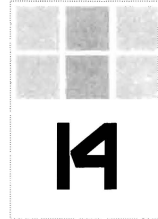


FRANCIS PARKER SHEPARD

1897 - 1985

BY JOSEPH R. CURRAY



■ ■ Introduction

Francis Parker Shepard has frequently been called the "Father of Marine Geology." This honorary title, which I will explain later, was mainly based on his work and teaching while he was a professor of submarine geology at Scripps, although a review of his work and publications shows that his fascination with the geological features and



Francis P. Shepard, 1976, with Scripps Pier in the background.

sediments around the oceans started many years before he held a permanent appointment there. The study of marine sediments had been started well before Fran came to Scripps, notably by T. Wayland Vaughan, Roger Revelle, and others, but Shepard justly deserves credit for forming the basis for marine geology at Scripps.

I had the great privilege and pleasure of knowing and working with Fran for over thirty years, first as my mentor, and subsequently as a colleague and friend. I knew him well, although the men who undoubtedly knew him the best were two of his early students, Robert Dietz and K. O. Emery. For this brief biography, I have drawn freely from notes they wrote and published, and I have also learned much from Fran's unpublished autobiography and from his sons, Tom and Tim. In this biography I have quoted many statements from Shepard's autobiography without specifically referencing the source.

Before we go on, let me repeat one story about referring to Shepard as the "Father

of Marine Geology" (Dietz and Emery 1971). "The venerable Madame Klenova of the U.S.S.R Institute of Oceanography was a delegate to the International Geological Congress in Mexico City in 1956, when the cold war had first thawed sufficiently for Soviet scientists to attend such functions. As she met Shepard for the first time, Mme. Klenova warmly remarked, 'You are the father of marine geology and I am the mother of marine geology.' To this, Elizabeth, Fran's lovely wife for well over fifty years, replied, 'And that, in turn, must make me the concubine.'" Mme. Klenova was perhaps the first to name him the Father of Marine Geology.

Shepard was not of humble beginnings, but was the son of a "moderately wealthy family" at Peaches Point, Marblehead, MA. He attended mainly private schools, at times with the Boston Lowells and Cabots. At 14 he took his first trip to Europe and discovered a love for mountains, but he broke his leg on his first venture into the Dolomites in Italy. Discovering this love for mountains may have been an early turning point in his life. Although he described himself as a "poor student," he earned his degree in geology in about two and a half years before and after serving briefly in the Navy during the First World War. Reginald A. Daly, Charles Palache, J. B. Woodward, and Wallace Atwood were among his influential professors at Harvard. Professor Atwood directed Shepard's BA thesis work.

While at Harvard, Shepard met one of his sister's friends from Vassar, Elizabeth Buchner. He quickly fell madly in love with Elizabeth. When making a decision about selecting a graduate school, he was influenced by the fact that Elizabeth lived in Milwaukee, so he went to the University of Chicago. There he came under the influence of R. D. Salisbury, J. Harlan Bretz, and Rollin T. Chamberlain, son of T. C. Chamberlain. Salisbury's courses assumed that his students were completely familiar with the T. C. Chamberlain and Salisbury's 3-volume textbooks. As Fran described his experiences, "Come unprepared and old 'Sal' would fire questions at you 'til you were covered with perspiration, and you would never come unprepared again." Shepard also recalled that during his three years at Chicago immediately after T. C. Chamberlain's retirement, students and colleagues took Chamberlain's ideas almost as a religion. "It's too bad I entered the field after most of the important problems had been solved."

R. T. Chamberlain was working in the Rocky Mountains, so Shepard took up the study of structural geology. He did his dissertation on the Rocky Mountain Trench. Fran and Elizabeth took their honeymoon in the field camping in a pup tent for three months. They had no car, so they traveled by train from area to area, packing with them Elizabeth's wardrobe trunk with her trousseau. The trunk sat at each railway station for the three months unopened, while they traveled with two duffel bags in ranchers' cars, by horseback, by wheelbarrow and by backpacks. It seemed an unlikely experience for the gracious lady I knew many years later, but after spending many months on ships with Fran and Elizabeth, I realized what a wonderfully flexible and adaptable lady she was.

Shepard received his Ph.D. in 1922, and accepted an appointment as an instructor at the University of Illinois that fall. During his stay at Illinois, he continued his main interest in structural geology and tectonics and published his first 11 papers on the subject. As a young graduate student in Pennsylvania, I remember reading his 1923 paper "To question the theory of periodic diastrophism." I did not realize it at the time, but this was the start of

his lifelong habit of challenging recognized authority in geology. Only a year after receiving his Ph.D., he was challenging the ideas of T. C. Chamberlain, R. T. Chamberlain, Charles Schuchert, Bailey Willis, and others. Shepard was efficient, hard working, and prolific: he published over 200 papers and authored or co-authored ten books. And he loved to challenge and upset cherished dogma.

Shepard's career in geology had two periods: structural geology and mountains, and marine geology (he called it submarine geology). But through both of those careers, he showed several characteristics. He was an observer, and he was eager to publish everything he observed. Fran was skeptical of theoretical analyses, and instead, he overwhelmed his opposition with extensive collection of data. As Dietz and Emery (1971) stated it, "He develops his views in the field rather than accepting answers recorded in authoritative books, thus 'counting the lion's teeth instead of consulting Aristotle'... He also utilized T. C. Chamberlain's principle of multiple working hypotheses, setting up 'truth tables' listing the points for or against any idea."

What have Shepard's contributions been in his two careers, first in tectonics, structure, and the Rocky Mountains, and second in marine geology? And what were his contributions to Scripps Institution, which he dearly loved?

■ ■ ■ Structure and Mountains

Shepard chose to do his dissertation research on the Rocky Mountain Trench, the great intermontane valley that extends northwesterly from the U.S.-Canadian border west of the main ranges of the Rocky Mountains. This 1500 km long valley contains the headwaters of the Columbia, Fraser, Crooked, Canoe, and other rivers. The origin was a geological mystery at the time. Reginald Daly, Shepard's former professor at Harvard, had suggested that it was a graben (fault bounded, depressed crustal area). Shepard's fieldwork, however, demonstrated the existence of at least two thrust faults, and he showed that it is a synclorium at the western side of the Rocky Mountain thrust system. In fact parts of it are a horst, in contrast with the previously accepted idea that it was a graben.

Shepard's conclusions were based on careful observations and field work, whereas some of the earlier ideas were based, at least in part, on assumptions and interpretations just of the topography alone, that a "trench" must be a graben. This was the pattern of Shepard's work throughout his career: observation and collection of actual field data.

Several of Shepard's first papers dealt with folding and evidence of compression in this area, including some experimental work in compressional folding with R. T. Chamberlain.

One of Shepard's earliest more general papers attacking accepted theories by the authorities of the day was his 1923 paper "To question the theory of periodic diastrophism," as put forth by T. C. Chamberlain, R. T. Chamberlain, Charles Schuchert, Bailey Willis, and others. The accepted Chamberlain idea was that diastrophism was mainly concentrated at the ends of geologic periods and eras, separated by extended times of quiescence. Shepard demonstrated that diastrophism is more nearly continuous. He also became interested in the role and preservation of isostasy in mountain building. He started developing these ideas at Chicago before his dissertation defense, and was prepared to shock the Chicago faculty with his radical ideas during that session. As he explained in his autobiography, perhaps it was just

as well that the faculty did not give him an opportunity to state his radical ideas, because "I would probably have been torn limb from limb...." In retrospect he appreciated the tolerance of the University of Chicago faculty in later permitting him to publish part of his rebellious ideas in the *Journal of Geology*, a publication controlled by that department.

■ Marine Geology

Shepard's father, the head of Shepard Steamship Line, was an avid sailor, so he had provided Fran and his sister with a sailboat at an early age. This was to be the trigger for launching Fran into the second phase of his career. His father, with a family heritage of the sea, of course, had a considerably larger and more elegant yacht, a New York 40-footer. Fran's father, by the way, must have been a most remarkable and interesting person, judging from the wonderfully entertaining biography his grandson, Tim Shepard, wrote about him: *Peaches Point* (Shepard, T., 1976).

When Elizabeth was expecting her first child in 1923, Fran accepted his father's offer of use of his yacht that summer "to do some kind of geological work," rather than do field work in the Rocky Mountains. The story has become legend in marine geology: that Shepard took surface sediment samples from the continental shelf off the New England coast, and did not find what theory had predicted, i.e., coarser sediments near shore and only finer sediments farther offshore. Some of the coarsest sediments did not lie near the shore, but near the shelf edge. After several additional summers in Marblehead broadening his survey area, and after considerable study of the notations on published nautical charts, Shepard published a 1927 abstract "Influence of oscillating sea level on the development of the continental shelf," to be followed by his classic 1932 paper "Sediments of the continental shelves." Elizabeth's story about taking her very young son to sea with them every day is also wonderful. They carried him aboard in a basket, which they then tied to the gimballed salon table. Young Tom, now Dr. Thomas Shepard, M.D., Professor Emeritus of the University of Washington Medical School, apparently slept soundly, undisturbed, and probably lulled to sleep by the motion of the vessel.

Shepard was now well into the second and more important stage of his career, as a submarine geologist. His interests broadened through continued use of his father's various yachts, exploring the New England continental margin up to Newfoundland and through increasing study of published charts. He was given a grant from the University of Illinois to obtain nautical charts from all over the world. As he published his series of papers on submerged deltas, sea level changes, glacial troughs, continental shelves and submarine canyons, he was able to back up his observations from his study area to global observations from these charts. During this period he met and worked with Henry Stetson of the recently founded Woods Hole Oceanographic Institution. Stetson, of very similar family background and facilities, was developing similar interests by field observations. And Shepard continued to challenge authority by attacking some of the ideas of Douglas Johnson on the classification of coasts. Also during this period, he developed a very good and mutually beneficial relationship with the U.S. Coast and Geodetic Survey, and worked with the captains of several of their vessels off other U.S. coasts, including the California off shore. He became very interested in California submarine canyons, many of which head just outside the shoreline.

Shepard started working on the California canyons during a sabbatical leave from the University of Illinois in 1933. He then continued spending more time in California during his summers, but in 1936, his career took another major change. In that year, Charles Palache, one of Shepard's Harvard professors, became the President of the Geological Society of America. He changed the G.S.A. policy, heretofore of only small research grants, and recommended that Shepard apply for a very large grant, \$10,000.

Harald Sverdrup, by then the Director of the Scripps Institution of Oceanography, encouraged Fran to use the institution's newly modified ex-yacht, 96-foot *E. W. Scripps*, for his research on the canyons of the California continental margin. So in 1937 he took a leave from the University of Illinois, and brought his family and two of his promising graduate students to La Jolla, acquiring each for \$30 per month. Robert S. Dietz arrived by hitchhiking; K. O. Emery rode boxcars. For the \$10,000 Fran had six months on *E. W. Scripps*, paid his two assistants, who developed and built the necessary equipment. Many significant papers resulted from this study, with follow-on grants from the G.S.A. With co-investigator Roger Revelle, more papers came out on Gulf of California research results. Fran continued teaching in Illinois, but by then had a formal relationship with Scripps.

Shortly after Pearl Harbor, Fran moved to La Jolla to join the University of California Division of War Research. He analyzed and interpreted hydrographic charts, made coastal studies in California, and spent three months in Hawaii and on Midway, where he discovered the delights of swimming with a faceplate observing coral reefs. After the war, he resigned from the University of Illinois and accepted a permanent appointment at Scripps, where he spent the rest of his distinguished career.



Shepard emerging from his first dive in La Jolla Submarine Canyon in the Cousteau SOUCOUPE, in 1964. These were his first personal direct observations in the canyon he had studied for many years.

Geologists worldwide know Shepard's subsequent career from his many papers and books. His initial text, *Submarine Geology*, was a standard for the subject for many years after publication of the first edition in 1948. That was one of the main reasons I decided to apply to Scripps for continuing my graduate studies in the early 1950s.

One of Shepard's favorite research subjects, and one for which he is best known, was the study of submarine canyons. Before he started on his shelf sediment studies in 1923, he had been intrigued by a master's thesis about the Hudson Submarine Canyon by George Ekblaw at the University of Illinois. Earlier these mysterious sea valleys had been discussed in the literature notably in 1863 by J. D. Dana, but the geologists who had written the papers had never themselves studied the valleys at sea. Shepard, in his typical method of working, did some of his own surveying, he rode on ships of the U.S. Coast and Geodetic Survey, and he examined the contours of previous surveys on published charts. Contemporaries like Henry Stetson of Woods Hole and Jacques Bourcart in southern France also actually explored canyons on the eastern seaboard and northwestern Mediterranean coast, respectively. Shepard's interest in submarine canyons persisted for his entire career in marine geology. During his career, he put out nearly 80 publications on submarine canyons, culminating in two books on the subject, the first with Robert Dill, the second with several of his assistants who made current measurements in submarine canyons. In the first five years of his canyon studies, from 1932 through 1936, he published 13 papers specifically on these features.

These early workers proposed a variety of origins. Some of the first noted the similarity to land canyons, and considered them submerged river valleys that had been eroded at times of great continental uplift. Some specific canyons were attributed to diastrophism and faulting. Ocean floor currents, tsunamis, artesian sapping, and density currents were also suggested as possible mechanisms of origin. An early observation by J. Milne in 1897 noted that displacement of sediment by submarine slumping might cause seafloor cable breaking.

Shepard's first papers specifically devoted to submarine sea valleys—in 1932 and 1933—proposed that the canyons were cut "a long time ago," the continental margins subsided and the canyons were filled. Later in the Quaternary when the continental shelves of the world were cut to their present depth, the canyons were exhumed by submarine landslides. This is essentially the same origin as in the first edition of his text *Submarine Geology* in 1948. R. A. Daly had first suggested erosion by turbidity currents in 1936. Ph. H. Kuenen supported this idea in 1937, and Shepard rejected it. However, Kuenen wrote another paper on suspension currents in 1947 after Shepard had written the text of his 1948 first edition. Shepard recognized it in a footnote, but apparently did not have the time to fully reconsider the consequences in his text. The classic paper by Kuenen and Migliorini in 1950 on modeling of turbidity currents forever changed Shepard's and other researchers explanation of submarine canyons, as being initiated in the upper shallow parts by river erosion, but cut by turbidity currents and other submarine mass movement below the depths to which earlier sea levels had sunk. Shepard had fully accepted this origin and the idea that turbidity currents are powerful agents of submarine erosion by the time of publication of the second and third editions of his text *Submarine Geology* in 1963 and 1973.

To Shepard's full credit, when faced with new evidence, he did not hesitate to modify his ideas in print. His interpretations of geological phenomena were based on observations, not on mere theory.

Shortly after Shepard arrived at the University of Illinois, another young professor appeared—Harold R. Wanless. The two became close friends. Wanless worked on cycles in the Carboniferous, and the two collaborated on several papers relating those cycles (cyclothem) to glacial sea level changes. Later, after both were emeriti, they wrote a massive book on coastlines of the world.

After World War II Shepard completed publication of the 1939 and 1940 *E. W. Scripps* surveys of the Gulf of California and continued his work on submarine canyons and coastal processes. In April 1946 while he was working on the draft of his first edition of *Submarine Geology* on the north coast of Kauai, an earthquake caused a submarine landslide in the Aleutian Trench, creating a large tsunami that reached the Hawaiian Islands. Always an observer, Shepard did not run from the threat, but instead went closer to the coast with his camera to record the event. He did obtain some photographs, but the cottage he and Elizabeth were occupying was demolished, the entire draft of the text of his book was lost, and Shepard had to climb a palm tree to escape the wave. Again always a scientist, he wrote papers on the tsunami with G. A. Macdonald and D. C. Cox.

In 1950, Shepard submitted a proposal to the American Petroleum Institute for study of the coastal, deltaic, and continental shelf areas of the northwest Gulf of Mexico with his colleague, micropaleontologist Fred B Phleger. Fran was in charge of the project, not an easy job, which produced a multitude of papers by him, his students, and colleagues until publication of the summary volume in 1960. Shepard himself wrote several of the most significant publications to result from the project, including important papers on the Mississippi Delta and the bays and barrier islands of the central Texas coast. As an aid to study of the textures of the sediments, Shepard devised a system of classification by the relative proportions of sand, silt, and clay. At an office celebration of this paper, his 100th reprint, one of his graduate students, Harris B. Stewart, who later went on to a distinguished career with the U. S. Coast and Geodetic Survey and NOAA, wrote this poem in his honor, titling it

"One Sansicle, Please, and No Mud"

We had drinks and hors d'oeuvres from the platter.

The department was there to a man.

It was during a lull in the chatter

That Shepard put forth his new plan.

"If clay and silt are contiguous,

And next to the silt is the sand,

Then 'mud' as a term is ambiguous,

And in consequence should be banned.

If a triangle's used in the riddle,

And sand, silt and clay juxtaposed,

For the triangle left in the middle,

The term 'sansicle' is proposed.

Directing the API 51 project of study on the Gulf Coast at times required considerable diplomacy. While it was supported by the oil industry research interests as a whole, several of the larger companies already had their own research groups working on the Recent sediments and environments of the area, and they resented having a west coast group come into their turf. Nevertheless, there was a mutually beneficial exchange of data and ideas, and the project was a brilliant success, contributing significantly to our knowledge of Recent sediments and environments.

After the politically difficult years of leading the API 51 project, Fran once again returned to his real interests: submarine canyons, coastal processes and features, and sea level changes. A major exciting event in 1964 was success in bringing Jacques Cousteau's saucer submersible SOUCOUPE to Scripps for several surveys, including the Scripps and La Jolla Submarine Canyons. Even though Shepard had many times sent first hardhat divers and later scuba divers into the canyon, he finally had an opportunity to see it himself. "It was one of the best days in my life. I felt I learned more about canyons that day than in 30 years of remote control from the surface."

Also in 1964, a group of Shepard's former students dedicated a volume of papers to him entitled *Papers in Marine Geology; Shepard Commemorative Volume*. To keep preparation of this volume a secret, the effort was dubbed "Project Sextant," to recognize the thousands of horizontal sextant angle positions Shepard had plotted during his career in surveying nearshore features from both small boats and larger ships. That was prior to his formal retirement in 1966. Another special volume, *From Shoreline to Abyss* was posthumously dedicated to him in 1991.

Shepard's international recognition brought him awards and honors. I came to realize his international reputation when, as a young man, I attended my first international meeting. When introduced to the great men present, I would first explain that I was a marine geologist from UCSD; then I would say I was from Scripps; but it was not until I explained that I worked with Professor Shepard that I even existed. He was an honorary member of the Society of Economic Paleontologists and Mineralogists (now called the Society for Sedimentary Geology), the Natural History Society of Lausanne, and the Netherlands Geological Society. He received the Wollaston Medal from the Geological Society of London, the Sorby Medal from the International Association of Sedimentologists; he was president of the International Association of Sedimentologists, and he received honorary doctorates from Beloit College and the University of Southern California. Each year the Society for Sedimentary Geologists awards one of its major medals, a by-product of "Project Sextant," the Francis P. Shepard Medal, for excellence in marine geology.

■ The Scripps Institution of Oceanography

Finally, what were Shepard's contributions to the Scripps Institution of Oceanography? He loved Scripps and dedicated his career to it for the last five decades of his life. Fran conveyed his enthusiasm to all around him and attracted a host of graduate students over his long years of teaching, who in turn trained other generations of marine geologists. To them and to his colleagues and associates, he was ever a kind and generous friend. His manner was gentle, even courtly. He was known to have assisted some of his

students financially in time of need, including research support. His productivity as a scientist outlasted many of those students. He established the Geosciences Research Division Marine Geology Reading Room, which still functions with an endowment from the Shepard Foundation.

Fran continued to work long after his formal retirement in 1966, spending at least a

part of every weekday in his office, until frailty and illness made his visits less frequent during his last few months. Even then, he continued working, literally until the day before his death.



Shepard taking horizontal sextant angles for location of one of his many near-shore surveys, ca. 1975.

I thank Tom Shepard, Tim Shepard, and Dave Moore for assistance in preparation of this brief biography. I have also drawn extensively from Shepard's unpublished autobiography.

◆◆ Selected References and Additional Reading

- Curray, J. R., 2001. Francis Parker Shepard, 1897-1985. *Rock Stars, GSA Today*. pp.20-21.
- Curray, J. R., E. L. Winterer, and D. L. Inman, 1988. Memorial to Francis Parker Shepard. *Geological Society of America Memorial Volume 18*. pp.1-5.
- Daly, R. A., 1936. Origin of submarine canyons. *American Journal of Science*, v.31. pp.401-420.
- Dana, J. D., 1863. *A Manual of Geology*. Philadelphia. 798pp.
- Dietz, R. S. and K. O. Emery, 1971. Portrait of a scientist, Francis Shepard. *Earth Science Reviews*, v.7. pp.A9-A15.
- Dietz, R. S. and K. O. Emery, 1976. Early days of marine geology. *Oceanus*, v.19. pp.19-22.

- Emery, K. O., R. S. Dietz, G. G. Kuhn, R. E. Stevenson, and J. R. Curray, 1986. Francis Parker Shepard (1897-1985), Memorials. *Bulletin of the American Association of Petroleum Geologists*, v.70. pp.331-333.
- Kuenen, Ph. H., 1937. Experiments in connection with Daly's hypothesis on the formation of submarine canyons. *Leidsche Geologische Mededeelingen VII*. pp.316-351.
- Kuenen, Ph. H., 1947. Two problems of marine geology: atolls and canyons. *Verhandelingen der Koninklijke Nederlandsche Akademie van Wetenschappen, Afd. Natuurkunde Tweede Sectie, XLIII*, no. 3.
- Kuenen, Ph. H., and C. I. Migliorini, 1950. Turbidity currents as a cause of graded bedding. *Journal of Geology*, v.58. pp.91-127.
- Ludwick, J. C., 1985. In Memoriam. *Marine Geology*, v.69. pp.v-vii.
- Miller, R. L., editor, 1964. *Papers in Marine Geology, Shepard Commemorative Volume*. Macmillan Company, New York. 531pp.
- Milne, John, 1897. Sub-oceanic changes. *Journal of Geology*, v.10. pp.129-146.
- Osborne, R. H., editor, 1991. From Shoreline to Abyss: Contributions in Marine Geology in Honor of Francis Parker Shepard. *SEPM Special Publication*. no.46. 320pp.
- Rusnak, G. A., 1991. Afoot and afloat along the edge: adventures of an ingenious beach-comber - a tribute to Francis Parker Shepard (1897-1985). In *From Shoreline to Abyss, SEPM Special Publication*, no.46. pp.1-7.
- Shepard, F. P., 1923. To question the theory of periodic diastrophism. *Journal of Geology*, v.31. pp.599-613.
- Shepard, F. P., 1926. Further investigations of the Rocky Mountain Trench (British Columbia). *Journal of Geology*, v.34. pp.623-641.
- Shepard, F. P., 1932. Sediments of the continental shelves. *Geological Society of America, Bulletin*, v.43. pp.1017-1040.
- Shepard, F. P., 1933. Submarine valleys. *Geographical Review*, v.23. pp.77-89.
- Shepard, F. P., 1937. Daly's submarine canyon hypothesis. *American Journal of Science*, v.33. pp.369-379.
- Shepard, F. P., 1948. *Submarine Geology*. Harper & Brothers, New York. 348pp.
- Shepard, F. P., 1956. Marginal sediments of the Mississippi Delta. *American Association of Petroleum Geologists, Bulletin*, v.40. pp.2537-2632.
- Shepard, F. P., 1973. *Submarine Geology. 3rd Edition*. Harper & Brothers, New York. 517pp.
- Shepard, F. P., J. R. Curray, D. L. Inman, E. A. Murray, and E. L. Winterer. Submarine geology by diving saucer. *Science*, v.145. pp.1042-1046.
- Shepard, F. P., and R. F. Dill, 1966. *Submarine Canyons and Other Sea Valleys*. Rand McNally & Company, Chicago. 381 pp.
- Shepard, F. P., G. A. Macdonald, and D. C. Cox, 1947. The tsunami of April 1, 1946, in the Hawaiian Islands. *Pacific Science*, v.1. pp.21-37.
- Shepard, F. P., and D. G. Moore, 1955. Central Texas coast sedimentation: characteristics of sedimentary environments, recent history and diagenesis. *American Association of Petroleum Geologist Bulletin*, v.39. pp.1463-1493.
- Shepard, F. P., F. B. Phleger, and Tj. H. Van Andel, editors, 1961. *Recent Sediments, Northwest Gulf of Mexico*. American Association of Petroleum Geologists. 395pp.

- Shepard, F. P., and H. R. Wanless, 1971. *Our Changing Coastlines*. McGraw-Hill, New York. 579pp.
- Shepard, F. P., with Elizabeth Shepard, ca. 1983. Autobiography, unpublished manuscript, Scripps Institution of Oceanography. 200 pp.
- Shepard, T., 1976. *Peaches Point*. Thomas Y. Crowell Company, New York. 267pp.

