

Selected Scripps Institution of Oceanography Expeditions: Summaries & Selected Publications

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Scripps Institution of Oceanography Archives

July 2003

Alexander Agassiz Expedition, November 1, 1907

In 1907, scientists from the Marine Biological Laboratory in La Jolla sailed its first research vessel ALEXANDER AGASSIZ on a shakedown cruise to the Los Coronados Islands. This cruise is considered the institution's first expedition.

Gulf of California Expedition, 1939

This expedition to Gulf of California on E.W. SCRIPPS was led by Harald Sverdrup and studied the hydrography of the Gulf and the exchange of water between the Gulf and adjacent parts of the Pacific Ocean. 2500 soundings were made which changed the scientific view of the Gulf floor and showed its southern part consisted of steep ridges and deep basins and troughs. The expedition also proved that the Seri Indians of Tiburon were not cannibals.

Fleming, R.H. "A contribution to the oceanography of the Central American region." Proceedings of the Sixth Pacific Science Congress v. 3 (1939): 167-175.

Marsh, Jessie Jean. "Science at Sea." California Monthly (December 1938): 14-15.

Revelle, Roger. "Soundings in the Gulf of California and Off the West Coast of Lower California in 1939." Records of Observations, Scripps Institution of Oceanography, v. 1. no.2 (May 1943): 81-83.

Sverdrup, H.U. "The Gulf of California: Preliminary Discussion of the Cruise of the "E.W. SCRIPPS" in February and March 1939." Proceedings of the Sixth Pacific Science Congress, v 3 (1939): 161-166.

Revelle, Roger. "Soundings in the Gulf of California and Off the West Coast of Lower California in 1939." Records of Observations, Scripps Institution of Oceanography, v. 1. no.2 (May 1943): 81-83

Sverdrup, Harald. "Cruises of the E.W. Scripps in 1939." Scientific Monthly (Oct. 1939): 389-391.

Sverdrup, Harald, as told to Andy Hamilton. "Science puts a new jigsaw together." Los Angeles Times Sunday Magazine (May 21, 1939): 4-5, et seq.

Gulf of California Expedition, 1940

During the fall of 1940, the E.W. SCRIPPS returned to the Gulf of California in an expedition funded by the Geological Society of America and Scripps Institution of Oceanography and led by Roger Revelle and Francis P. Sumner. The expedition studied the geologic processes active in the Gulf through coordinated investigations of the recent geologic history of the land, of the bottom topography and sediments, and of the nature of the marine environment. The 1940 expedition concentrated on Guaymas, the Carmen Island area in the western gulf, Concepcion Bay and Tiburon.

Anderson, Charles Alfred et al. 1940 E.W. Scripps cruise to the Gulf of California. Geological Society of America. Memoir 43. New York : Geological Society of America, 1950.

Ford, James L.C. "Seven Scientists at Sea: Outward Bound, Part One: How a group of scientists made a laboratory of Gulf of California." California Monthly (March 1942): 19-22, 38.

Ford, James L.C. "Seven Scientists at Sea: Gadding About the Gulf; Part II-The Story of California's Sea-Going Laboratory." California Monthly (April 1942): 20-23, 36.

Moberg, E.G. and J. Lyman. "The "E.W. SCRIPPS" Records of observations, Scripps Institution of Oceanography, v. 1. no. 1 (July 1942).

Sverdrup, H.U. and Staff. "Research within Physical Oceanography and submarine geology at the Scripps Institution of Oceanography during April 1940 to April 1941." Transactions, American Geophysical Union (1940): 490-494.

MidPac Expedition, 1950

This joint Scripps Institution of Oceanography-U.S. Navy expedition discovered the Mid-Pacific Mountain Range on the bottom of the Pacific Ocean and confirmed Darwin's theory about the origin of atolls. Expedition scientists on the research ship HORIZON and the navy ship PCE(R) 857 were surprised to find that the seafloor was young, deep and rocky, not flat, old and filled with sediments. Measurements of continental heat flow from the ocean raised questions about the history of the Pacific Ocean basin that were later answered by Plate Tectonics theory.

Bullard, E.C., Maxwell, A.E., and Revelle, R.R. Heat flow through the deep sea floor. *Advances in Geophysics* 3 (1956): 153-181.

Deep Sea Mountains. *Pic* (December 1951): 14-19.

Dietz, Robert S. The Pacific Floor. *Scientific American* 186 (1952): 4.

Dietz, Robert S. Sea floor results: Scripps-Navy Mid-Pacific Expedition, 1950. *Assoc. Oceanog. Phys., Proces-Verbaux* 5 (1952): 143.

Dietz, Robert S. and Menard, H.W. Mendocino submarine escarpment. *Journal of Geology* 60, no. 3 (1952): 266-278.

Dietz, Robert S., Menard, H.W., and Hamilton, E.L. Echograms of the Mid-Pacific Expedition. *Deep Sea Research* 1, no. 4 (1954): 258-272.

Emery, K.O., J.I. Tracey, Jr., and H.S. Ladd. *Geology of Bikini and Nearby Atolls: Part I, Geology*. U.S. Geological Survey. Professional Paper 260 A (1954): xv, 255, plus plates and 20 charts. (With a foreword by Roger Revelle discussing MidPac Expedition)

Geology of Bikini and Nearby Atolls: Part II, Oceanography. U.S. Geological Survey. Professional Paper 260 B (1954): xv, 255, plus plates and 20 charts.

Hamilton, E.L. *Sunken islands of the Pacific Mountains*. University of California, Ph.D. dissertation, 1952.

Hamilton, E.L. *Sunken islands of the Pacific Mountains*. GSA Memoir No. 64 (March 1956).

Hamilton, Edwin L. Upper cretaceous, tertiary and recent planktonic foraminifera from Mid-Pacific flat topped seamounts. *Journal of Paleontology* 27, no. 2 (March 1953): 204-237.

Hamilton, Edwin L. and Robert W. Rex. Lower Eocene Phosphatized Globigerina Ooze from Sylvania Guyot, Bikini and Nearby Atolls, Marshall Islands. U.S. Geological Survey. Professional Paper 260 W (1959): iii, pp. 785-798, plus plates 250-254.

Ladd, H.S., J.I. Tracey, and G.G. Lill. Drilling on Bikini Atoll, Marshall Islands. *Science* 107: 51-55.

Menard, Henry W. Archipelagic Aprons. *Bulletin of the American Association of Petroleum Geologist* 40, no. 9 (September 1956): 2195-2210, 8 figures.

Menard, Henry W. Deformation of the Northeastern Pacific basin and the west coast of North

- America. *Bulletin of the Geological Society of America* 66 (September 1955): 1149-1198.
- Menard, H. W. *Marine Geology of the Pacific*. New York: McGraw Hill, 1964. 271.
- Menard, Henry W. and Robert S. Dietz. Mendocino submarine escarpment. *Journal of Geology* 60, no. 3 (May 1952): 266-278.
- Morita, Richard Y. and Claude E. ZoBell. Occurrence of bacteria in pelagic sediments collected during the Mid-Pacific Expedition. *Deep-Sea Research* 3 (1955): 66-73.
- Raitt, Russell. The 1950 Seismic Refraction Studies of Bikini and Kwajalein Atolls and Sylvania Guyot. La Jolla: SIO Reference 52-38, 40 pages.
- Raitt, Russell L. and Beauregard Perkins, Jr. Seismic-Refraction Studies of Bikini and Kwajalein Atolls, with a section on coordination of seismic data, Bikini Atoll. U.S. Geological Survey. Professional Paper 260-K (1954): pp. 507-526
- Revelle, Roger. Notes on the Joint Scripps Institution of Oceanography-U.S. Navy Electronics Laboratory Mid-Pacific Expedition. 1 November 1950.
- Revelle, Roger R. Paleocology and deep sea exploration. NRC Committee on a treatise on marine ecology and paleocology Report 1950-1951, pp. 57-61.
- Revelle, Roger. The Earth beneath the sea, Geophysical exploration under the ocean. *Modern Physics for the Engineer*, edited by Louis N. Ridenour. New York: McGraw Hill, 1954, 306-329.
- Revelle, Roger. Geology of Bikini and Nearby Atolls, Part I. U.S. Geological Survey, Professional Paper 260 (1954): iii-vii.
- Revelle, Roger. On the history of the Oceans. *Journal of Marine Research*, 14, no. 4 (December 31, 1955): 88-155.
- Revelle, Roger and Arthur E. Maxwell. Heat Flow through the Floor of the Eastern North Pacific Ocean. *Nature* 170, no. 4318 (August 2, 1952): 199-200.
- Revelle, Roger and K.O. Emery. Chemical Erosion of Beach Rock and Exposed Reef Rock, Bikini and Nearby Atolls, Marshall Islands; A study of the solution of calcium carbonate in the intertidal zone. U.S. Geological Survey. Professional Paper 260 T (1957): pp. 699-709, and plates 225-229. SIO 1 UN485, v. 260R-Z.
- Revelle, Roger and R.L. Fisher. The Trenches of the Pacific. *Scientific American* 193, no. 5 (Nov. 1955): 36-41.

UC. SIO. Midpac Expedition, August-September 1950. List of cores and dredge samples. Copied from shipboard logs. Second edition, completed and corrected, 6 pages. La Jolla: SIO Reference Series 72-38.

UC. SIO. ONR Quarterly Progress Report No. 17, July-September 1950. La Jolla, SIO Reference 50-25, 17 pages.

Von Arx, William S., et. al. Bikini and Nearby Atolls: Part 2, Oceanography (Physical). U.S. Geological Survey. Professional Paper 260 B, C, D (1954): xv, 255, plus plates and 20 charts.

Capricorn Expedition, 1952

This was the first Scripps expedition to use scuba divers to explore the Pacific. Research ships HORIZON and SPENCER F. BAIRD mapped seamounts and guyots and other features of the Pacific seafloor. Scientists studied the 35,400 foot deep Tonga Trench, the second deepest place in the ocean, and measured heat flow on the East Pacific Rise. Operation Ivy, the U.S. first test of a thermonuclear bomb, preceded the expedition.

Bascom, Willard N. et al. Diving During Capricorn Expedition. Originally intended to be published as a technical report SIO Reference 53-22, but was not published.

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Fisher, Robert L. and Roger Revelle. The trenches of the Pacific. Scientific American 193, no. 5 (1955): 36-41.

Menard, H.W. and Robert L. Fisher. Clipperton fracture zone in the northeastern equatorial Pacific. Journal of Geology 66, no. 3 (1958): 239-253. [Also cites MidPac.]

Raitt, Helen. Exploring the Deep Pacific. NY: W.W. Norton, 1956.

Raitt, Russell W. Seismic refraction studies of the Pacific Ocean basin. I. Crustal thickness of the central equatorial Pacific. Bulletin of the Geological Society of America 67 (1956): 1623-1640. [Also cites MidPac.]

Raitt, Russell W., Robert L Fisher and Ronald G. Mason. Tonga Trench. Geological Society of America, Special Paper 62 (1955): 237-254, 9 figures.

Revelle, Roger. On the history of the oceans. *Journal of Marine Research* 14, no. 4 (1955): 446-661. SIO 1 JO595 v. 14.

Shor, George G. Jr. Reflexion studies in the eastern equatorial Pacific. *Deep Sea Research* 5 (1959): 283-289.

Shumway, George. Carnegie Ridge and Cocos Ridge in the east Equatorial Pacific. *Journal of Geology* 62, no. 6 (1954): 573-586.

UC. SIO. List of Cores collected on CAPRICORN (1952-1953), CUSP (1954) and CHUBASCO (1954) Expeditions. SIO Reference No. 72-23, 1 May 1955.

UC SIO. Shipboard Report, Capricorn Expedition 26 September 1952-21 February 1953. SIO Reference Number 53-15 (February 25, 1953): vi, 60.

Shellback Expedition, 1952

Shellback Expedition explored the eastern Tropical Pacific. Particular attention was paid to direct measurements of the equatorial and Peru currents. Deep trawls sampled life in subsurface waters of very low oxygen content. The Panama Basin was delineated, and ports were visited in Costa Rica, Peru and Ecuador, including the Galapagos Islands.

Alvarino, Angeles. Bathymetric Distribution of Chaetognaths. *Pacific Science* 18, no. 1 (January 1964): 64-82.

Berner, Leo D. Two New Pelagic Tunicates from the Eastern Pacific Ocean. *Pacific Science* 9, no. 2 (April 1955): 247-253.

Fisher, Robert L. Middle American Trench: Topography and Structure. *Geological Society of America Bulletin* 72 (1961): 703-720.

Knauss, J.A. Shellback Expedition. *Naval Research Reviews* 6 (May 1953): ii, 1-6.

Wooster, Warren S. and Bruce A. Taft. On the reliability of field measurements of Temperature and Salinity in the Ocean. *Journal of Marine Research* 17 (1958): 552-566.

Wooster, Warren S. Report, Shellback Expedition 17 May to 28 August 1952. La Jolla: SIO Reference Number 52-63, 1 December 1952, 14 + 3 pages.

Yoshida, Kozo, Han-Lee Mao and Paul L. Horrer. Circulation in the Upper Mixed Layer of the Equatorial North Pacific. *Journal of Marine Research* 12 (1953): 99-120.

Transpac Expedition, 1953

SPENCER F. BAIRD worked in the Gulf of Alaska, southern Bering Sea, and the western North Pacific Ocean on hydrography and pelagic biological collections (net tows). Jimmu guyot in the Emperor Seamount chain was dredged for ice-rafted Kiril volcanic cobbles. Observations were made in the Oyashio and Kuroshio Currents off Japan and Russia. Geologist Robert L. Fisher was the first person to visit Bayonnaise Rocks to retrieve volcanic specimens. Transpac was the first U.S. oceanographic expedition to visit Japan after World War II, and its scientists were welcomed by Japanese marine scientists and honored with a palace laboratory visit with Emperor Hirohito.

Brinton, Edward. Variable Factors affecting the Apparent Range and Estimated Concentration of Euphausiids in the North Pacific. *Pacific Science* 16, no. 4 (October 1962): 374-408.

Dietz, Robert S. "Manganese deposits on the northeast Pacific sea floor." *California Journal of Mines and Geology* 51, no. 3 (1955): 209-220.

Dietz, Robert S. "Marine geology of northwestern Pacific: Description of Japanese Bathymetric Chart 6901." *Bulletin of the Geological Society of America* 65 (1954): 1199-1224.

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Kuno, Hisashi, Robert L. Fisher and Noriyuki Nasu. Rock Fragments and pebbles dredged near Jimmu Seamount, northwestern Pacific. *Deep Sea Research* 3 (1956): 126-138.

Morimoto, Ryohei, Robert L. Fisher and Noriyuki Nasu. Bathymetry and Petrography of the Bayonnaise Rocks, Japan. *Proceedings of the Japan Academy* 31, no. 10 (1955): 637-641.

Morita, Richard. Shinkai no bakteria. *Kagaku Asahi* 83, no. 150 (December 1954): 27-28. (In Japanese). SIO Subject Files, Box 7, Folder 36.

Nasu, Noriyuki. Taiyo no kaitei, Part I and II. *Kagaku* (1954): 378-451 (In Japanese)

Plunkett, Mary Alys and Norris W. Rakestraw. Dissolved organic matter in the Sea. In: *Papers in marine biology and oceanography, dedicated to Henry Bryant Bigelow by his former students and associates on the occasion of the twenty-fifth anniversary of the founding of the Woods Hole Oceanographic Institution, 1955*. London: Pergamon Press, 1955, 12-14.

Scripps Institution of Oceanography. Quarterly Progress Report, October–December 1953. Office of Naval Research Progress Report No. 30.

The 1953 Trans-Pacific Expedition. *Science* 119 (January 22, 1954): 116-117.

Taihieyo gakujutsu tankensen (Supensa F. Beado-go) mo dojoshite. *Kagaku Asahi* 83, no. 150 (December 1954): 6-14. SIO Subject Files, Box 7, Folder 36.

Tsuji, Yutaka and Keiichi Akimoto. Gatujuutsu tankensen Beado-go Hakodate/ Tokyo k okai nisshi. *Kagaku Asahi* 83, no. 150 (December 1954): 21-26. (In Japanese) . SIO Subject Files, Box 7, Folder 36.

Wooster, Warren S. Recent Oceanographic Exploration in the North and Equatorial Pacific Ocean. *Proceedings of the Pacific Science Congress* (8th, Philippines, 1953) 3: 679-683.

Wooster, Warren S. and Feenan Jennings. Exploratory oceanographic observations in the eastern tropical Pacific, January to March 1953. *California Fish and Game* 41 (1955): 79-90.

NORPAC Cruise, 1955

Scientists from Japan, Canada, and the United States combined their facilities to make a great synoptic oceanographic survey of the North Pacific Ocean in 1955. The survey provided background knowledge of hydrography for studies of fisheries problems. Twenty oceanographic vessels, including SPENCER F. BAIRD, HORIZON and STRANGER occupied one thousand oceanographic stations. This expedition demonstrated the success of international cooperation in oceanography.

UC SIO. NORPAC Hydrographic Data: Report of the Scripps Institution of Oceanography, University of California, and South Pacific Fishery Investigations, U.S. Fish and Wildlife Service, for the NORPAC Cruise of August-September 1955. SIO Reference Number 56-4 (February 10, 1956), 173 pages.

Report of a meeting on oceanography of the North Pacific Honolulu, February 13-17, 1956.

Wooster, Warren S. International Oceanography. In: *Recent researches in the fields of hydrosphere, atmosphere and nuclear geochemistry*, published by Editorial Committee of Sugawara Festival Volume, Japan (1964): 203-216.

Downwind Expedition, 1957-1958

Downwind Expedition was the first of three Scripps IGY expeditions. It was a two-ship expedition on HORIZON and SPENCER F. BAIRD. It examined by large-volume sampling the isotope properties of deep water and its circulation in the Southeast Pacific and studied the areal distribution of carbon dioxide in the atmosphere, near the sea surface, and in the surface waters. It studied the carbon dioxide exchange at the air-sea boundary. The two ships made geological-geophysical studies of the structure of the Southeast Pacific basins, the Peru-Chile Trench, and major intermediate-depth entities. Nasca Ridge was discovered, and the subduction model was established for the active deep trench off western South America. The expedition made Scripps' first visit to Easter Island in January 1958. The results of the expedition proved to be important to plate tectonics.

Alvarino, Angeles. Bathymetric Distribution of Chaetognaths. *Pacific Science* 18, no. 1 (January 1964): 64-82.

Brinton, Edward. The distribution of Pacific Euphauslids. *Bulletin of the Scripps Institution of Oceanography*, 1962.

Fisher, R.L., editor. Preliminary report on Expedition Downwind, University of California, Scripps Institution of Oceanography, IGY Cruise to the Southeast Pacific. IGY General Report Series, No. 2 (June 26, 1958). Washington, D.C.: IGY World Data Center A, National Academy of Sciences, 1958, [82] pages.

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Keeling, Charles D. et. al Carbon dioxide in surface waters of the Pacific Ocean. 1. Measurements of the distribution. *Journal of Geophysical Research* 70 (1965): 6087-6097.

Keeling, Charles D. The concentration and isotopic abundances of carbon dioxide in the atmosphere. *Tellus* 12 (1960): 200-203.

Menard, H. W. Consolidated slabs on the floor of the Eastern Pacific. *Deep-Sea Research* 7 (1960): 35-41.

Menard, H. W. Geology of the Pacific Sea. *Experientia* 15, no. 6 (1960): 205-213.

- Menard, H. W. *Marine Geology of the Pacific*. New York: McGraw Hill, 1964. 271 pages.
- Menard, H.W. The East Pacific Rise. *Scientific American* 205, no. 6 (December 1961): 52-61.
- Menard, H.W. The East Pacific Rise. *Science* 132, no. 3441 (December 9, 1960): 1737-1746.
- Menard, H.W. and C. Shipek. Surface concentrations of manganese nodules. *Nature* 182 (1958): 1156-1158.
- Mero, John L. Minerals on the ocean floor. *Scientific American* 203, no. 6 (December 1960): 64-72.
- Raitt, R.W. Geophysics of the South Pacific. In: *Research and Geophysics*, edited by Hugh Odishaw, Cambridge, Mass., M.I.T. Press [1964] pp. 223-241.
- Reid, Joseph L., Jr. Evidence of a South Equatorial Countercurrent in the Pacific Ocean. *Nature* 1284 (July 18, 1959): 209-210.
- Riedel, William R. Oligocene and Lower Miocene radiolaria in tropical Pacific sediments. *Micropaleontology* 5, no. 3 (July 1959): 285-302.
- Shipek, Carl J. Photographic study of some deep-sea floor environments in the eastern Pacific. *Bulletin of the Geological Society of America* 71 (July 1960): 1067-1074.
- UC. SIO. Downwind Expedition, 1957-1958. List of cores and dredge samples copied from shipboard logs. La Jolla: SIO Reference Series 58-86, May 1958, 28 pages.
- UC. SIO. Oceanographic Expedition Downwind. *Naval Research Reviews* 11 (March 1958): 18-21.
- UC. SIO. Quarterly Progress Report No. 3. Seismic sea exploration – Pacific Program. La Jolla: SIO Reference Series 57-46 (October 30, 1957), 3 pages.
- Von Herzen, R. Heat-flow values from the south eastern Pacific. *Nature* 183 (March 28, 1959): 882-883.
- Zieshenne, Fred C. A New Sea-Star from Easter Island. *Annals and Magazine of Natural History* 6 (August 1963): 461.

Naga Expedition, 1959-1961

The governments of the United States, South Vietnam and Thailand developed this expedition jointly. The objectives of this expedition were to survey of the marine resources available for development in the Gulf of Thailand and in that portion of the South China Sea adjacent to South Viet Nam and to train marine scientists and technicians of the two Southeast Asian countries. STRANGER, an oceanographic vessel of the Scripps Institution of Oceanography was the principal vessel for the expedition. Anton Bruun led Naga Expedition until his death when the work was taken over by James L. Faughn.

Faughn, James L. and Bruce A. Taft. Current measurements at the mouth of the Gulf of Thailand, November 1964. *Journal of Geophysical Research* 72, no. 6 (1967): 1691-1695.

Naga Expedition Reports [some online at <http://repositories.cdlib.org/sio/naga/>]

Naga report ; v.1. Naga Expedition, station index and data / by James L. Faughn, 1974

NAGA report ; v.2. Physical oceanography of the Southeast Asian waters / by Klaus Wyrski, 1961

Naga report ; v.3, pt.1. The physical oceanography of the Gulf of Thailand, Naga Expedition / by Margaret K. Robinson, 1974. Bathythermograph (BT) temperature observations in the Timor Sea, Naga Expedition, cruise S11 / by Margaret K. Robinson, 1974

Naga report ; v.4, pt.1. The portunid crabs (crustacea: portunidae) collected by the Naga Expedition / by W. Stephenson, 1967. Gammaridean amphipoda from the South China Sea / by Marilyn Clark Imbach, 1967.

Naga report ; v.4, pt.2. The Chaetognatha of the NAGA Expedition (1959-1961) in the South China Sea and the Gulf of Thailand / by Angeles Alvarino, 1967.

Naga report ; v.4, pt.3. Nephtyidae (polychaeta) from the Bay of Nha Trang, South Viet Nam / by Kristian Fauchald, 1967. Polychaeta from the Bay of Nha Trang, South Viet Nam / by Victor A. Gallardo, 1967.

Naga report ; v.4, pt.4. The brachyura (crustacea: decapoda) collected by the Naga Expedition : including a review of the homolidae / by R. Serène and P. Lohavanijaya, 1973.

Naga report ; v.4, pt.5. Euphausiids of Southeast Asian waters / by Edward Brinton, 1975

Naga report ; v.4, pt.6. Euthecosomatous pteropods (Mollusca) in the Gulf of Thailand and the South China Sea : seasonal distribution and species associations / by Marcia Rottman, 1976

Naga report ; v.5, pt.1. Description of the larvae of *Rastrelliger* (mackerel) and a comparison of the juveniles and adults of the species *R. kanagurta* and *R. brachysoma* / by Tetsuo Matsui, 1970.

Vermilion Sea Expedition, 1959

Vermilion Sea Expedition ships SPENCER F. BAIRD and HORIZON explored and delineated the bathymetry, tectonic elements and crustal structures of the entire length of the Gulf of California. The tectonic relations that were revealed anticipated the plate tectonics theory of the 1960's. Sediment distribution, thickness and individual characteristics within the several basins were determined.

UC. SIO. Physical and Chemical Data Vermilion Sea Expedition 13 April-29 May 1959. SIO Reference No. 60-51, September 28, 1960, 25 pages.

Calvert, Stephen Edward. The diatomaceous sediments of the Gulf of California. La Jolla: PhD. dissertation, oceanography, 1964, xx, 245 leaves.

Monsoon Expedition, 1960-1961

ARGO sailed 38,450 nautical miles on the first Scripps exploration of the tropical and temperate the Indian Ocean. Monsoon Expedition was part of the multinational collaborative International Indian Ocean Expedition (IIOE) organized by UNESCO 1960-1964. ARGO identified and delineated major seafloor topographic features, and made geophysical crustal measurements across the Sunda Trench. C.D. Keeling's carbon dioxide monitoring apparatus was employed for the first time aboard ship.

Alvarino, Angeles. Bathymetric Distribution of Chaetognaths. *Pacific Science* 18, no. 1 (January 1964): 64-82.

Alvarino, Angeles. The Chaetognatha of the Monsoon Expedition in the Indian Ocean. *Pacific Science* 18, no. 3 (July 1964): 336-348.

Knauss, John A. and Bruce A. Taft. Equatorial undercurrent of the Indian Ocean. *Science* 143, no. 3604 (1964): 354-356

Preliminary Results of Scripps Institution of Oceanography Investigations in the Indian Ocean During Expeditions Monsoon and Lusiad, 1960-1963. San Diego: UCSD, 1964 (SIO Reference Number 64-19):vii, 237 pages.

Swan Song Expedition, August 21-December 1, 1961

Swan Song Expedition explored the North Pacific at the equator and Eastern Tropical Pacific on ARGO. The expedition collected large water samples for analysis, studied the Cromwell Current (Pacific Equatorial Undercurrent), and undertook a limited biological program for the Inter-American Tropical Tuna Commission. This was the last Scripps expedition headed by John Knauss.

UC. SIO. Physical, Chemical, Current Measurements and Biological Data Swansong Expedition 21 August-1 December 1961, sponsored by Office of Naval Research. SIO Reference No. 66-1, 15 September 1965, 125 pages.

Lusiad Expedition, 1962

This was the longest Scripps sea trip to date and was part of an international effort to explore the Indian Ocean. On this expedition, the Scripps vessels HORIZON and ARGO sailed around the world to study the Indian Ocean, its currents and map its seafloor. As the Indian Ocean was less well known than other oceans, many seafloor features were discovered and named. The Mid Indian Ocean Ridge was explored, and biologists studied the marine life of the Indian Ocean. The scientists and crew represented many nations, and the ship visited ports in India, Africa and Asia.

Behrman, Daniel. Assault on the largest unknown: the International Indian Ocean Expedition, 1959-65. Paris: Unesco Press, 1981, 96 pages.

Caputo, M., M.D. Helfer and C.L. Hager. Gravity measurements in the Atlantic, Indian and Pacific Oceans. Interim Report, July 1964. Los Angeles: UC, IGPP, July 1964.

Chow, T.J. and A.W. Mantyla. Inorganic Nutrient Anions in Deep Ocean Waters. Nature 206 (1965): 383-385.

Cromwell. Townsend. Circulation in a meridional plane in the central equatorial Pacific. Journal of Marine Research 12 (1953): 196-213.

Cromwell. Townsend, R. B. Montgomery and E.D. Stroup. Equatorial undercurrent in Pacific Ocean revealed by new methods. *Science* 119 (1954): 648-649.

Federal Council for Science and Technology (U.S.). Committee on Oceanography. United States participation in the International Indian Ocean Expedition and the International Cooperative Investigations of the Tropical Atlantic [Washington?] 1964 76 pages.

Fisher, R.L. Discussion-Continental Drift Symposium, March 1964. *Philosophical Transactions of the Royal Society, London* 258 (1965): 139-140.

Fisher, R.L. The Median Ridge in the South central Indian Ocean, in *The World Rift System*, edited by T.N. Irvine. Geological Survey of Canada, Paper 66-14 (1966): 135-147.

Fisher, R.L., G.L. Johnson and B.C Heezen. Mascarene Plateau, Western Indian Ocean. *Bulletin of the Geological Society of America* 78, no. 10 (1967): 1247-1266

Francis, T.J.G., and R.W. Raitt. Seismic refraction measurements in the southern Indian Ocean. *Journal of Geophysical Research* 72, no. 12 (1967): 3015-3041.

Francis, T.J.G. and G.G. Shor, Seismic refraction measurements in the Northwest Indian Ocean. *Journal of Geophysics* (1966).

Harrison, C.G.A. and M.N.A Peterson. A magnetic mineral from the Indian Ocean. *American Mineralogist* 50 (1965): 704-712.

Helfer, M.D., M. Caputo and R.L. Fisher. Gravity measurements in the Indonesian Archipelago, January-February 1963 (R/V ARGO). Interim Report. Los Angeles: UC IGPP, December 1963.

IGY World Data Center A--Oceanography. Special catalogue of data from the International Indian Ocean Expedition /, World Data Center A, Oceanography. Washington, D.C. : WDC-A, 1967. iii, 293 pages.

India (Republic). Indian National Committee on Oceanic Research. International Indian Ocean expedition: Indian scientific programmes, 1962-1965 New Delhi, 1962 46 pages.

Keeling, C.D. Carbon dioxide in surface waters. 4. The global distribution. *Journal of Geophysical Research* (1968).

Keeling, Charles D. and Lee S. Waterman. Carbon Dioxide in Surface Ocean Waters. 3. Measurements on Lusiad Expedition 1962-1963. *Journal of Geophysical Research* 73, no. 14 (1968): 4529-4541.

Knauss, J.A. and Taft, B.A. Measurements of currents along the Equator in the Indian Ocean. *Nature* 198, no. 4878 (1963): 376-377.

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This expedition used two ships, HORIZON and ARGO to explore the southwest Pacific. Previous expeditions carried data in paper form home in suitcases, but this expedition was able to produce new maps of the Pacific while still at sea. The crew and scientists included men and women from 25 countries. They investigated the drift of continents and the expansion of the seafloor in Melanesia. Deep trenches in the ocean near Fiji were found to be the site of frequent submarine earthquakes.

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Circe Expedition investigated bottom topography, magnetic patterns, heat flow, sediment thickness and age, chemical properties of sediments and the overlying water and made localized dredge hauls for petrological crustal studies in the west and southwest Indian Ocean. Igneous rock suites dredged deep in the cross-fractures of the slowly-spreading Southwest Indian Ridge consisted of large little-altered specimens of lower crustal mafic and upper mantle ultramafic rocks never before recovered in oceanic areas. ARGO field-tested the IBM 1800 shipboard computer linked to a prototype satellite navigation system, marking the first time a Scripps vessel's position at sea was obtained automatically by combining ARGO's maneuvering data with observations received from the satellite for display by computer. The expedition also surveyed potential deep sea drilling sites for JOIDES.

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R/V MELVILLE departed San Diego on her maiden cruise on Antipode Expedition on February 14, 1970 enroute to Osaka. The expedition undertook a deep-sea geological-geophysical exploration of the western and northwestern Pacific and north and western Indian Oceans. Its purpose was to survey twenty five sites for deep sea drilling, but its stated goal was to study the age and movement of vast ocean bottom crustal masses in light of the sea-floor spreading hypothesis.

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Indopac Expedition, 1976-1977

INDOPAC was a cooperative international expedition consisting of some 15 legs on THOMAS WASHINGTON. The expedition investigated the deep circulation of the waters, the nature of the crust beneath the sea floor in the marginal basins of the western Pacific Ocean in cooperation with CHIU LIEN, SAMUDERA, and ATLANTIS II. One of the most significant accomplishments of the cruise was the recovery of live benthic amphipods from 5700 meters in pressure retaining traps. This was the first successful attempt to recover and maintain live deep-sea benthic animals in the laboratory. Legs 4, 5 and 6 provided preliminary site surveys for the

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