE, ERNEST.
1917. Condition and extent of the natural oyster beds and barren bottoms in the vicinity of Apalachicola, Fla. Rept. U. S. Comm. Fish., 1916, App. V, 68 pp., 5 pls., fold. map. Washington.

DUNN, WILLIAM EDWARD.
1917. Spanish and French rivalry in the Gulf region of the United States, 1678–1702; the beginnings of Texas and Pensacola. Univ. Texas Bull. 1705, 238 pp., 1 fold. map., Jan. 20. Austin, Tex.

EHLERS, ERNST.
1879. Preliminary report on the worms. In: Reports on the results of dredging . . . by the U. S. Coast Survey steamer *Blake*. Bull. Mus. Comp. Zool. Harvard Coll. 5 (12): 269–274.

FISKE, JOHN.
1892. The discovery of America, with some account of ancient America and the Spanish conquest. 2 vols., illus., 7 maps. Houghton, Mifflin and Co., Boston and New York.

FOLIN, L. DE, and L. PERIER.
1867–81. Les fonds de la mer. 4 vols. Bordeaux.

FOOTE, LUCY B.
1942. Bibliography of the official publications of Louisiana, 1803–1934. No. 19 of American Imprints Inventory, Hill Memorial Library, Louisiana State University.

FORSHEY, C. G.
1878. The physics of the Gulf of Mexico and its chief affluent, the Mississippi River. Salem. Proc. Am. Assoc. Advance. Sci., vol. 26, August 1877, Nashville meeting.

GALTSOFF, PAUL S.
1931. Survey of oyster bottoms in Texas. U. S. Bur. Fish., Investigational Rept. No. 6, 30 pp. Washington.
1952. Early explorations in the Gulf of Mexico. Proc. Gulf and Caribbean Institute, 4th Ann. Session: 129–134.

GARCILASO, DE LA VEGA, THE INCA.
1605. The Florida of the Inca. A history of the Adelantado, Hernando de Soto . . . Translated and edited by J. G. Varner and J. J. Varner, 1951. 655 pp. University of Texas Press, Austin.

GAULD, GEORGE.
1790. An account of the surveys of Florida . . . to accompany Mr. Gauld's charts. 27 pp., 1 map. London.
1796. Observations on the Florida Keys, Reef and Gulf . . . to accompany his charts. 28 pp. London.

GEYER, R. A.
1950. The occurrence of pronounced periodic salinity variations in Louisiana coastal waters. Jour. Mar. Res. 9: 100–110.

GREENHOW, ROBERT.
1849. Early discoveries of the Mississippi . . . DeBow, J. D. B., Ed. The Commercial Review of the South and West 7: 319–321. New Orleans.
1849. Second visit of the Spaniards to the mouth of the Mississippi. DeBow, J. D. B., Ed. The Commercial Review of the South and West 7: 321–322. New Orleans.

GULF BIOLOGIC STATION.
1902–10. Bulletin of the Gulf Biologic Station, Nos. 1–15. Louisiana.

HAKLUYT, RICHARD.
1850. Divers voyages touching the discovery of America and the islands adjacent. Collected and published by Richard Hakluyt . . . in the year 1582. Ed. with notes and an introduction, by John Winter Jones. Printed for the Hakluyt Society, 3 p. l, CXI, 171, 6 p. London.

HAKLUYT, RICHARD.
1907–13. The principal navigations, traffiques & discoveries of the English nation, made by sea or overland to remote & farthest distant quarters of the earth at any time within the compasse of these 1600 yeares. 8 vols. London, Dent.

HAKLUYT SOCIETY, THE.
1850. Divers voyages touching the discovery of America and the islands adjacent. Collected and published by Richard Hakluyt, edited with notes and an introduction by John Winter Jones. CXI. 171 pp, index 6 pp. London.
1847–1899. Works. Vols. 1–100. London.

HARRISSE, HENRY.
1895. Americus Vespuccius; a critical and documentary review of two recent English books concerning that navigator. 72 pp. B. F. Stevens, London.
1900. Decouverte et evolution cartographique de terr-neuve et des pays circonvoisins 1497–1501–1769. Essais de Geographie historique et documentaire. 420 pp. Henry Stevens, Son & Stiles, London. H. Welter, Editeur, Paris.

HEDGPETH, J. W.
1947. The steamer *Albatross*. Scientific Monthly 65: 17–22.

HEDGPETH, J. W., and W. L. SCHMITT.
1945. The United States Fish Commission steamer *Albatross*. Am. Neptune 5 (1): 5–26.

HERRERA Y TORDESILLAS, A. DE.
1601. Historia general de las hechos de las castillanos en las Islas y Tierra Firme del mar oceano.
1725–26. The general history of the vast continent and islands of America . . . Translated into English by Capt. John Stevens. 6 vols. Printed for J. Batley, London.
1728. Historia general de las Indias occidentalis . . . Nueva impression enriguecida con lindas figuras y retratos. Amberes, J. B. Verdussen. 4 vols., pls., fold. maps. Also 1720 edition in 5 vols. Madrid.

HULBERT, ARCHER BUTLER.
1904–8. The Crown collection of photographs of American maps, selected and edited by Archer Butler Hulbert. 5 vols. The A. H. Clark Company, Cleveland, Ohio.

HUMBOLDT, ALEXANDER VON.
1836–39. Examen critique de l'histoire de la géographie du nouveau continent, et des progrès de l'astronomie nautique aux 15^{me} et 16^{me} siècles. 5 vols., 4 fold. maps. Paris.

KERHALLET, CHARLES-PHILIPPE DE.
1853. Manuel de la navigation dans la Mer des Antilles et dans le Golfe du Mexique. 2 vols., 3 fold. maps. Paris.

KOHL, J. G.
1857. A descriptive catalogue of those maps, charts, and surveys relating to America, which are mentioned in vol. III of Hakluyt's great work. Washington.

KOHL, J. G.
1862. A popular history of the discovery of America from Columbus to Franklin. Trans. from the German by R. R. Noel, 2 vols. London.
1863. Aelteste Geschichte der Entdeckung und Erforschung des Golfs von Mexico und der ihn umgebenden Küsten durch die Spanier von 1492 bis 1543. Zeitschrift für Allgemeine Erdkunde. Vol. 15, pp. 1–40 and 169–194. Berlin.
1868. Geschichte des Golfstroms und seiner Erforschung von den Ältesten Zeiten bis auf den grossen Amerikanischen Bürgerkrieg; eine Monographie zur geschichte der Oceane und der geographischen Entecknungen. 224 pp. Bremen.
1885. History of discovery and exploration on the coasts of the United States. Report Supt. U. S. Coast and Geodetic Survey, 1884, App. 19, pp. 495–617. Washington.

LELEWEL, JOACHIM.
1852. Géographie du Moyen Age. Vol. 2, pp. 135–140. Bruxelles.

LE MOYNE, JACQUES.
1564. Narrative of Le Moyne, an artist who accompanied French expedition to Florida under Laudonnière. Translated from the Latin of de Bry, Boston, 1875, 15 pp. with 42 heliotypes of the engravings taken from the artist's original drawings.

LINDENKOHL, A.
1896. Resultate der Temperatur-und Dichtigkeitsbeobachtungen in den Gewässern des Golfstroms und des Golfs von Mexico. Durch das Bureau des U. S. Coast and Geod. Sur., Petermanns Geogr. Mitteilungen 42: 25–29, map.

LOWERY, WOODBURY.
1912. Descriptive list of maps of the Spanish possessions within the present limits of the United States, 1502–1820. Edited with notes by Philip Lee Phillips, F. R. G. S., Chief, Division of Maps and Charts. Library of Congress. The Lowery Collection. 567 pp. U. S. Govt. Printing Office, Washington.

MADRID, MUSEO NAVAL.
1945. Catálogo guia. 9th ed., 248 pp. Madrid.

MAURY, MATTHEW FONTAINE.
1858. The physical geography of the sea. XXIV, 25, 274 pp. incl. map, 3d ed. Harper & Bros., New York.

MITCHELL, JOHN.
1755. A map of the British and French dominions in North America. London.
1757. The contest in America between Great Britain and France . . . 260 pp. London.

MOORE, H. F.
1907. Survey of oyster bottoms in Matagorda Bay, Texas. U. S. Bur. Fish. Doc. 610, 86 pp., 13 pls., 1 map. Washington.

MOORE, H. F.
1913a. Condition and extent of the natural oyster beds and barren bottoms of Mississippi east of Biloxi. U. S. Bur. Fish. Doc. 774, pp. 1–41, 6 pls., 1 map.
1913b. Condition and extent of the natural oyster beds and barren bottoms of Mississippi Sound, Alabama. U. S. Bur. Fish. Doc. 769, pp. 1–61, 5 pls., 1 map.

MOORE, H. F., and ERNEST DANGLADE.
1915. Condition and extent of the natural oyster beds and barren bottoms of Lavaca Bay, Texas. Rept. U. S. Comm. Fish., 1914, App. II, 45 pp., 5 pls., 1 map. Washington.

MORISON, SAMUEL ELIOT.
1940. Portuguese voyages to America in the fifteenth century. Harvard Hist. Monog. XIV, 151 pp. Harvard University Press, Cambridge.

NAVARRETE, MARTIN FERNANDEZ DE.
1837–80. Colección de los viajes y descumbrimientos que hicieron por mar los Españoles desde fines del siglo XV, con varios documentos inéditos concernientes a la historia de la marina castellana y de los establecimientos españoles en Indias, coordinata e illustrada. Imprenta nacional. 5 vols. Madrid.
1943. Colección de diarios y relaciones para la historia de los viajes y descubrimientos . . . Instituto historico de marina. 5 vols., illus., fold. maps. Madrid.

NIELSEN, J. N.
1925. Golfströmmen. Geografisk Tiddsskrift. 28 Bind. 1 Hefte. Copenhagen.

PARIS, BIBLIOTHÈQUE NATIONALE.
1892. Quatrième centenaire de la découverte de l'Amérique: Catalogue des documents géographiques exposés à la Section des cartes et plans de la Bibliothèque nationale. Paris, J. Maisonneuve. 77 pp.

PARR, ALBERT E.
1935. Report on hydrographic observations in the Gulf of Mexico and the adjacent straits made during the Yale Oceanographic Expedition on the *Mabel Taylor* in 1932. Bull. Bingham Oceanog. Coll. 5 (1): 1-93. New Haven.
1937a. A contribution to the hydrography of the Caribbean and Cayman Seas. Bull. Bingham Oceanog. Coll., Peabody Mus. Nat. Hist. 5 (4): 1-110. New Haven.
1937b. Report on hydrographic observations at a series of anchor stations across the Straits of Florida. Bull. Bingham Oceanog. Coll., Peabody Mus. Nat. Hist., Art. 3, 6: 62 pp., 36 figs. New Haven.

PEARSE, A. S., and G. W. WHARTON.
1938. The oyster "leech," *Stylochus inimicus* Palombi, associated with oysters on the coasts of Florida. Ecol. Monog. 8: 605-655.

PEARSON, JOHN C.
1928. Natural history and conservation of the redfish and other commercial sciaenids on the Texas coast. Bull. Bur. Fish. 44: 129-214.

PEIRCE, BENJAMIN, and CARLILE P. PATTERSON.
1881. List of the dredging stations occupied by the U. S. C. S. steamers *Corwin, Bibb, Hassler* and *Blake* for 1867–1879. Bull. Mus. Comp. Zool. Harvard Coll. 6: 1–16.

PHILLIPS, P. LEE.
1901. A list of maps of America in the Library of Congress, preceded by a list of works relating to cartography. 1137 pp. Government Printing Office, Washington.
1909–20. A list of geographical atlases in the Library of Congress, with bibliographical notes. 4 vols. Government Printing Office, Washington.
1924. Notes on the life and works of Bernard Romans. The Florida State Historical Soc., 128 pp. Deland, Fla.

POURTALÈS, L. F. DE.
1863-69. Contribution to the fauna of the Gulf Stream at great depths. Bull. Mus. Comp. Zool. Harvard Coll. 1: 121-142.
1870. Preliminary report on the Crustacea dredged in the Gulf Stream in the Straits of Florida. Part I. Brachyura. Bull. Mus. Comp. Zool. Harvard Coll. 2: 109-160.
1880. VI. Reports on the corals and antipatharia. In: Reports on the results of dredging . . . by the U. S. Coast Survey steamer *Blake*. Bull. Mus. Comp. Zool. Harvard Coll. 6 (4): 95–118.

PRÉVOST, ANTOINE FRANCOIS.
1746–89. Histoire génerale des voyages, ou nouvelle collection de toutes les relations de voyages par mer et par terre, etc. 20 vols. Paris, chez Didot.

PRÉVOST, JEAN FRANCOIS DE.
1780–1801. Abrégé de l'Histoire générale des voyages . . . par M. de la Harpe. 32 vols. and atlas of 74 maps. Paris.

ROMANS, BERNARD.
1776. A concise natural history of East and West Florida . . . 342 pp. New York.

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SANZ, MANUEL SERRANO.
1933. Expedición de Hernando de Soto a la Florida. 87 pp. Madrid.

SCAIFE, WALTER BELL.
1892. America: its geographical history, 1492–1892. Six lectures delivered to graduate students of the Johns Hopkins University; with a supplement entitled: Was the Rio del Espiritu Santo of the Spanish geographers the Mississippi? 176 pp. The Johns Hopkins Press, Baltimore.

SMITH, F. G. WALTON; H. FRANCO MEDINA; and A. F. BROOKS ABELLA.
1951. Distribution of vertical water movement calculated from surface drift vectors. Bull. Mar. Sci. Gulf and Caribbean 1(3): 187–195.

SOLEY, JOHN C.
1914. The Gulf Stream in the Gulf of Mexico, by Lieut. John C. Soley, U. S. N., in charge of the Branch Hydrographic Office at New Orleans, La. Reprinted from the Pilot Chart of the North Atlantic Ocean for June 1914. Washington.

STEARNS, S.
1884. On the position and character of the fishing grounds of the Gulf of Mexico. Bull. U. S. Fish Comm. 11: 289–290.
1887. The fishing grounds of the Gulf of Mexico belonging to the United States, 1887. In: The Fisheries and Fishery Industry of the United States by George Brown Goode. Sec. III, pp. 55–60. Washington.
1887. The red snapper fishery and the Havana market fishery of Key West, Florida. In: The Fisheries and Fishery Industries of the United States by George Brown Goode. Sec. V, 1, (10): 585–594. Washington.

STEARNS, S., and DAVID STARR JORDAN.
1887. Fisheries of the Gulf of Mexico. In: The Fisheries and Fishery Industries of the United States by George Brown Goode, Sec. II, (15): 533–587. Washington.

STOMMEL, HENRY.
1950. The Gulf Stream. A brief history of the ideas concerning its cause. Scientific Monthly 70: 242–253.

SWANTON, JOHN R.
1946. The Indians of the Southeastern United States. Smithsonian Institution, Bur. Amer. Ethnology, Bull. (3) 943 pp., 107 pls.

SWEITZER, N. B., JR.
1898. Origin of the Gulf Stream and circulation of waters in the Gulf of Mexico, with special reference to effect upon jetty construction. Trans. Am. Soc. Civil Engrs. 40: 86–98.

SWIFT, FRANKLIN.
1897. Report of a survey of the oyster regions of St. Vincent Sound, Apalachicola Bay, and St. George Sound, Florida. U. S. Comm. Fish and Fish., Rep. of the Comm. for 1896, App. 4, pp. 187–221, fold. map. Washington.

TANNER, Z. L.
1886. Report on the work of the United States Fish Commission steamer *Albatross* for the year ending December 31, 1884. U. S. Comm. Fish and Fish., Rep. of the Comm. for 1884, App. A, 112 pp., 3 pls. Washington.

THACHER, JOHN BOYD.
1896. The continent of America: its discovery and its baptism. 270 pp., illus., pls., maps. W. E. Benjamin, New York.

TORRES LANZAS, PEDRO.
1900. Relación descriptiva de los mapas, planos de México y Floridas, existentes en el Archivo general de Indias. 2 vols. Sevilla, El Mercantil.

UNITED STATES BUREAU OF FISHERIES.
1919. Report of the U. S. Commissioner of Fisheries for the fiscal year ending June 30, 1917. P. 80. Washington.

UNITED STATES COAST AND GEODETIC SURVEY.
1878–1953. Report of the Superintendent of the U. S. Coast and Geodetic Survey showing the progress of the work during the fiscal year. Issued annually. Washington.

UNITED STATES COAST SURVEY.
1845–77. Reports of the Superintendent of the United States Coast Survey. Washington.

UNITED STATES DE SOTO EXPEDITION COMMISSION.
1939. Final report of the United States De Soto Expedition Commission. 76th Cong., 1st Sess., House Doc. No. 71, XVI, 400 pp. incl. maps. GPO, Washington.

UNITED STATES LIBRARY OF CONGRESS.
1901. A list of maps of America in the Library of Congress, preceded by a list of works relating to cartography. By P. Lee Phillips, F. R. G. S., Chief of the Division of Maps and Charts. 1137 pp. GPO, Washington.
1909–20. A list of geographical atlases in the Library of Congress, with bibliographical notes. Comp. under the direction of Philip Lee Phillips, F. R. G. S., Chief, Division of Maps and Charts. Vols. 1–2 paged continuously. GPO, Washington.

URING, NATHANIEL.
1928. The voyages and travels of Captain Nathaniel Uring (first published in 1726). The Seafarers Library, London, 253 pp.

VARNHAGEN, F. A. DE.
1858. Vespuce et son premier voyage. 31 pp. Paris. Imp. de L. Martinet.
1865. Amerigo Vespucci, son caractère, les écrits et sa vie. Lima, Peru.
1869a. Nouvelles recherches sur les derniers voyages du navigateur florentin. Vienna.
1869b. Le premier voyage de Amerigo Vespucci. Vienna.
1870. Nouvelles recherches sur les derniers voyages du navigateur florentin, et le reste des documents et eclaireissement sur lui. 57 pp. Vienna.

VESPUCCI, AMERIGO.
1926. The letter of Amerigo Vespucci describing his four voyages to the New World, 1497–1504. 5 p. l., 28 pp. The Book Club of California, San Francisco.
1893. The first four voyages of Amerigo Vespucci reprinted in facsimile and translated from the rare original edition (Florence, 1505–06). X., 32 p. facs. B. Quaritch, London.

WALFORD, LIONEL A.
1950. A coordinated program of marine studies for the Gulf and Caribbean. Proc. Gulf and Caribbean Fish. Inst., Second Ann. Sess., p. 129. Miami, Florida.

WALKER, S. T.
1880. Report on the shell heaps of Tampa Bay, Florida. Ann. Rep. Bd. of Regents Smithsonian Inst. for 1879, pp. 413–422. Washington.
1883. The aborigines of Florida. Ann. Rep. Bd. of Regents Smithsonian Inst. for 1881. Pp. 677–680. Washington.
1885. Mounds and shell heaps on the west coast of Florida. Ann. Rep. Bd. of Regents Smithsonian Inst. for 1883, pp. 854–868. Washington.

WILLEY, GORDON R.
1949. Archeology of the Florida Gulf coast. Smithsonian Misc. Coll. 113: 599 pp., 60 pls. Washington.

WINSOR, JUSTIN.
1884–89. Narrative and critical history of America. 8 vols. Houghton Mifflin and Company, Boston and New York.
1904. The Kohl Collection (now in the Library of Congress) of maps relating to America. A reprint of Bibliographical Contribution number 19 of the library of Harvard University. GPO, Washington.