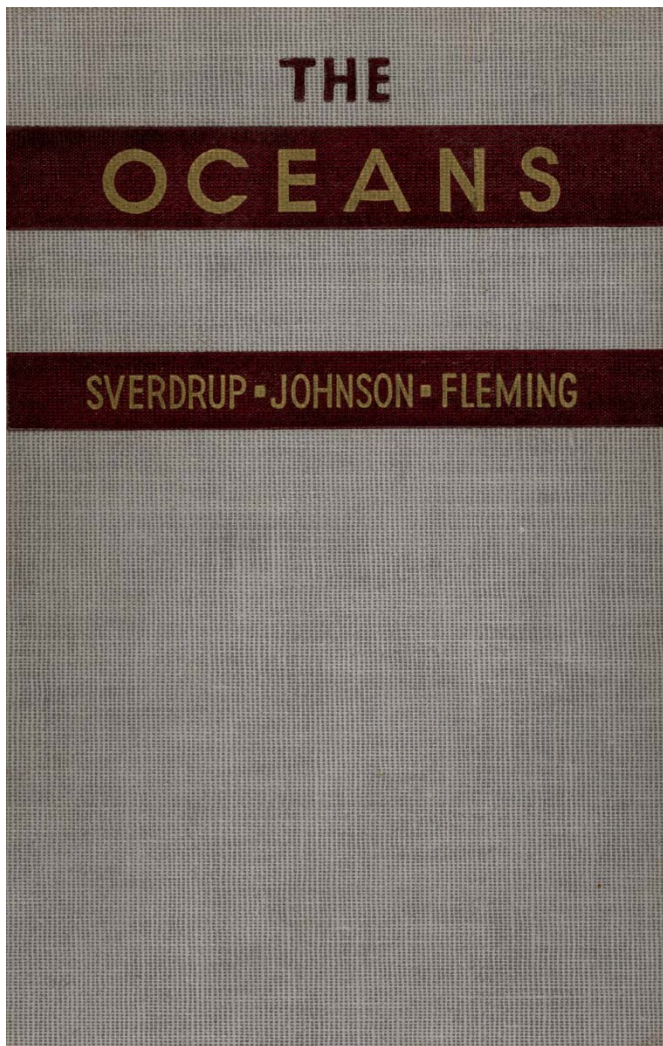


A History of “The Oceans: Their Physics, Chemistry and General Biology”

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The Oceans: Their Physics, Chemistry and General Biology is described as the first comprehensive textbook in oceanography. It is a book dear to the hearts of oceanographers around the world, particularly those of the immediate postwar generation who used it as a textbook in the classroom and at sea. *The Oceans* is particularly significant to the Scripps Institution of Oceanography (SIO), the home campus of its three authors. Scripps was established in 1903 as a marine biological station in San Diego, California and adopted an oceanographic program in 1925. In 1936, it developed the first curriculum in oceanography in the United States. *The Oceans* spread that curriculum through the world. The book attracted an international body of students to California. Scripps was a small marine station in 1936, but Harald Sverdrup turned it into an oceanographic research center of international reputation. A key element of that transition was the publication of this book, which was a great success from the day of its publication in 1942.

On December 21, 1937, D.A. Tacke of Prentice-Hall in New York wrote Harald Sverdrup, Director of the Scripps Institution of Oceanography at the recommendation of Theodore von Karman to ask Sverdrup to write a textbook on oceanography. Sverdrup intended to reply that he would not undertake a textbook, but his secretary, Ruth Ragan said, “Why don’t you consider it? You are the best qualified man in the country to do a book on the oceans.”

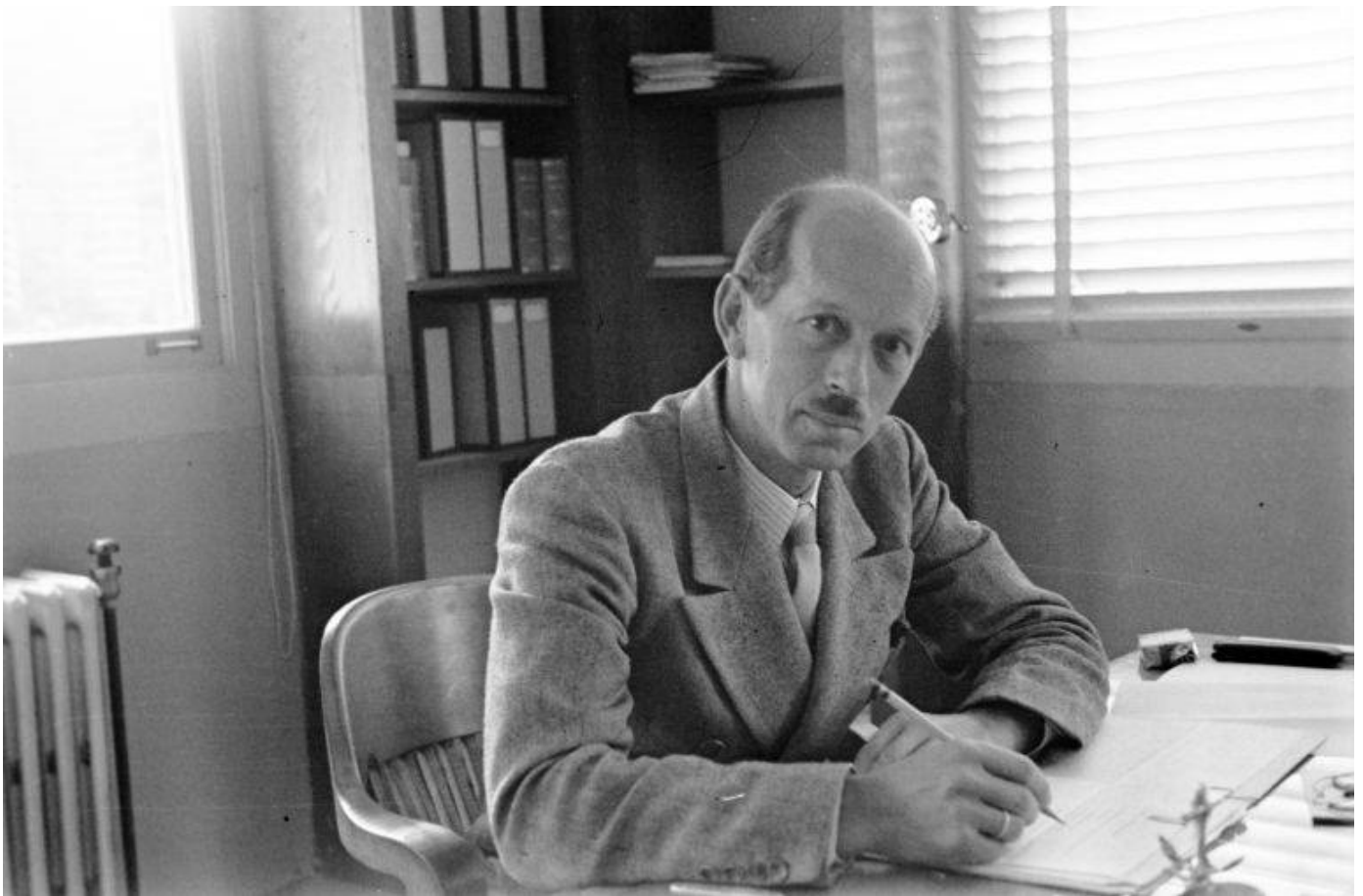
Sverdrup replied to Tacke:¹

There exists no adequate text-book in oceanography in the English language, and I hope that there will be need for one. The best book at present is the volume on

¹ H.U. Sverdrup to D.A. Tacke, December 29, 1937. Manuscript and Papers regarding the Oceans, Volume 1, page 4, SIO Archives, UCSD 81-123. The book to which Sverdrup refers was written by a committee of oceanographers chaired by the venerable H.B. Bigelow.

oceanography which was published by the National Research Council in 1932 in their series, "Physics of the earth." It is possible that a new edition will be prepared, - last spring I discussed this matter briefly with Dr. Robert Millikan.

Sverdrup met with S.B. Cunningham, Vice President of Prentice Hall and by August 1938, and agreed to do the book. On September 20, 1938 Sverdrup and his co-authors Martin W. Johnson and Richard H. Fleming signed a contract with Prentice Hall for a book on oceanography containing 500-600 printed pages, which was to be completed on or before November 1, 1939. What changed his mind?



Harald U. Sverdrup, December 1938

There was talk about the need for a textbook at Scripps as early as 1936. Richard H. Fleming wrote Roger Revelle that the notes for the Scripps lectures on oceanography "are all being kept...for the time when we write that textbook."²

² Richard H. Fleming to Roger Revelle, September 29, 1936, SIO Biographical Files f194. Fleming recalled in 1965, "A representative of Prentice Hall said why don't you write up your lectures and we'll publish it." See notes of a conversation between Helen Raitt and Richard Fleming, SIO Biographical Files, folder 439.

Martin Johnson recalled³:

In 1936 some of us at SIO initiated a course in general oceanography but the lack of an integrated text in the field was a serious handicap. This finally prompted Dr. H.U. Sverdrup, our new Director at SIO, Dr. R.H. Fleming and me to undertake the task of writing such a book.

The development of a new curriculum in oceanography at Scripps was a major motivating factor for the writing of *The Oceans*. There were other factors. The only general texts in oceanography were outdated.⁴ The 1932 text published by the National Research Council was a compilation of knowledge inadequate as a textbook. The best textbook on physical oceanography in any language at the time was Albert Defant's *Dynamische ozeanographie* (1929). Defant, whom Sverdrup knew well, had expanded on this book for his lectures on oceanography at the University of Berlin, and wanted an English translation of the book. Defant's doctoral student Dutch oceanographer Ludowyk (Louis) Lek had already begun the English translation. Lek was Jewish and fled Europe for the United States in 1936. In 1939, Sverdrup invited Lek to continue his work at Scripps. Sverdrup was already writing about oceanography for a new edition of Vilhelm Bjerknes' *Dynamic Meteorology and Hydrography*.⁵ So, Sverdrup had in hand a series of lectures on oceanography that provided a structure, he was already writing a summary of physical oceanography for Bjerknes, and Sverdrup could talk the work over with European colleagues like Lek and C.G. Rossby who were now in the United States.

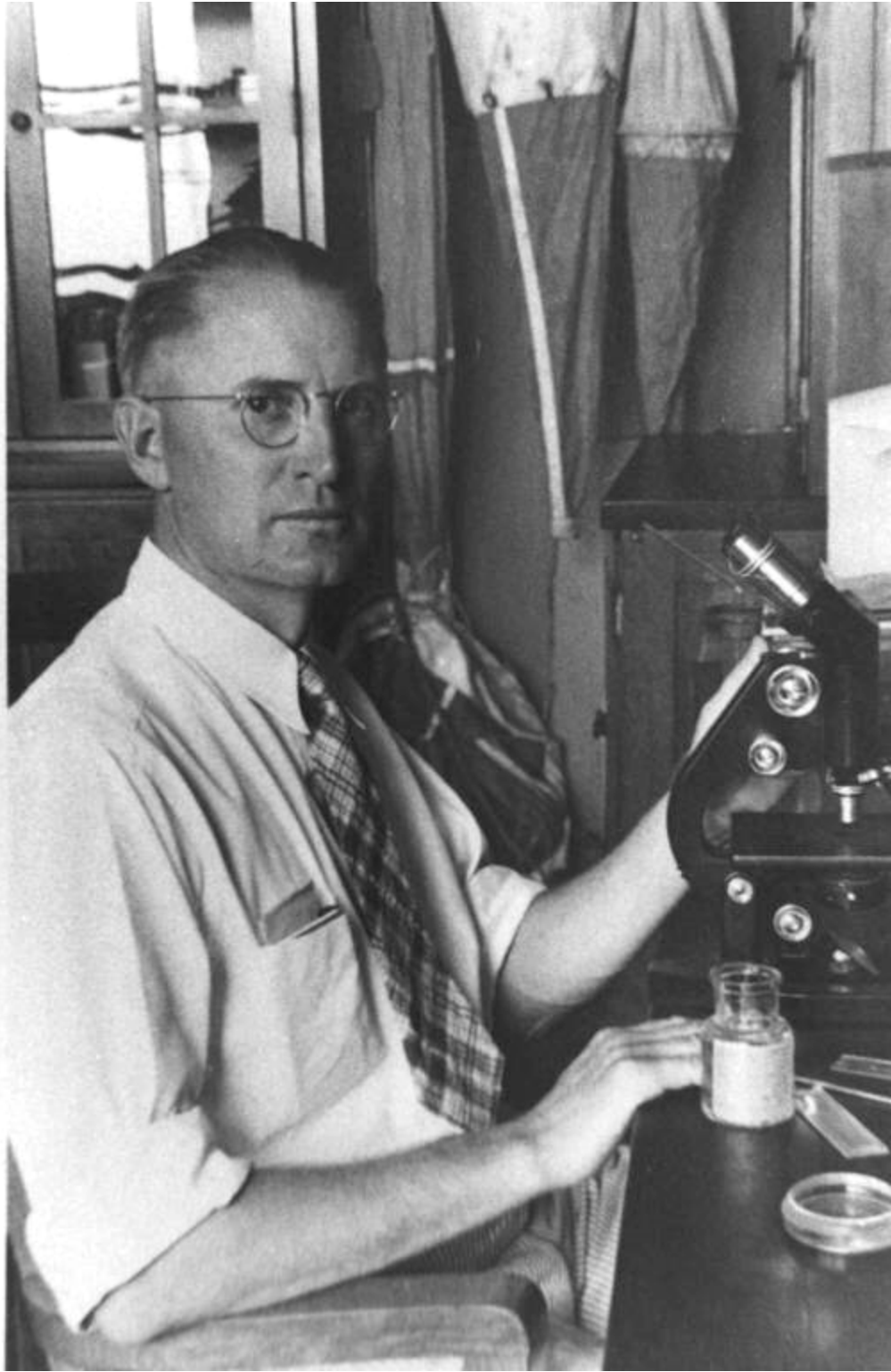
There is little information recorded on Sverdrup's selection of his coauthors. Sverdrup, Johnson and Fleming had worked closely together to revise the curriculum and present a series of lectures on oceanography in 1936. Johnson was an able biologist and Fleming a chemist, and these were exactly the fields needed to balance Sverdrup's strength in physical oceanography. The choice of coauthors appears to have been built naturally on that collaboration, strengthened by the fact that the three men were also shipmates. Other potential collaborators were unavailable that year. Roger Revelle was in Norway, Lek was in New York and Francis Shepard had just arrived from Illinois.

Eugene LaFond, a Scripps researcher and photographer, prepared figures for Sverdrup and Fleming. Johnson, a skilled artist, did his own. The team was completed with Ruth Ragan as typist.

³ Martin W. Johnson, "Oceanographic Medley #1, page 98. Martin Johnson Papers 84-29, Box 2, folder 7. SIO Archives UCSD.

⁴ Krümmel, Otto. *Handbuch der Ozeanographie*. Stuttgart: Engelhorn, 1907 (in German) and Schokal'skii, Jules. *Okeanografiia*. Petrograd: Gidrometeoizdat, 1917 (in Russian).

⁵ This book was long delayed by the war and was finally published under the editorship of C.L. Godske in 1957.



Martin W. Johnson, 1936



Richard H. Fleming, 1936



Ruth Ragan, 1930s



Eugene LaFond, 1935

While Walter Munk, Sverdrup's student, agreed that the curriculum was the impetus for the text book, he noted that Sverdrup felt compelled to demonstrate the underlying unity of oceanography, its physics, chemistry, biology and geology, a conviction he developed during seven years of arctic exploration aboard MAUD.⁶ *The Oceans* would give him an opportunity to do so.

⁶ Walter Munk, "The Ocean 'Bible': Reminiscences." *Oceanography* 5, no. 3 (1992): 157.

Each author worked in his own way. Sverdrup drafted the preface in penciled longhand, but generally dictated chapters in large sections to Ruth Ragan, who typed the manuscript. Fleming recalled that Sverdrup began writing the book while awaiting the arrival of E.W. SCRIPPS in Guaymas on Gulf of California Expedition in 1939. Johnson worked from detailed outlines of his chapters. Sverdrup noted that the flow of Fleming's published papers:

...has been somewhat hampered partly...because he has committed himself to contribute to a general text book on oceanography which is under preparation by himself, Dr. Martin Johnson and the Director. I mention this phase of his work because the preparation of a text book in oceanography meets with particular difficulties owing to the fact that no such text book exists, and owing to the rapid expansion of our knowledge of the sea. Critical examination of a large number of original papers must be made and I have found that Dr. Fleming has the ability to undertake such examination and feel confident that his contribution to the text book will be of a personal nature and will be much more than a compilation of known facts.⁷

All three authors commented on how difficult it was to write the book. Sverdrup wrote Hans W. Ahlmann that he was working like a horse on the volume in September 1940. Fleming wrote Revelle:

Sv[erdrup], Martin and I have turned on the heat and are making a noble effort to finish the book. ...Don't ever get involved in writing a book!!⁸

In his memoirs, Johnson remembered writing the text. "It was a long task with much literature research and burning of midnight oil."⁹

Everyone on campus knew the work on the manuscript was underway. The campus artists, Sam Hinton and Martin Johnson, both featured the effort in cartoons.

⁷ "Special recommendation concerning the promotion of R.H. Fleming...." C1939. SIO Biographical Files, Box 6, f194.

⁸ Fleming to Revelle, November 28, 1940. SIO Biographical Files, Box 6, f194.

⁹ Martin W. Johnson, "Oceanographic Medley #1," page 99.



Martin W. Johnson cartoon depicting Richard H. Fleming, Harald U. Sverdrup and Walter H. Munk watching Ruth Ragan type the manuscript of *The Oceans*



Sam Hinton cartoon of Martin W. Johnson, Harald U. Sverdrup and Richard H. Fleming as the Three Musketeers standing on *The Oceans*

The book achieved a synthesis of the field of oceanography. The three authors began their collaboration when Sverdrup asked each for a list questions that should be answered in the book. The questions suggested themes that were then enlarged and organized into a rough outline of chapter headings, and this outline became a table of contents by October 1938.

Sverdrup's first outline was heavily weighted toward physical oceanography.¹⁰ For instance, he estimated the length of the book at 330-500 pages, including 130 pages on dynamics and 40 pages on chemical oceanography. Biology was at the bottom of the list. The earliest penciled table of contents was written in Sverdrup's hand before October 1938, and this bears his annotation assigning each chapter to an author. But each author then had the task of outlining the contents of his chapter. This led to many discussions and revisions. For instance, Johnson was assigned to write chapter IV, Sea water as Environment for Organisms. On September 12, 1938, Johnson wrote Sverdrup that he had changed the title of the chapter to "The Sea as a Biological Environment" and greatly expanded its scope.

The organization of the book changed significantly during the first months of work, but the contents of the book grew organically and lengthened as the work progressed. Sverdrup said in the preface that he originally conceived of the book as a survey of well-established oceanographic knowledge, but oceanographic knowledge was barely established in 1937. The authors developed their own definition of what constituted oceanography, and several reviewers commented that the personal perspectives of the authors lent strength and charm to the book. In the end, the authors' personal perspectives of what constituted oceanography defined the field for a generation. The book's readership included all of the students trained in oceanography after the war, and its influence was enormous. While factual knowledge of the field of oceanography has changed, the synthesis remains, and that makes this book a classic in its field that is still worthy of study today.

The book was put immediately to use. Miss Ragan prepared a master manuscript for Prentice-Hall, but a second carbon copy of the manuscript, complete with all the illustrations, was bound and cataloged into the Scripps Institution of Oceanography Library. Dale Liepper recalls that Sverdrup used the yet unpublished textbook for the fall term 1942 course on oceanography taught to Air Force cadets enrolled in the nine-month meteorology program.

By the time the book was published in 1942, it consisted of 1,087 pages printed in a diminutive font. It weighed four pounds and sold for ten dollars. Johnson remembered, "This increase in length led to some grumbling by the publisher but they relented and agreed to publish as a loss if necessary."¹¹ The first printed copies of the book arrived in La Jolla on December 19, 1942 and were the occasion for a party at the Sverdrup's house.¹² It was at this party that the book was first called "The Bible" of oceanography. Advance publicity was already out on the book by then, and the authors breathlessly awaited reviews and sales statistics. Prentice-Hall enclosed a card with each volume sold soliciting the opinion of its purchaser. The returned cards were favorable, as were the first American reviews, which appeared in 1943 and 1944. Lyman Spitzer reviewed the book favorably in the *Journal of Applied Physics* and L.A. Walford called the book authoritative in *Copeia*. Sverdrup waited impatiently for reviews by Ekman and other oceanographer in European scientific journals. He would have a long wait.

¹⁰ The earliest outline appears in 81-123 Manuscript and Papers regarding the Oceans Volume 1 page 9.

¹¹ Ibid, p. 14.

¹² Ruth Ragan, Notes on interviews with Helen Raitt, 1965, p. 2. SIO Biographical Files, f434.

The war had a significant impact on the distribution of the book. On March 2, 1943, G.A. Morriss of the Prentice-Hall Foreign Department wrote Sverdrup to inform him that the Navy had found that the book “would be of great aid to the enemy should it fall into his hands,” and consequently its export was restricted.¹³ Luckily Morriss had already sent a copy of the book to J.N. Carruthers at the British Admiralty, at Sverdrup’s suggestion. The Hydrographer of the Royal Navy, Sir John A. Edgell, made a personal request to the U.S. Hydrographer, and four additional copies of the book were sent to London by diplomatic pouch. Carruthers’ complementary review of the book in the *Quarterly Journal of the Royal Meteorological Society* appeared in April 1944. Trygve Wyller wrote Johnson that *The Oceans* arrived at the University of Oslo library in October 1945.¹⁴

One of the important American reviews was not entirely flattering. Rear Admiral G.S. Bryan, the retired hydrographer of the Navy reviewed the volume in the *U.S. Naval Institute Proceedings* in 1943. After praising the book, Bryan noted:

While many references are made to the work of individuals and organizations who have contributed data of value to the study of oceanography, it is regretted that very little credit has been given the U.S. Navy and the Hydrographic Office for the original development of sonic sounding, for their major contribution of deep-sea soundings throughout the world, and for their comprehensive data on ocean currents.

And he regretted that the name of the famous American naval oceanographer, Matthew Fountaine Maury was absent from the volume.¹⁵

Sir George Deacon praised the book in a review in *Nature* on June 2, 1945, but the same issue carried a letter by Walfried Ekman expressing distress that the book attributed the discovery of internal waves to Helland-Hansen and Nansen rather than Otto Pettersson.¹⁶ Ekman reviewed the book in Swedish in *Ymer* and in English in *Geografiska Annaler* in 1946. His review commented on the book chapter by chapter, noting specific errata but concluding:

In the main, however, the conclusions seem to be well founded. According to the reviewer’s opinion the authors have accomplished their task in a highly interesting manner and with remarkable success.¹⁷

The Oceans was the foundation for the postwar curriculum in oceanography at Scripps and many other places. Dale Leipper recalled that in the fall of 1946, the textbook provided much of

¹³ G.A. Morriss to H.U. Sverdrup, March 2, 1943. Manuscript and Papers regarding the Oceans, Volume 1, page 4, SIO Archives, UCSD 81-123, volume 4.

¹⁴ Trygve Wyller to Martin Johnson, October 27, 1945. Martin Johnson Papers, Box 2.

¹⁵ Bryan, G.S. Review of *The Oceans*, U.S. Naval Institute Proceedings, August 1943.

¹⁶ G.E.R. Deacon, “Oceanographic Investigations,” *Nature* 155 (June 2, 1945): 652. V. Walfried Ekman, “Internal Waves in the Sea,” *Nature* 155 (1945): 669.

¹⁷ V. Wilfrid Ekman, Review of *The Oceans*, *Geografiska Annaler* 1946: 388-391.

the subject material for the curriculum at Scripps, and open book examinations based on the text were the norm.

Walter Munk recalls that Sverdrup originally expected a printing of 550 copies. Fleming said that the authors told Prentice Hall that they hoped to sell 1,500 copies over a period of twenty years. By 1965, 23,766 copies of the American edition alone had been sold.¹⁸ The first printing rapidly sold out, and Prentice-Hall asked the authors for corrections for a second printing in November 1946. Fleming said that Sverdrup made only one minor revision in the section on waves (pages 532-537). In fact, a number of small corrections were made by each of the authors. While there was only one edition of the book, the printings are distinguished one from another by these changes.

The book was reprinted every 1-3 years through the 1960's. It was eventually translated into many languages; the Modern Asia edition was released in 1961, and the Hindi translation appeared in 1974. The Soviets told Ekman that they were planning an even bigger book on oceanography in 1946, but Fleming later recalled that the most dog-eared copy of the book he ever saw was on the Soviet oceanographic ship VITIAZ.

In his 1945 review in *Nature*, Sir George Deacon commented that “*The Oceans* will appeal to many seafarers; many ships would be glad to have a copy.” This prediction came true. *The Oceans* was found in the libraries of the great oceanographic ships of the world, and oceanographers boasted of how badly their copies were worn.

¹⁸ Helen Raitt and Beatrice Moulton. *Scripps Institution of Oceanography: First Fifty Years*. San Diego, Ward Ritchie Press, 1967, 165n18.



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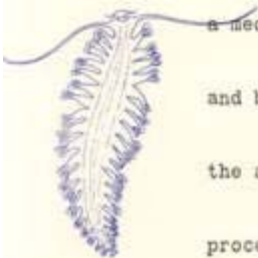
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THE AUTHORS

H. U. Sverdrup is at present the director of the Norwegian Polar Institute, Oslo; he was formerly Director of the Scripps Institution of Oceanography. Martin W. Johnson is currently teaching at the Scripps Institution. Richard H. Fleming is with the Department of Oceanography, University of Washington, Seattle.

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