

Diving under Antarctic ice: a history, 1902 - 1964

Peter Brueggeman



The author diving under the ice at Cape Armitage. Norbert Wu photo

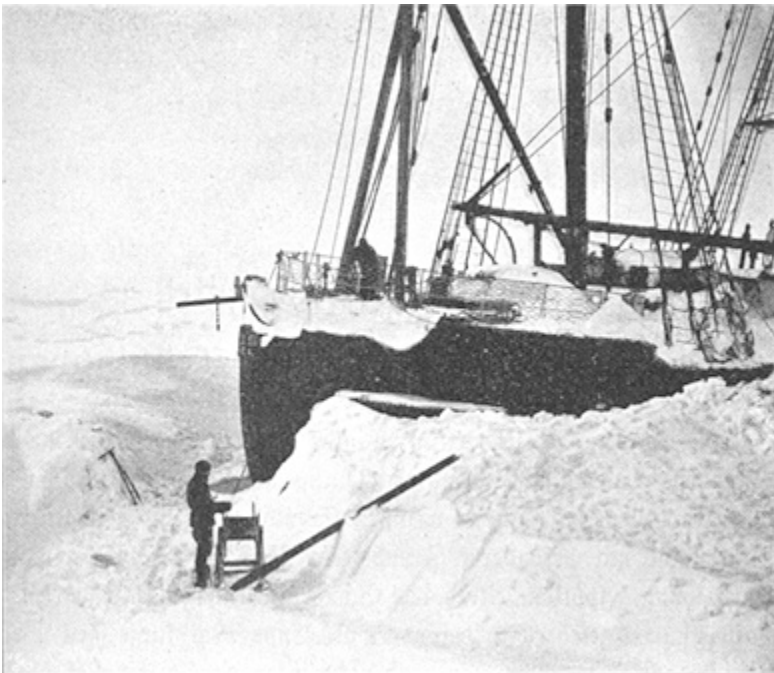
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THE FIRST DIVE UNDER ANTARCTIC ICE



Willy Heinrich was the first to dive under Antarctic ice on or around 16 April 1902 [10]. Heinrich was the second carpenter on Erich von Drygalski's Deutsche Südpolar-Expedition from 1901-1903 aboard the *Gauss* [8,10]. Willy Heinrich was born 27 January 1878, in Altona, Germany, and was taken onto the expedition straight from active naval service, where he had learned diving [10]. Heinrich became known on the expedition for inventing and improving mechanical equipment; his invention of an ice-bicycle was noted for its entertainment value [10].

After this first dive around 16 April 1902, Drygalski's expedition narrative notes that Willy Heinrich did further diving under the ice sometime around June 1902, during the austral winter, in topside temperatures down to -30 deg Celsius [10]. On Drygalski's Antarctic expedition, Heinrich used a Siebe diving helmet and gear to dive under the ice and conduct ship repairs, including caulking and rudder work [8,10]. At Kerguelen Island, Heinrich was sent down to free the anchor chain from seaweed [10].



Here is a picture of the stern of the *Gauss*, where Heinrich would have conducted his diving to work on the ship's rudder; in this photo, someone is fishing [10]. Heinrich reported on the appearance of the underside of the sea ice to Drygalski, but no scientific work was done under the ice, though there was a lot of scientific work undertaken by Drygalski's expedition [8,10].

Of Heinrich's diving observations, Drygalski writes, "mostly it was dark down there, but light came through in places, apparently at points where there were hollows in the snowdrifts around larger pieces of ice [10]." Willy Heinrich appears to have done all the "firsts" in Antarctic and subantarctic diving: open water diving, and diving under the ice.

Willy Heinrich was hired as a carpenter on the Second German Antarctic Expedition of 1911-1912, led by Wilhelm Filchner, on the ship *Deutschland*, but left the expedition after it arrived in Buenos Aires on 7 September 1911 [59,60,61].

Excepting Willy Heinrich, open water diving in Antarctica generally preceded most diving under the ice.

Jean-Baptiste Charcot led the Second French South Polar Expedition of 1908-1910, and wrote that in December 1908, the ship *Telefon*, bringing coal to whalers at Deception Island, ran aground at the entrance to Admiralty Bay and was abandoned [55]. Men from one of the Norwegian whaling companies there got the *Telefon* off the rocks and ran it aground at the end of Deception Bay opposite Pendulum Cove [55]. The next season, the Norwegian whalers got the *Telefon* afloat in November 1909, and Charcot writes [55]:

"The diver began his work. Without any water-tight gloves -- for the poor fellow did not expect to find the sea so cold -- he plunged into the water at a temperature of -8 degrees, and after a few minutes of work under these conditions he had hours of suffering. He went on, nevertheless. The *Telefon* was afloat and, helped by a temporary loosening of the ice, she was brought into Whalers' Cove."

That diver was **Otto Mikkelsen**; in his book on the expedition, Charcot has his name as M. Michelson [55,56].



On December 8, 1909, Mikkelsen examined the hull of Charcot's ship *Pourquoi Pas?*, which had been leaking two tons of water an hour [55]. The captain of the *Telefon* had cut a leather pair of gloves for the diver, but the seams let in water [55]. The crew of the *Pourquoi Pas?* had tubes of liquid rubber, and were able to make Mikkelsen's diving gloves watertight, which was "of priceless value in our friend's work" [55]. About Mikkelsen's examination of the hull of the *Pourquoi Pas?*, Charcot wrote [55]:

"He has been at work nearly three hours beneath the ship, examining minutely all the submerged portions. The low temperature of the water compels him to come up to the surface practically every ten minutes, and even then he remains a few moments without power of speech. Before he began his inspection I asked him, if he found anything serious,

to tell no one but me. His report on the hull, apart from the bows, is satisfactory, and is given aloud. He has discovered a curious big hole on the port-side, extending a long way; a good deal of wood torn off where the hull struck the rock several times at Petermann Island; a few grazes almost all over, caused by the ice; and, finally, what we saw ourselves, a fragment of the false keel torn off astern. Our new irons on the rudder have held good. But when the diver comes up after examining the bows he contents himself with saying, in front of the crew, that there is evidently an injury, though of small importance; and he makes a sign to me that he wants to speak to me in private. A few minutes later I go to see him on board his own ship and, looking rather pale, he tells me that he has discovered a most serious injury. The whole bow below the water-line is torn away as well as several meters of the keel, the wood being pulped right down to the rabbet, and splinters sticking out on all sides [English translation has it as 'stem' and not bow; checking the original French, it's bow]. "You cannot, you must not navigate in such a state in the midst of ice," he says to me. "Mere ordinary navigation is already dangerous, and the slightest shock might send you to the bottom." A few minutes later, M. Andresen [head of the Norwegian whaling crew] comes to look for me and tells me that Michelson has begged him to speak to me and explain to me the seriousness of the matter. I thank them both, but in my turn beg them to let out nothing of what they know. We must continue the task we have undertaken, our honor and, still more important, that of our country being at stake. ... I try in vain to induce Michelson to accept some remuneration for his examination of the ship. He answers with a laugh that he did not come to Deception Island to dive around the vessels of scientific expeditions, so that this has been a pleasant distraction for him. ..."

The Mikkelsen Islands, a small group of islands and rocks lying off the southeast coast of Adelaide Island, 2 miles southeast of the Leonie Islands, were named after him by Charcot [56].

There were undoubtedly other divers like Otto Mikkelsen associated with the various Antarctic whaling companies and operations, who did underwater ship inspections and repairs in Antarctica as needed.



Open water Antarctic diving occurred with US Navy Underwater Demolition Team divers who accompanied Byrd's US Navy "Operation Highjump" expedition to the Antarctic in 1946-1947 [6,22,46]. Their first dive was made shortly after January 1, 1947, by divers Lieutenant Commander **Tommy Thompson** and Chief **John Marion Dickison**, using "Jack Brown" masks and Desco oxygen rebreathers, who inspected a propeller for damage on the submarine USS *Sennet* (SS-408) in the Ross Sea pack ice [12,30,46]. The divers wore thin rubber suits and several layers of woolen underwear as thermal protection [43,44].

Clay Jansson photos at left and below.



About this dive, John Dickison said in his oral history:

"My next assignment was to "Operation High Jump" in Antarctica. My job was to go down aboard the submarine Sennet SS 408, and mount what is called an aerial K-20 camera in the periscope shears, then dive under the Ross ice shelf and take some pictures of the bottom side. This was for research purposes. When we got down there we found the "upside down" fathometer on the sub did not work, so I made the round trip down there as a passenger; I did take some pictures with the portable gear when we got caught in an ice jam. The remote camera showed one screw bent and a chunk taken out of another blade. We went to Wellington, New Zealand, for repair and then we went on to Tahiti for liberty before we went on to Panama [46]."



Operation Highjump U.S. Navy UDT divers, photos from Eric Dean Jansson





Though not covered in this Antarctic diving history, there were snorkeling Antarctic divers aka skin divers. An example is Commander **Standish Backus** on Operation Deep Freeze I, who inspected the port shaft of the USCGC *Eastwind* on 23 February 1956 [58].

POLAR PLUNGE—CDR Standish Backus comes up with report after 1956 dive into Antarctic waters to inspect damage to USCGC *Eastwind* (WAGB 279).



Royal Australian Navy diving equipment consisting of a Siebe-Gorman Salvus suit with a brass helmet was brought on the ANARE ship *Kista Dan* for emergency use at the direction of **Phillip Law**, ANARE Director [38]. On 1 March 1956, Phillip Law wore it in open water at Mawson Station [38]. Law wore heavy woolen underwear inside the suit, and entering the water at shore, floated facedown on the water surface while being towed around by a DUKW [38]. Law wore a canvas mitten on his left hand for inadequate insulation and no mitten on his right hand, in order to hang onto the DUKW; he soon had to get out [38].

Phillip Law, Mawson Station, March 1, 1956.
Photo: www.antarctica.gov.au

During Operation Deep Freeze II, on December 31, 1956, the U.S. Navy cargo ship *Arneb* was operating with the icebreaker *Northwind* at Cape Hallett [57]. Maneuvering in a 60-knot gale, the *Northwind* broke a propeller blade, and the *Arneb* was squeezed against solid bay ice, damaging its hull, bending frames, and flooding a compartment [57].



ARNEB TIED TO ICE NEAR CAPE HALLETT JUST BEFORE THE BIG SQUEEZE WHICH DAMAGED THE SHIP GREATLY.



ARNEB NEAR NORTHWIND FIGHTS ICEPACK.

Damage control crews worked to patch the holes, shore bulkheads, and pump water [57]. Scuba divers aboard the *Arneb* went underwater to check damage to the *Arneb* (photo below at left) and into *Arneb*'s flooded Hold Number 2 to make repairs (photo below at right) [57].



A diver also checked the damaged propeller on the Northwind [57].



UDT MAN CHECKS NORTHWIND'S BROKEN PROP.

Perhaps the first scuba divers under the ice in Antarctica were two US Navy UDT divers from the *Arneb*, who did a single scuba dive under the Antarctic ice on 14 January 1957 [25,45,47,57].

On 14 January 1957, a tracked US Navy Weasel vehicle, carrying six people, was driving along the sea ice off Hut Point, inspecting a pipeline carrying fuel from a tanker at the sea ice edge along the surface of the sea ice to McMurdo Station [25,45,47,57]. The Weasel fell through a thin spot in the ice, and US Navy Seabee Ollie Barrett Bartley, was not able to escape from the vehicle as it sank, due to his arm entangling in the Weasel's radio wire, whereas the other five escaped [25,45,57].

Four Navy divers flew in from the cargo ship *Arneb*; two of the divers, Norman H. Olson of Providence, Rhode Island and James McGee of Granite Falls, North Carolina, did a dive to 30 feet under the ice to recover Bartley's body inside the Weasel vehicle, while the other two divers stood by in case of emergency [25,45,47]. A small boat was placed in the hole through the ice broken open by the Weasel; the boat was tied off to the ice around the hole, with a hang line with a seventy-five pound weight dropped down from the boat to the Weasel, for the divers to follow up and down [45].

UDT MEN RECOVER BODY OF OLLIE BARTLEY FROM SLUSHY BANKS OF HUT POINT WHERE WEASEL PLUNGED.



The United States Board on Geographic Names Advisory Committee on Antarctic Names named Bartley Glacier, a hanging glacier on the south wall of Wright Valley, Victoria Land, just west of Meserve Glacier, after Ollie Barrett Bartley.

At Mawson Station in early 1957, while the ice was breaking up but there was still substantial ice coverage, **John S. Bunt** wore ANARE's Salvus suit and helmet to walk into the water from the shore for a single open water dive of five minutes duration for the purposes of algal collection, using a hookah air line [23]. Bunt found it too cumbersome to use in his further work [23].

In 1958, **Michael Neushul, Jr.**, **Roger O. Dains** (Lt. UDT 12, US Navy) and **Juan Carlos Carosella** (Teniente de Corbeta, Argentine Navy) made 33 open water dives at locations in the South Shetland Islands and the Antarctic Peninsula using wet and dry suits, Pirelli closed circuit rebreathers, and open circuit scuba gear [18,42].

Paul Grua (CNRS Station Biologique de Roscoff) made open water scuba dives at subantarctic Saint Paul and New Amsterdam Islands in the 1958/1959 season [39]. Grua continued diving and with **Andre Tanguy** made open water scuba dives at subantarctic Crozet Islands (Possession Island on 17-18 December 1962) and Kerguelen Island (Morbihan Bay from 23 December 1962 to 5 February 1963, studying flora and fauna in 54 dives down to fifteen meters depth, including dives in the presence of leopard seals; cinematographer **G. Dassonville** made some dives with them [41]. A film on the Morbihan Bay diving, entitled "ECOLOGIE INFRA-LITTORALE À KERGUELEN EN SCAPHANDRE AUTONOME," is at

https://www.canal-u.tv/video/cerimes/ecologie_infralittorale_a_kerguelen_en_scaphandre_autonome.9141

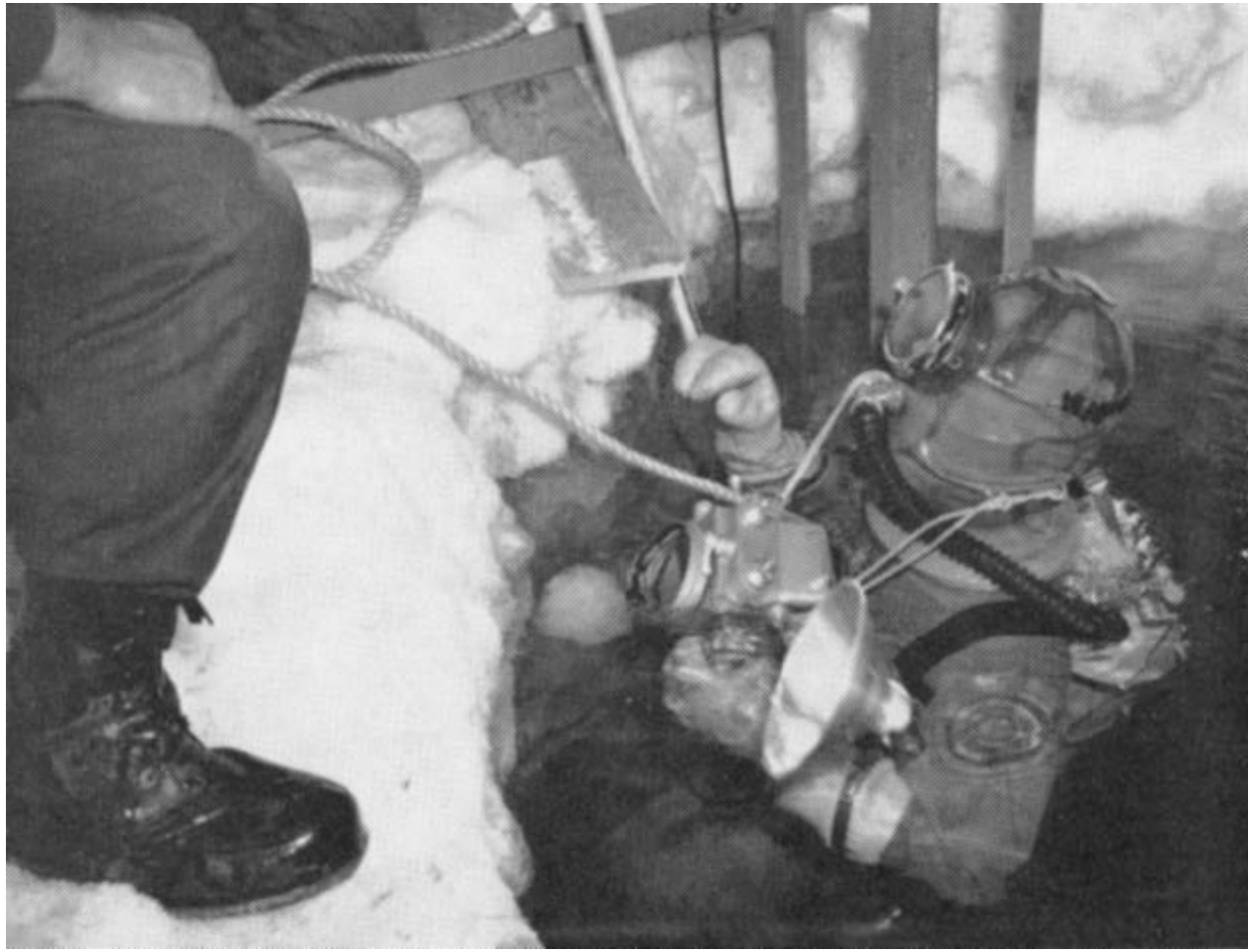


A single open-circuit scuba dive under the ice in Antarctica occurred on 5 January 1961, by divers **Jim Thorne**, a photographer from New York City, and **Donald Johnson**, a project engineer from Skokie, Illinois [48].

Jim Thorne was founder and head of Adventure, Inc., a Chicago photography and film company, and was Skin Diver of the Year for 1958 [49]. Thorne was at McMurdo Station to do underwater photography beneath the sea ice of an Aqua-Therm unit from the Future Products Research Company of Chicago, which was a submersible motor device to force water circulation under the sea ice to erode it, and establish openings [1,14,49,53]. In 7 to 8 foot thick sea ice, ten horsepower Aqua-Therm units opened a rectangular area 19 feet by 58 feet, as well as a hole 45 feet in diameter, keeping them open and ice free [53]. It was determined that larger units could cut ship channel sections or turning basins [53]. Thorne and Johnson made one dive to photograph the device at work underwater, with Thorne entering the water first [1,14,49].



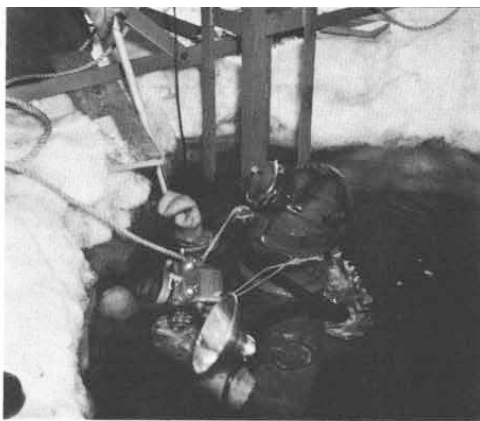
Using constant-volume fabric drysuits entered through the rubberized neck, the divers used two sets of waffle weave thermal underwear, two pairs of wool socks, wool gloves with rubber gauntlets sealed with a metal clamp at their wrists, and rubber hoods fastened to metal neck O rings [1,48].



Entering a seal hole about a thousand feet offshore Ross Island in McMurdo Sound, the tethered divers stayed on the underside of the sea ice ceiling for a 28-minute dive at 15 feet depth, with **Jim Thorne** (left) taking photos of the sea ice ceiling [1,49]. Their Rolleimarine camera had to be handed up through the dive hole after every photograph was taken, in order to change the flash bulb topside [1]. Thorne said he was so cold when he came out that he could just lift his arm [48].

The divers were unable to make additional dives due to poor weather, followed by a cancellation of all diving due to safety concerns, after a killer whale surfaced in the now-enlarged ice hole six days later [1,48].

Here is a report on Aqua-Therm testing that was published in the US Navy's newsletter All Hands (534):29, July 1961.



THE HOLE THING—Ice melter device is readied for test. Right: A diver goes below to photograph bottom of ice.

Ice-Melting Machine

IT MAY NEVER REPLACE icebreakers, but a new ice-melting device recently tested in the Antarctic could save a great deal of trouble for ice-bound areas of the world.

The device, called the Aqua-Therm, melts the ice by violently churning the water under it. During recent Antarctic tests, two 10-horsepower electric motors were submerged in 28-degree water to melt ice up to 10 feet thick. The relatively small motors moved the water at some 30 knots.

For actual operation, large motors would be needed, but the smaller 10-horsepower motors were used because they provided a suitable basis for calculations. Sixty-horsepower units are now available commercially.

During one test at McMurdo Sound a 10-horsepower unit was submerged to about 10 feet below

the ice surface. In something like eight days, an area 26 feet long and 80 feet wide was completely cleared of ice. In addition, another area more than 200 feet long and about 75 feet wide was reduced to a thickness of one or two feet from ice which earlier had been some eight feet thick.

A 45-foot-diameter hole was made in eight-foot ice during another experiment in that same area. During this test, some 7000 pounds of ice were cleared in about four and one half days.

Possible uses of such a device, if proved successful, would be to keep dock areas free from ice and, perhaps, even keep long channels like the St. Lawrence Seaway open.

Although a machine for clearing long channels hasn't yet been developed, indications are that a chain of motors spaced over a distance of



SEAL HOLE is measured before the start of ice melting experiments in ten-foot ice at McMurdo, Antarctica.

several miles has an eroding effect on ice which is greater than that of a machine operating independently.

Navy men who have seen the device work see many possibilities for it, but no steps have yet been taken to scrap any icebreakers.

THAW ENOUGH—New device starts melting process by moving 700,000 gals. of water an hour at speed of 30 knots.





Verne E. Peckham made a series of year-round scuba dives under the McMurdo sea ice.

Starting in November 1961, with a dive near Cape Armitage, Peckham did the first extensive diving under the Antarctic ice as well as the first scientific diving under the Antarctic ice. Peckham followed Willy Heinrich in doing winter diving under ice while Antarctica is cloaked in total darkness.

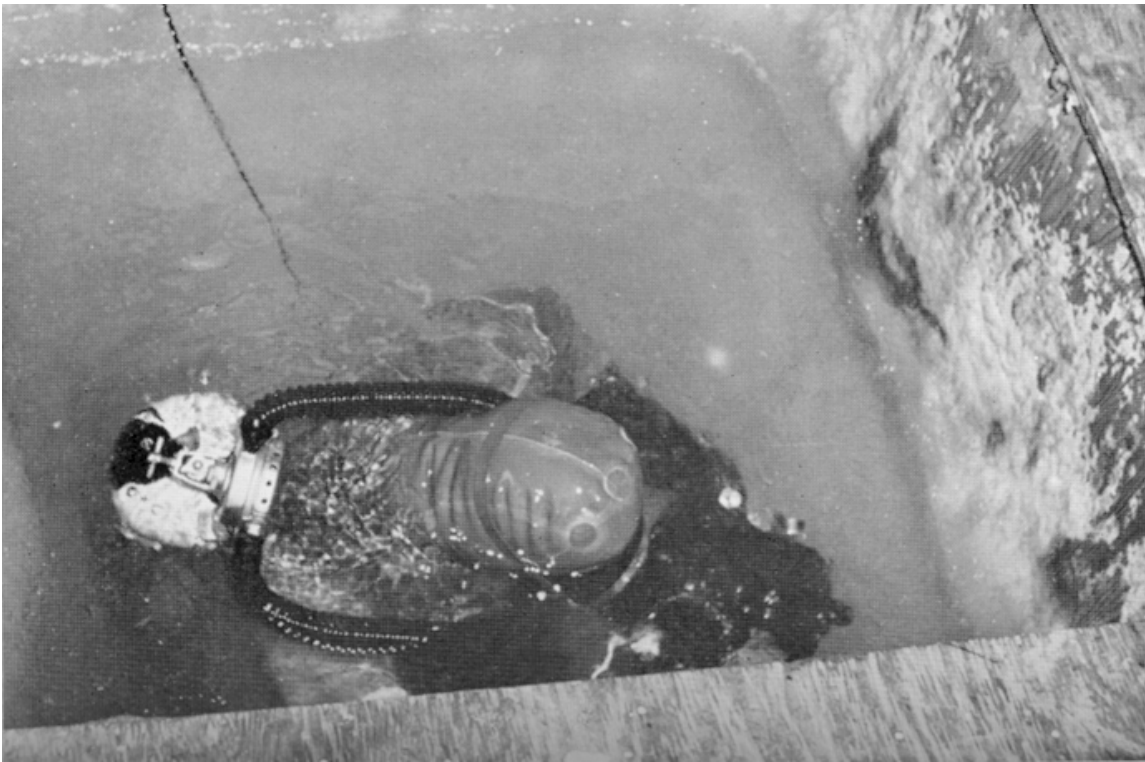
From November 1961 through October 1962, Peckham made thirty-five solo dives as a side interest from his work as laboratory manager for Donald (Curley) E. Wohlschlag (Stanford University Dept of Biological Sciences) [2,17].



Gerald (Jerry) Kooyman was a dive tender on Verne Peckham's first dive at Cape Armitage; Kooyman is shown at left with Peckham in front of the Bio Lab [27].

Peckham did most of his dives at Winter Quarters Bay, with two dives near Cape Armitage, and a single dive at Cape Evans, with dives lasting up to an hour, and his deepest dive to 160 feet [2,17].

Peckham studied benthic ecology and abundance, bringing up specimens to photograph in the lab; he also put down one meter diameter welded metal rings on the bottom for long term studies [17].



A portable wooden shack was placed over a hole cut in the ice with a chain saw by Arthur DeVries, and Peckham entered the water through a hole in the floor of that heated dive shack [2,17]. Peckham was tethered when he moved away from the dive hole [2].

To measure water clarity, Peckham used a pen-light globe and batteries placed in a glycerine filled glass jar, lowering it into the dark winter waters to be seen straight down at a depth of nearly 100 meters [2,17].



Donald E. Wohlschlag, for whom Verne Peckham was a laboratory manager.

PL. 10 Dr Donald Wohlschlag mending a wire trap at
McMurdo Sound.

Official U.S. Nat. Sci. Foundation photograph



Peckham's dive gear included a Bel-Aqua/Aquala dry suit with attached gloves, and a neoprene wetsuit, wool mittens, and wool sweater worn as undergarments for warmth [2,17]. Peckham wore Duckfeet fins and used a two hose Aqualung regulator and a single Aqualung tank with a pipe fitting [17]. Peckham took photographs with a Rolleiflex camera in a Rolleimarine housing, and a 22.5-volt battery capacitor for flash; he used a Bolex 16mm movie camera on one dive [2].



Verne Peckham being assisted by Art DeVries and others, January 1962.



On location for multiple dives, Peckham's tank was refilled from larger cylinders, brought out from base [25].

Underwater flood lights connected to a surface generator were used to illuminate the bottom during dives through the Antarctic winter [2,17].

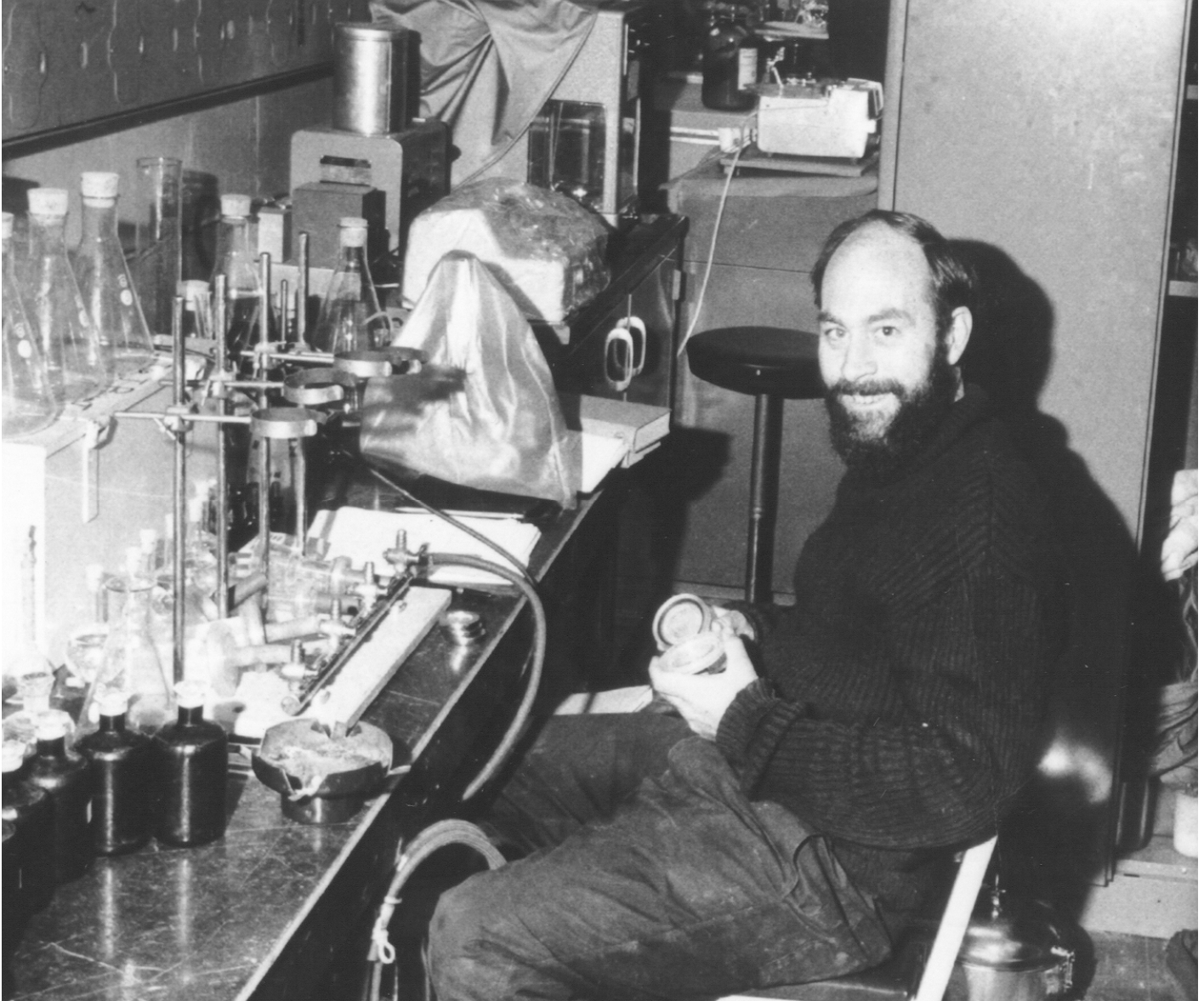
Peckham survived an uncontrolled feet-up ascent from 150-foot depth due to insufficient control over drysuit inflation, after which he coiled in his tether rope to find his dive hole [17].

The United States Board on Geographic Names Advisory Committee on Antarctic Names named Peckham Glacier, a steep tributary glacier in the Britannia Range, flowing south from Mt. McClintock into Byrd Glacier, after Verne E. Peckham.

Early in 1962, **Phillip Law**, ANARE Director, brought conventional scuba gear to Wilkes Stations in the ANARE ship *Thala Dan*, using it for the first time on 11 January on an open water dive [38]. Law wore a neoprene wetsuit with woolen undergarments and was tethered to a DUKW [38]. Thirteen days later, Law used his scuba gear again while the ship *Thala Dan* was tied up to an ice floe just off an ice tongue at Cape Mikhaylov [38]. On this dive, Law's single hose second stage regulator froze up from moisture in his breath, cutting off his air when he was ten meters deep beneath the ship's propeller [38].

Between 18 December 1962 and 7 January 1963, **John S. Bunt** (Univ of Sydney, School of Agriculture, Microbiology Laboratories) conducted seven scuba dives under the ice at two locations near Cape Armitage (over 25 meters and 300 meters of water), in order to collect sea ice microalgae [9,23].

Bunt was invited by Jack Littlepage as a guest of Donald E. (Curley) Wohlschlag (Stanford Univ) to conduct ice microalgae studies at McMurdo; Bunt was at McMurdo for the 1961/1962 and 1962/1963 seasons, with his diving occurring that second season [23].



Previously Bunt had studied microalgae at Mawson Station, Antarctica, from 19 June 1956 to 2 October 1957 using topside collecting apparatus, with one exception [23,24]. At Mawson Station in early 1957, while the ice was breaking up but there was still substantial ice coverage, Bunt wore ANARE's Siebe-Gorman Salvus suit with a brass helmet to walk into the water from the shore for a single dive of five minutes duration for the purposes of collection, using a hookah air line [23]. Bunt found it too cumbersome to use in his work [23].

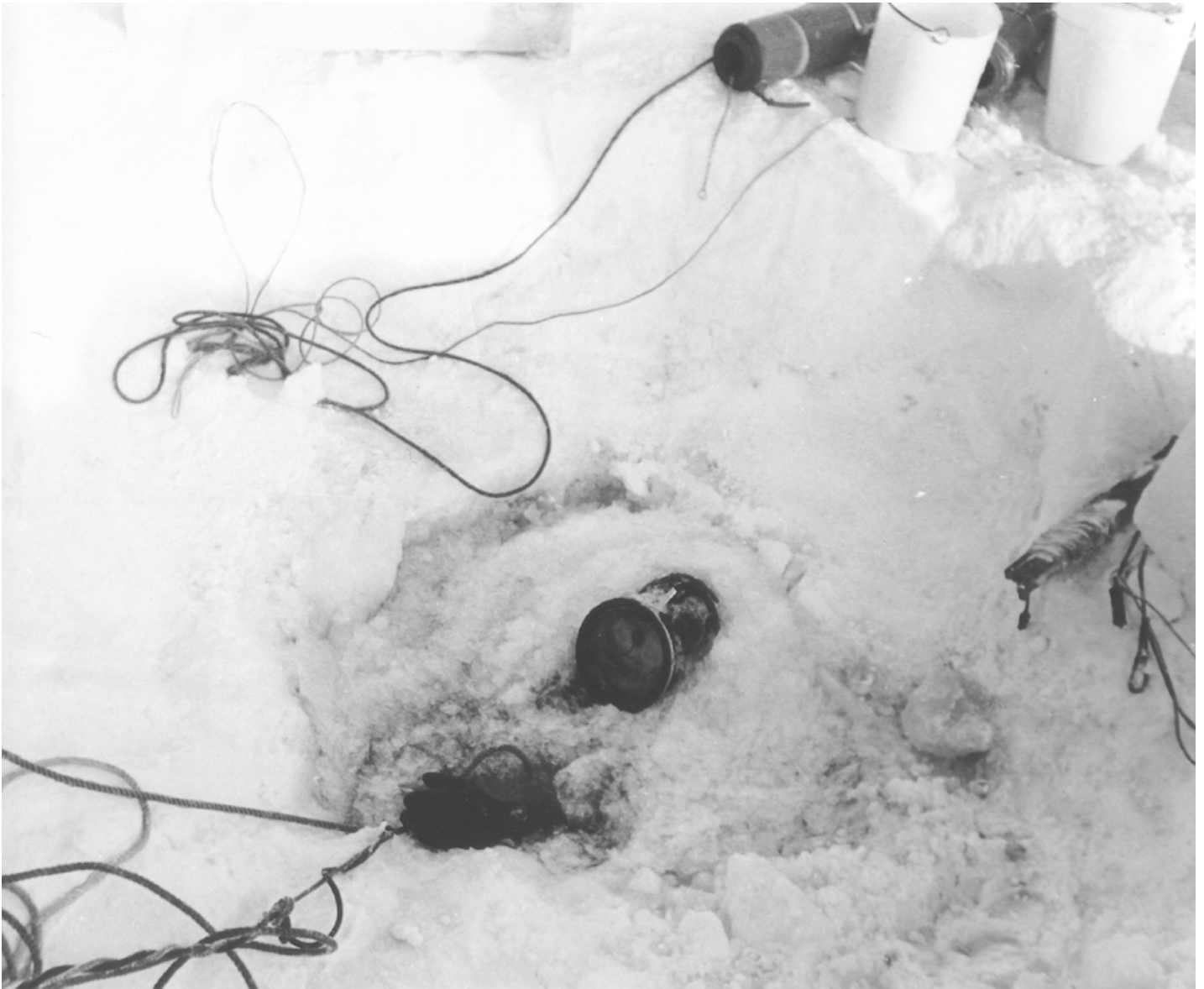


Shown here in December 1962, Bunt went diving at McMurdo through 4-5 meter thick sea ice in order to dive the underside of the sea ice, collecting algae in the brash ice on the underside [23]. Bunt used the drysuit recently used by Verne Peckham, and was a tethered diver, with topside dive assistance by Norman Laird [17,23]. Bunt wore normal indoor clothing under the drysuit (socks, pants, shirt, pullover) [23].

On his first dive Bunt used a Scubapro Visionaire full face dive mask with an integrated second stage regulator; Bunt found this problematic and switched to a standard twin hose regulator and face mask for subsequent dives [23]. Bunt hung a strong flashlight either above the dive hole or in the water, in order to find his way back to the dive hole in the dark using his tether [23].

In a later effort, John Bunt's work fielded a diverse diving program starting with winter diving under the ice at McMurdo Station on 25 June 1967, and continuing into summer diving through December 1967, followed by under ice diving from icebreaker channels in the Weddell Sea in February-March 1968 as part of the International Weddell Sea Oceanographic Expedition-1968 [26,35]. The U.S. Coast Guard *Glacier* and Argentina's *General San Martin* were the icebreakers used in the Weddell Sea, with Coast Guard divers **David Forsythe** and **Bob McLaren** accompanying the Bunt program divers of **Chun Chi Lee** and **William J. Boggs, Jr.** [26,32,35].

Coast Guard divers **David Forsythe** and **Bob McLaren** did extensive Antarctic diving from 1966-1968 in support of *Glacier* ship operations, including a 220-foot dive near Palmer Station [32].



Here is John Bunt diving under the ice through an enlarged seal hole at McMurdo in summer 1967, wearing a Scubapro Visionaire full face dive mask with an integrated second stage regulator, twin 70 cf tanks with J valves, and a ¼ inch neoprene wetsuit (waist-length pants, jacket with separate hood, zippers at wrists and ankles and down the jacket front, neoprene booties and three-fingered mittens) [23,26].

Bunt reported that they were thoroughly chilled after 45 minutes exposure, recommending more thermal protection like the suits used by Ray and Lavallee [26]. Bunt reported that the Scubapro Visionaire full face dive mask was problematic in that it provided insufficient air under heavy exertion, interfered with middle ear pressure equalization on deeper dives, encouraged mask flooding for ear pressure equalization which defeated the purpose of using a full-face mask for thermal protection, and could not support buddy breathing in an emergency [26].

Bunt Island, just east of Bowl Island at the head of Amundsen Bay in Enderby Land, was named by ANCA for John Bunt, as was Mount Bunt, a sharp, conical peak of 2,315 m, situated at the southwest end of a group of low peaks about 7 mi southeast of Mount Hollingshead in the Aramis Range, Prince Charles Mountains.

From 31 October to 12 November 1963, **G. Carleton Ray** (New York Zoological Society) led a project studying Weddell seals, including metabolism, physiology, and sound echolocation [4]. **Ray**, **Elmer T. Feltz** (Arctic Health Research Center, Anchorage, Alaska), and **David O. Lavallee** (Lt, USN) did ten scuba dives as part of this work [4].

In their first diving season, Ray, Feltz, and Lavallee moved no further than ten meters horizontally untethered, and tethered themselves if working further away, with dive durations from 15 to 34 minutes [4]. Some of their diving operations used a dive hut over a dive hole, and a drop line from the hole with an attached flashing beacon was used [4]. For underwater still photography, they used Calypso or Nikonos cameras with a fifty-watt second strobe designed by Harold Edgerton of MIT [4].

Ray's seal research continued for three more seasons, with the following two involving diving. In the next 1964/1965 season, Ray returned to work on seals, diving with David O. Lavallee and underwater cinematographer **Peter R. Gimbel** [5,31].



In the following 1965/1966 season, Ray (middle) returned for more seal work, diving with **Michael A. deCamp** (left), who functioned as lead diver, and Lavallee (right) [33,34]. In this third season, their diving commenced on October 17, 1965, while they were encamped at Turtle Rock [34].



Left to right are Feltz, Lavallee, and Ray in 1963, with Mount Erebus in the background. In this first diving season for Ray's work, dive gear included customized neoprene wet suits made by Parkways [1/4 inch (six millimeters) thick pants up to armpits; 1/8 inch thick hooded vest; 1/4 inch thick jacket with attached hood; no zippers; three-fingered gloves], double 70 cubic foot tanks with J reserve valves, Sportways Waterlung single hose regulator with pressure gauge, US Divers Aqua Master double hose regulator, and horse-collar inflatable safety vests [4].



Ray's research project included the use of a Sub-ice Observation Chamber (SOC) located over a thousand feet of water, with a twelve-foot access tube, suspending two people two meters below the surface [4,5,21].

At left, during their 1964/1965 season, Lavallee is shown next to the SOC [29].

Manufactured by Alpine Geophysical Associates Inc., the steel observation chamber was 1.8 meters high and 1.2 meters wide, with six glass observation windows, and underwater searchlights lighting up to 45 meters distance [21]. SOC was buoyant and counterbalanced by a suspended weight and held in position by four arms extending from the top of the access tube, anchored to 'dead men' in the sea ice [21].



A diver from the Carleton Ray group next to the SOC during the 1964/1965 season [52].



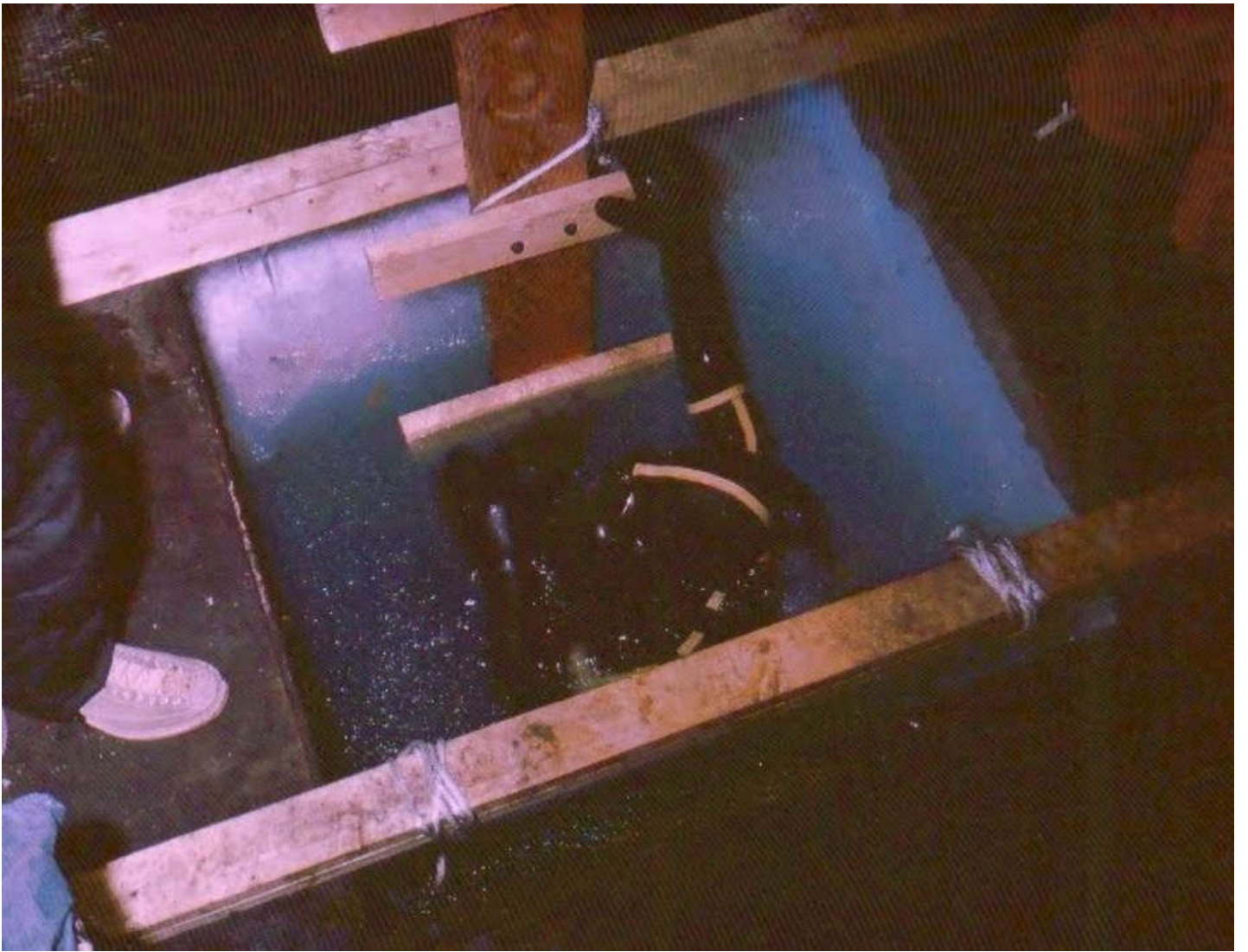
Divers during Deep Freeze 1964, National Science Foundation photo. From left to right: Elmer T. Feltz, Carleton Ray (with his back toward the camera), and David Lavallee [50].

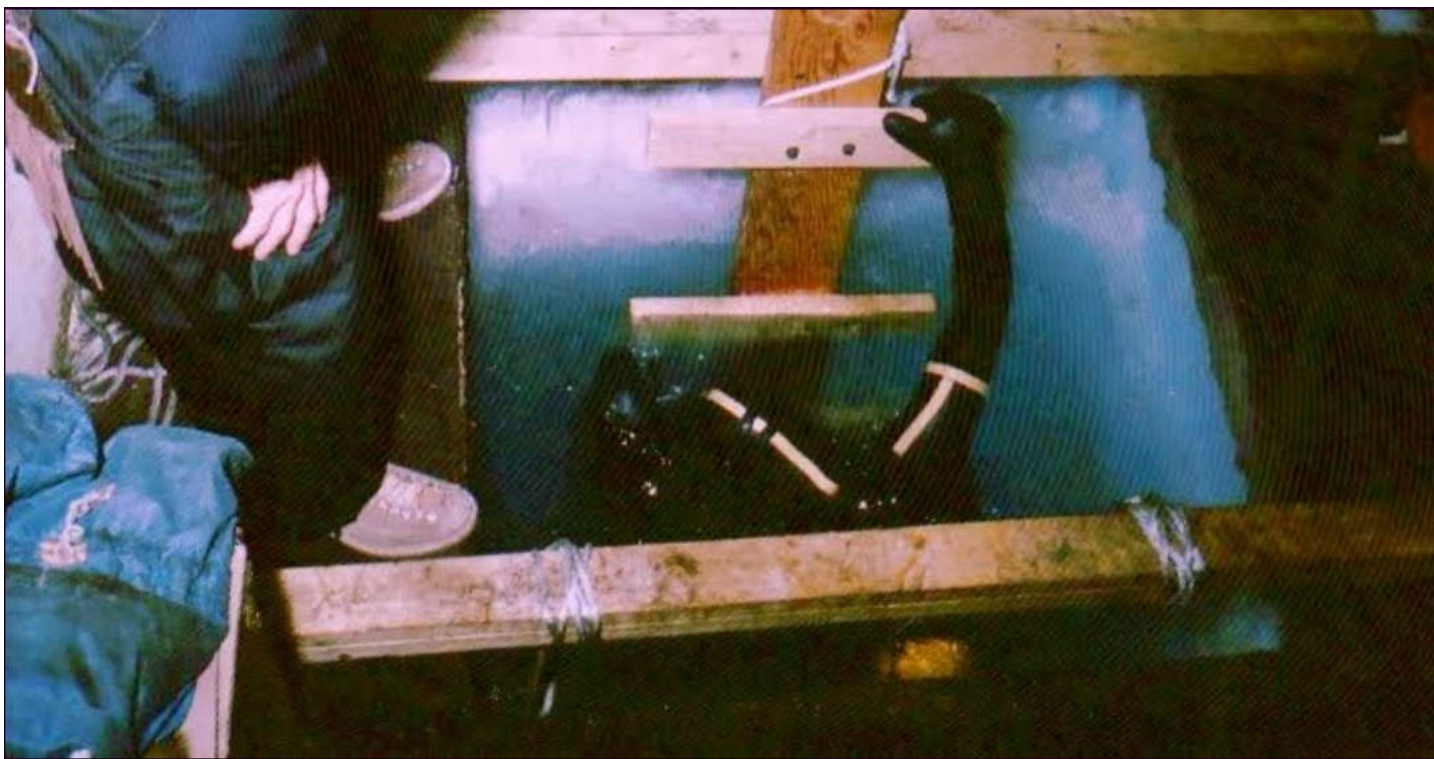
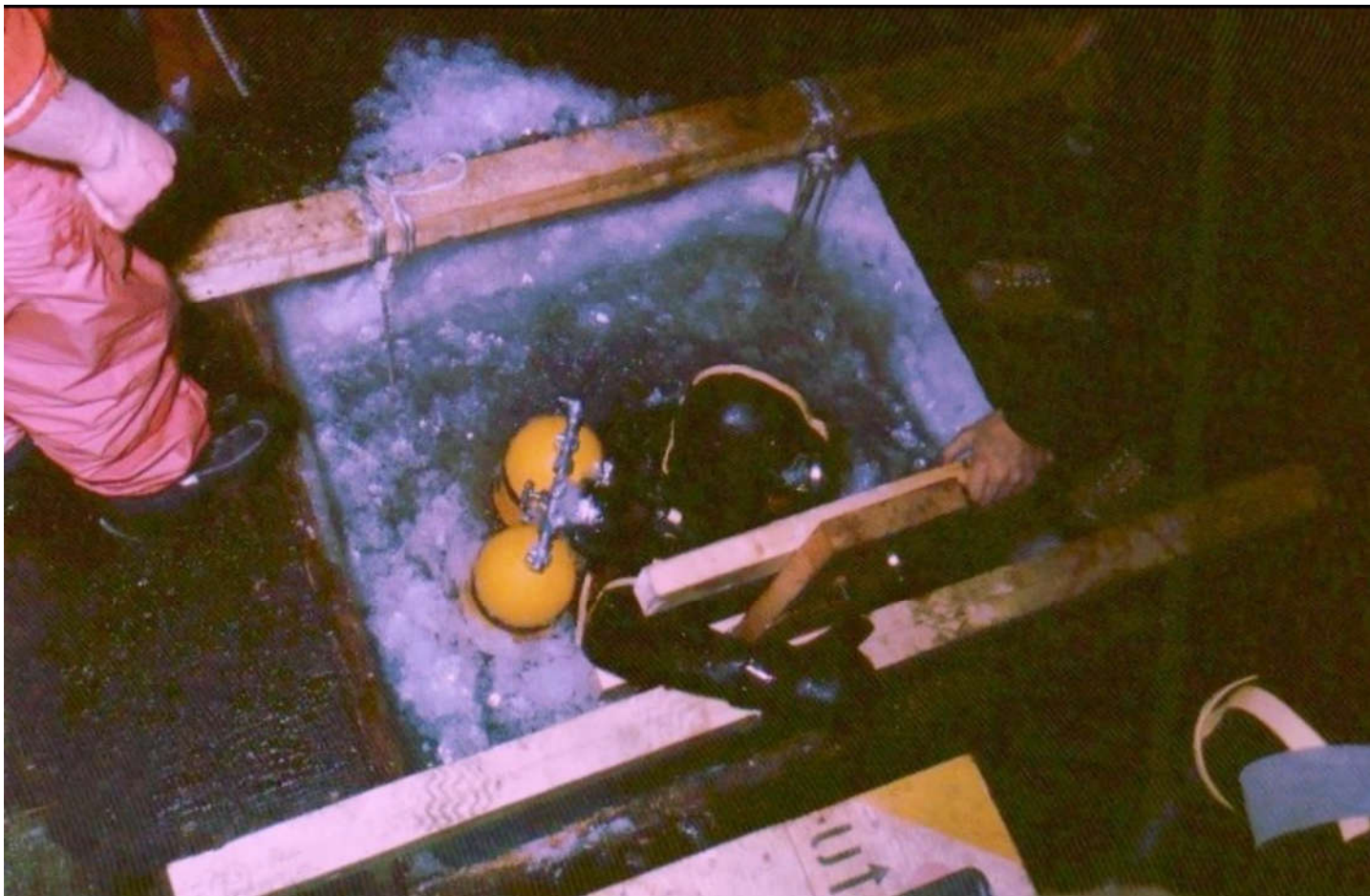
The United States Board on Geographic Names Advisory Committee on Antarctic named Mount Ray, a peak at 3,905 meters, standing 1.5 miles southeast of Mount Fisher in the Prince Olav Mountains after Carleton Ray, and named Lavallee Peak, a peak at 2,175 meters, just northwest of Gibraltar Peak in West Quartzite Range after David Lavallee. Lavallee Point, the northernmost point of Shipton Ridge in the Allan Hills, Victoria Land, was named by the New Zealand Antarctic Research Programme Allan Hills Expedition of 1964.

Photographs taken by Henry Rautio during Deep Freeze 1964 (1963/1964 season). Diver is David O. Lavallee [50].

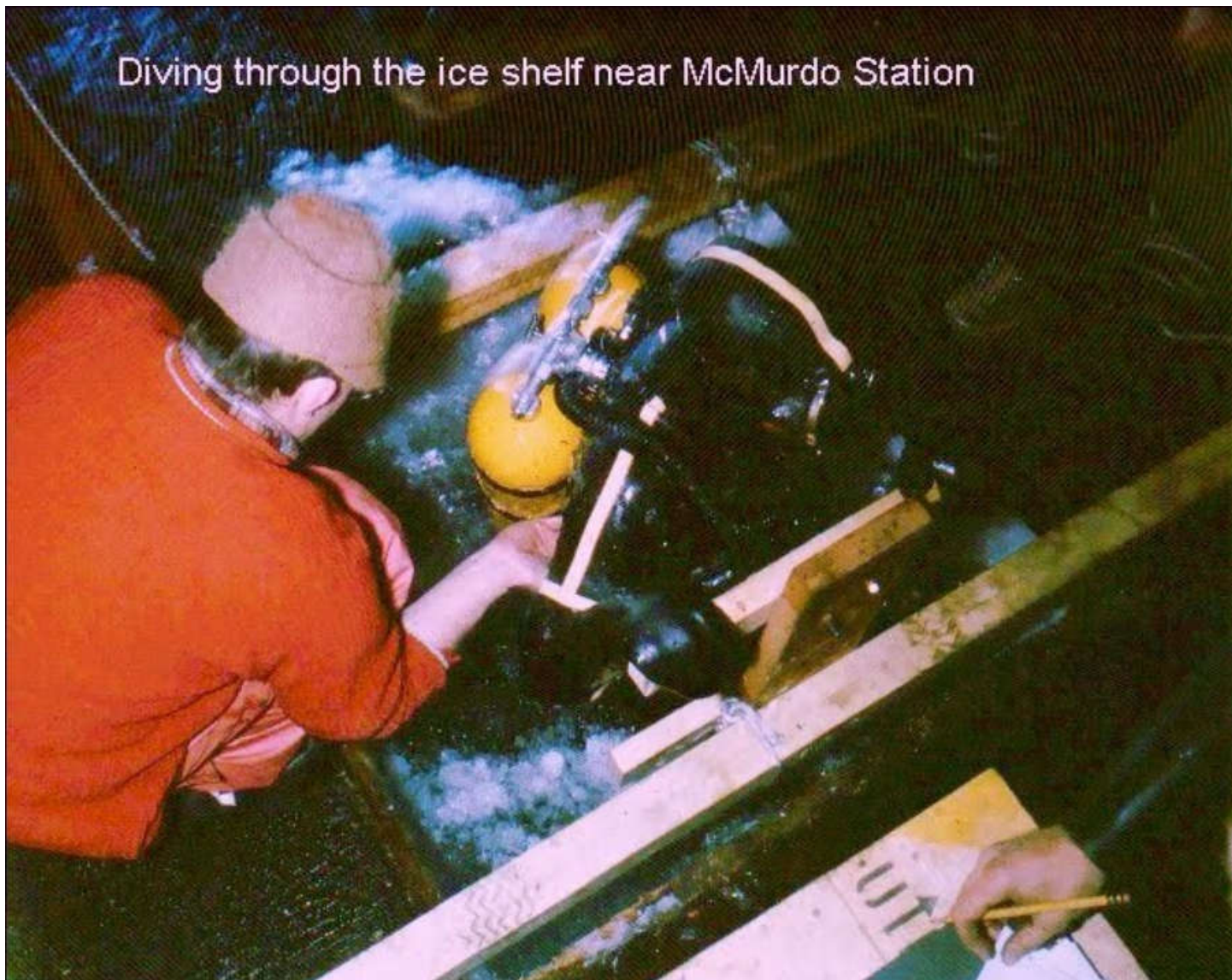








Diving through the ice shelf near McMurdo Station





Diving for algae

Photo of unidentified divers during 1963/1964 season, likely David Lavallee and Carleton Ray [51].



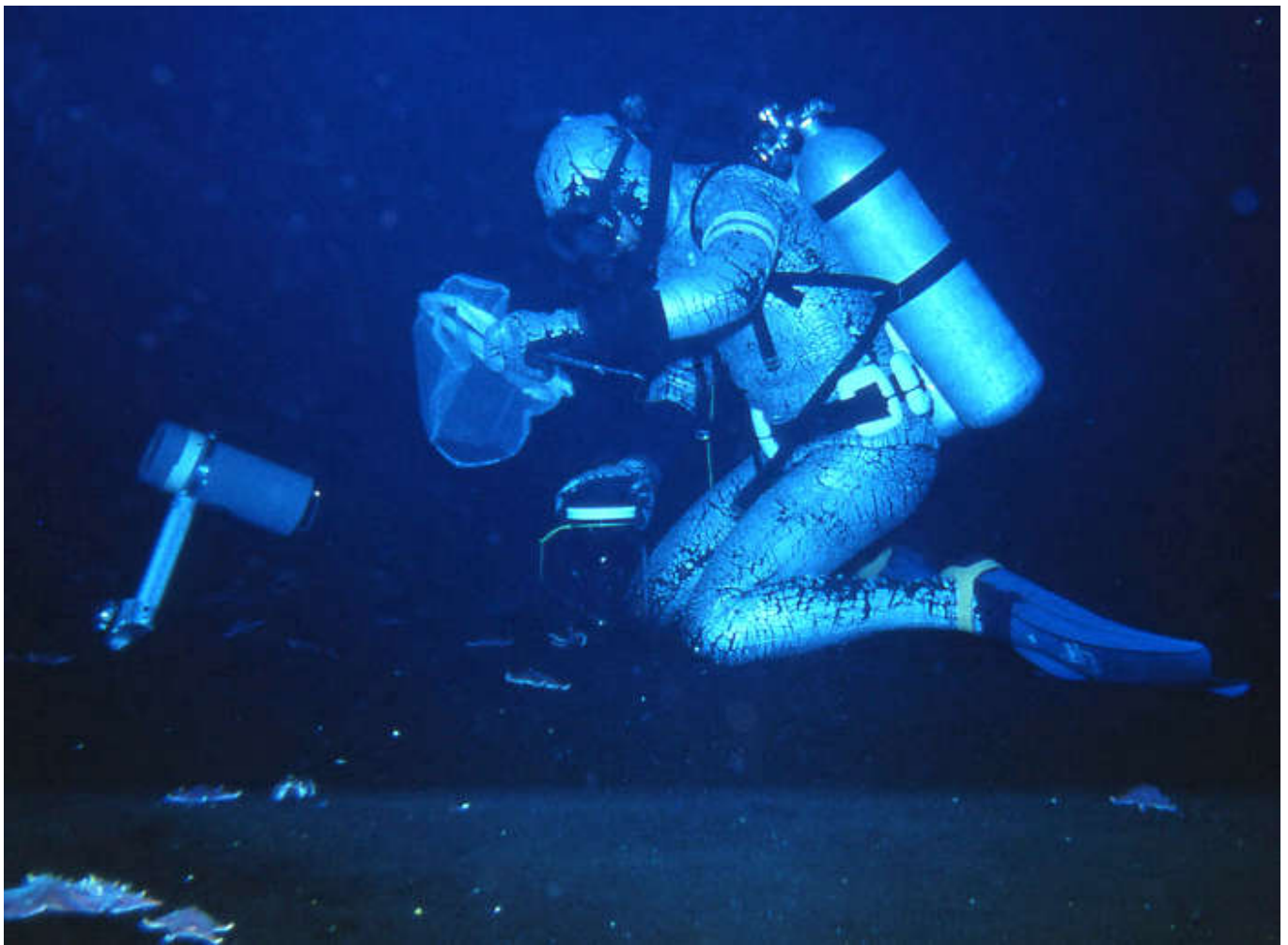
Rear Admiral **James R. Reedy** emerges from under the ice of McMurdo Sound, during the 1964/1965 season. Assisting divers are David Lavallee (left) and Carleton Ray (right) [52].



At left are screen snapshots from Carleton Ray's film footage shot in the 1964/1965 season (converted to grayscale for clarity).

The middle shot shows Ray collecting.





Carleton Ray collecting on the bottom at about 20 feet depth, 1966 (Lavallee photo) [29].



Carleton Ray collecting on the bottom, about 20 feet depth, 1966 [29]. (deCamp photo)



Carleton Ray facing Weddell seals under the ice, 1966 [29]. (deCamp photo)



Gerald (Jerry) Kooyman (University of Arizona Dept of Zoology) started diving under the ice in the 1963/1964 season as part of his research on Weddell seal diving physiology [11,13,20,27]. Kooyman was a dive tender on Verne Peckham's first dive at Cape Armitage during the 1962/1963 season and brought his own diving gear for his seal work the next season of 1963/1964 [27].

Kooyman's first dive was on 9 November 1963 with Carleton Ray and David Lavallee [27]. Kooyman's second dive was the following day on 10 November with Carleton Ray [27]. Kooyman and Ray went diving in Donald (Curley) Wohlschlag's hole at Cape Armitage near the helicopter port; Paul Dayton was a topside diving tender [27]. Kooyman may have made a few more dives under the ice his first diving season [27].



In this photo from the 1964/1965 season, Jerry Kooyman (left) with diving gear assisted by Jacques Zaneveld, on whose project Kooyman was diving [27].



Jerry Kooyman diving at a Weddell seal hole that following 1964/1965 season on Jacques Zaneveld's project, with James M. Curtis assisting [27].



In this photo from the 1964/1965 season, Jerry Kooyman (left) did some of his diving that season with Jacques Zaneveld's second season divers, **Jack K. Fletcher** (middle) and **James M. Curtis** (right) [27].



In this photo from the 1964/1965 season, Gerald Kooyman is in the middle between James M. Curtis (left) and Jack K. Fletcher (right) [27].



In this photo from the 1964/1965 season, Gerald Kooyman is at left being assisted by Jacques Zaneveld, with James M. Curtis (middle) and Jack K. Fletcher (right) [27].

The United States Board on Geographic Names Advisory Committee on Antarctic named Kooyman Peak, a mountain at 1,630 meters on a ridge just south of Dorrer Glacier in the Queen Elizabeth Range, after Gerald Kooyman.

From December 1963 to February 1964, a project led by Jacques S. Zaneveld (Old Dominion College, now University) studied the algal flora found under the ice, including the macroalgae on the seafloor [7,13,54]. **Willard I. Simmonds, Jr.**, an undergraduate student at Zaneveld's college, did 45 scuba dives, with Zaneveld assisting (Zaneveld was not a diver), including a dive at Cape Crozier [7,13,27,28,54]. Simmonds was tethered on many dives [28]. Zaneveld's collections were made by dredging and scuba diving, with collections including freshwater lake algae [13].

Zaneveld's initial project did its diving through two seasons, December 1963 to February 1964, and October 1964 to January 1965 [7]. Both seasons of diving encompassed 116 scuba dives, at depths down to thirty meters, for up to 21 minutes duration [7]. James M. Curtis and Jack K. Fletcher did the diving for Zaneveld's project during that second 1964/1965 season [7,31,54]. Over these two seasons Zaneveld's divers did their diving under the ice through hand-enlarged Weddell seal holes, at a variety of sites on Ross Island, Beaufort Island, Franklin Island, Possession Islands, and locations along the coast of Victoria Land up to Cape Hallett [7,54]. Zaneveld's divers made extensive algal collections, resulting in specimens dried on herbarium sheets and kept wet in preservative [19]. Zaneveld continued his algal work in the following seasons, with divers including **David M. Bresnahan** and **Leonard L. Nero** [40].

The United States Board on Geographic Names Advisory Committee on Antarctic named Simmonds Peak, a prominent rock peak at 1,940 meters, standing four miles south of Mount Dort on the east side of Amundsen Glacier, in the Queen Maud Mountains, after Willard I. Simmonds, Jr.

This historical tally closes as diving and divers under the Antarctic ice for scientific research multiplied in seasons following the 1963/1964 season. Some of the diving projects above continued into seasons following 1963/1964, including Bunt, Ray, and Zaneveld. It is difficult to ascertain from the scientific literature when diving under the ice began in the Antarctic programs of other countries than the US, but it seems to have started later than this closing 1963/1964 season.



Unidentified diver & helper in the 1964/1965 season [52]. Diver is either James M. Curtis or Jack K. Fletcher, who is handing over collected algae to Jacques Zaneveld [50].

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