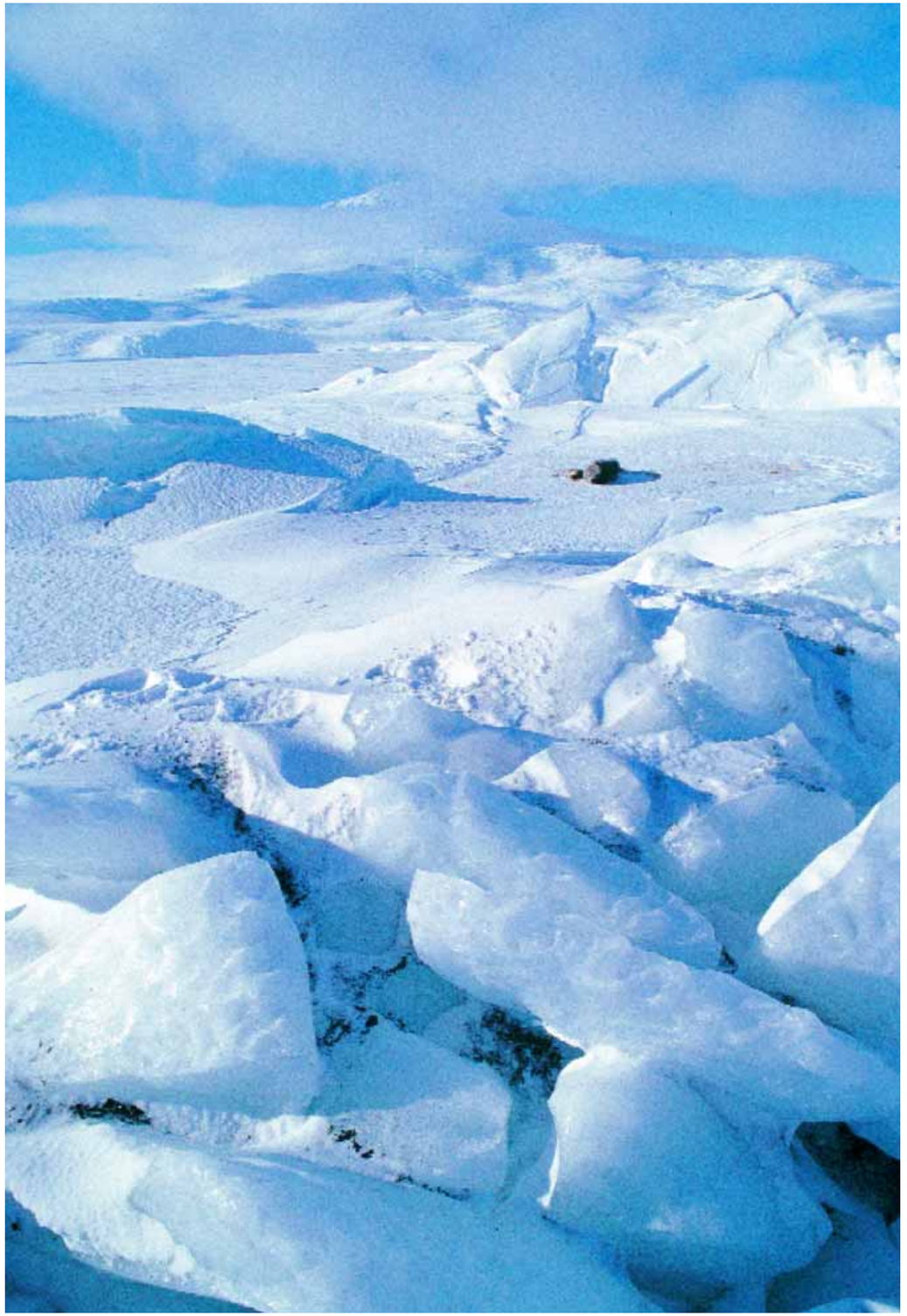
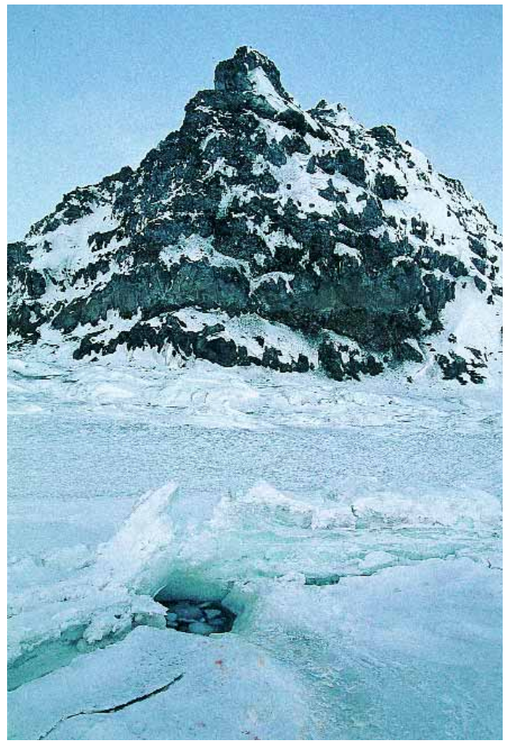
A mother Weddell seal and her newborn pup rest on the sea ice near a pressure ridge at Little Razorback Island. Few animals endure as dramatic a change in environment as a Weddell pup when it is born. The pup is ejected from a 37°C (98.6°F) liquid womb onto hard ice, where the temperature might be -20°C (-4°F) and a wind might be blowing at 30 knots. Fortunately, the pups are covered with a thick natal coat of gray fur called lanugo. After about two weeks, they begin to molt into a silver-gray, spotted coat like that of adults.



Most Weddell seal pups are born by early November. The mother stays with the pup constantly for the first two or three weeks, after which she may leave it alone on the ice while she makes short dives. The mother's milk starts out at about 30 percent fat and becomes progressively richer until it is as much as 60 percent fat. With that kind of diet, the pups are able to put on about 2 kilograms (4.5 pounds) a day, and they begin to lay down the thick blubber layer that will ultimately protect them from the cold. When they wean, at about seven weeks, they weigh 100 kilograms (220 pounds) or more. The mother, on the other hand, will have lost 100 to 150 kilograms (220–330 pounds) of her original 450 kilogram (990 pound) weight.

A mother Weddell seal sniffs her newborn pup. Smell seems to be an important means of identification between mothers and pups, though they also frequently call to each other. The mother sniffs the pup often and will turn away pups that don't smell right. If her own pup has been contaminated with the scent from another, she may reject it.



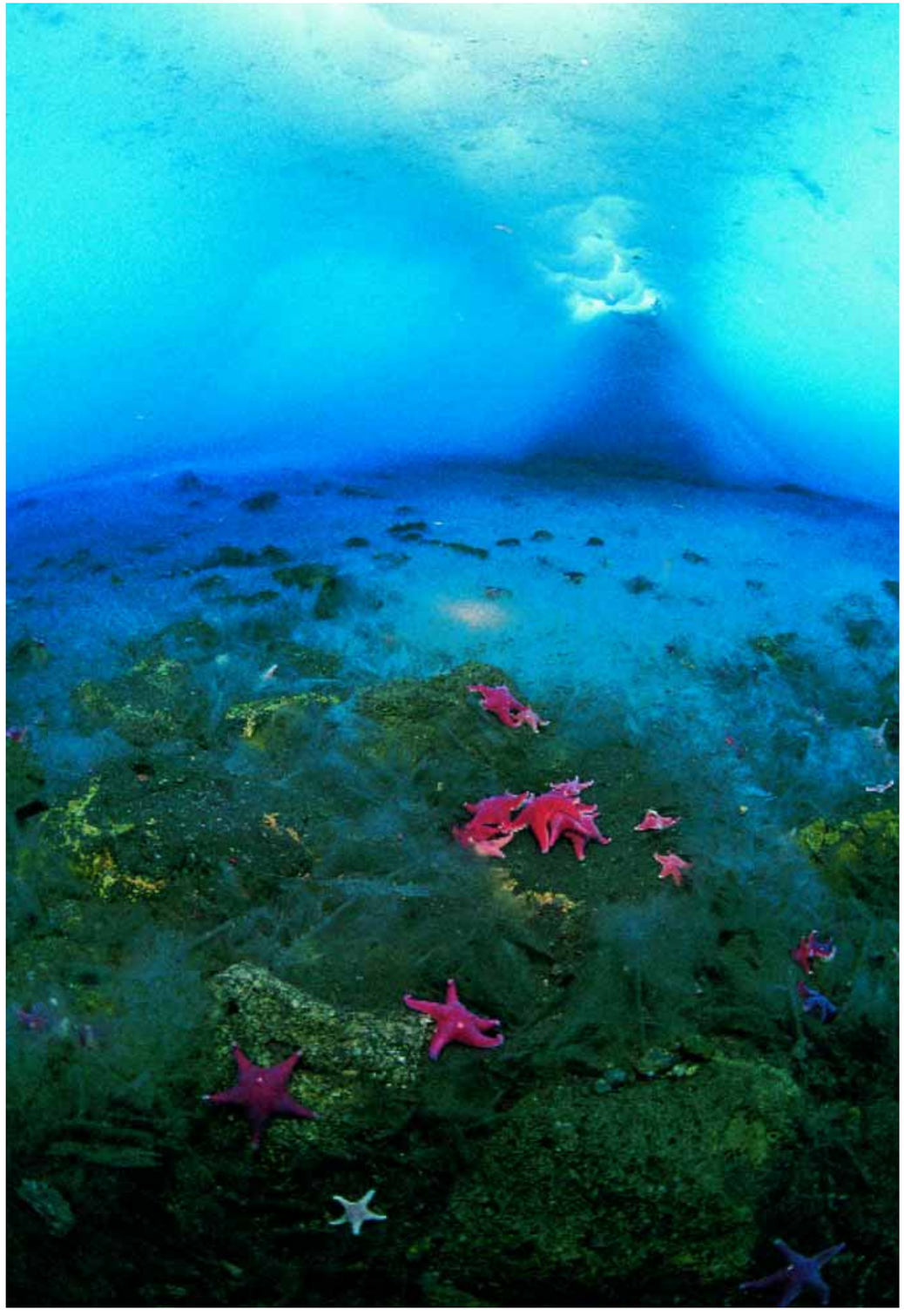
Of the five species of true seal that inhabit Antarctic waters, Weddell seals *(Leptonychotes weddellii)* are the only ones adapted to life in a fast-ice environment. They are also the only naturally occurring mammal to live this far south year-round. Weddells possess forward-angled upper incisors that allow them to ream breathing holes in the ice and keep them open during the winter, when standing water freezes quickly. At times, the hole they maintain is barely big enough for their nostrils. Nonetheless, the ability to live under nearly solid ice allows Weddell seals to thrive where no other mammal could even survive. Not only does this mean less competition for food resources, but the fast ice also affords them unparalleled protection against predation. In fact, only when the fast ice clears out of McMurdo Sound in late summer are Weddells at risk of attack by their only significant predators, the orca whale *(Orcinus orca)* and the leopard seal *(Hydrurga leptonyx).* ¶ Weddell seals eat a large variety of vertebrates and invertebrates, including fish, squid, octopus, and euphausiids. Although they consume many fish species, including on occasion the giant Antarctic toothfish, or cod *(Dissostichus mawsoni),* and the ice-dwelling bald notothen *(Pagothenia borchgrevinki),* a majority of their diet consists of the Antarctic silverfish *(Pleuragramma antarcticum),* which biologists believe lives in large schools in the midwater depths of the sound.

Exploring the shallow water near a seal colony can be both exhilarating and eerie. The otherworldly trills, buzzes, and thumps of Weddell seals fill the water and reverberate through the diver's body. The surface ice forms a multitude of caves and tunnels from which and into which seals are constantly slipping, like wraiths in a haunted house.

Shortly after losing their lanugo, at about two weeks, Weddell seal pups start taking to the water. The mothers encourage them, even forcing them in at times. The youngsters have only a short time to learn the fundamentals of caring for themselves and navigating the world under the ice before they are left to their own devices. When the two are in the water, the mother stays close by. If a bull or another female gets too close, the mother will chase it away. If the pup has trouble getting out of the water, the mother will assist by pushing from below. At the age of seven weeks, the pups are able to dive to 100 meters (330 feet) and hold their breath for 5 minutes. Within fifty days of birth, their mothers desert them.

A Weddell seal feigns aggression toward a diver, practicing for the day when he will have to defend a territory against other males. Much as other pinnipeds do on land, Weddell seal males establish well-defined territories underwater, which they defend aggressively against challengers, often engaging in violent undersea battles. During the October to mid-December breeding season, even the act of breathing can be dangerous: a male with his head in the air is a fair target for nips at flippers and genitals. For this reason, males tend to take quick breaths and keep their heads in the water as much as possible, always looking down and around. (For the same reason, discerning divers exit a dive hole as quickly as possible if territorial seals are nearby.) On occasion, Weddell males will assume a head-down posture with rear flippers in the air as they attempt to prevent other seals from using a hole.

Weddell seals are among the world's most proficient divers. Instruments attached to adult seals have recorded dives of up to 82 minutes' duration and to depths in excess of 700 meters (2,300 feet). Since this represents the bottom of McMurdo Sound, it is entirely possible they can go deeper. Weddell seals manage these feats through a series of physiological adaptations geared to increasing diving capacity. The seals store a tremendous amount of oxygen in their bodies, bound to hemoglobin in the blood and to myoglobin in the muscles. They conserve this oxygen by reducing their heart rate and their circulation to most organs except the brain during a dive. In addition, after a few initial strokes with the flippers, Weddells relax and let momentum and gravity take over. Essentially, they sink into the depths. ¶ The vast majority of Weddell seal dives last 20 minutes or less. This is no coincidence, as biologists have calculated that 20 minutes is the seal's aerobic dive limit. This simply means that the Weddell seal can function for 20 minutes purely on stored oxygen, without any need to engage in the less efficient anaerobic metabolism that produces lactic acid as a by-product. Anaerobic dives require longer surface intervals to eliminate the built-up lactic acid and recharge oxygen stores and are therefore less efficient.



At left is a brightly lit, shallow, underwater ice cave near a seal colony, replete with *Odontaster validus* stars, anchor ice, and seal feces.

The red sea star, *Odontaster validus,* eats almost everything, including sponges, crustaceans, bivalves, and even dead seals. Like a shark drawn to blood, *O. validus* is presumably attracted to chemicals released by decaying matter, or to internal fluids released by prey in the course of an attack. The stars swarm over a food source, creating a conspicuous pile-up on the ocean floor. These pile-ups take place in slow motion and can last for days or weeks. Occasionally, a benthic fish, such as this *Trematomus pennellii,* is drawn into the fray.

If *Odontaster validus* is drawn to food by a chemical signal, the nemertean worm *Parborlasia corrugatus,* another benthic scavenger, seems to be attracted in the same way. More often than not, these caustic worms, which exude an acidic slime, are found intertwined with the stars. Large feeding clusters, like the one seen here, are impressive, looking like great battle scenes in the eternal struggle between predator and prey. Often, however, they are nothing more exotic than scrambles for Weddell seal feces.

Below, three *Odontaster validus* stars of various sizes are joined by a sea urchin *(Sterechinus neumayeri)* and a spiny polychaete worm *(Flabelligera mundata)* on the dark, volcanic gravel that typifies the sea floor around Ross Island. The worm feeds on detritus and other organic material.

Little is known about the natural history of Antarctic cephalopods. Here a *Pareledone* species—probably *P. polymorpha* or *P. turqueti*—sits on the sea floor near a brine channel. Both species are found throughout Antarctica and the subantarctic, from about 15 to 1,116 meters' depth (50 to 3,660 feet). *Pareledone turqueti* has also been found in deep water near Brazil. Both are small animals, with a mantle size of about 11 centimeters (4.5 inches). Since they are similar in size, morphology, and habitat, it is likely the two species inhabit different niches and consume different prey. *Pareledone polymorpha* has a small, fine-pointed beak, a less muscular body that is prone to abrasion, and a higher number of small suckers, whereas *P. turqueti* sports a more robust beak and body. These differences suggest that *P. polymorpha* may hunt for prey in the water column, while *P. turqueti* probably forages for the bivalves and other benthic prey typically associated with octopuses.

As with any other animal population, there is a certain level of infant mortality among Weddell seals. When a pup's carcass remains on the ice, it is quickly devoured by skuas, voracious gull-like predators and scavengers. If a carcass falls to the bottom of the sea it is also devoured, though somewhat more slowly, by the ever-present scavenging sea star *Odontaster validus,* nemertean worms *(Parborlasia corrugatus),* and carnivorous amphipods, including *Orchomenella (Orchomenopsis) pinguides* and possibly *Hippomedon kergueleni.*

A typical field research camp on the sea ice, with Mount Discovery in the background. The buildings are mobile huts that serve as laboratories and living quarters. The small triangular black hut on the left is an outhouse. It's unheated, but vastly better than the alternative. ¶ At this camp, researchers are analyzing data from a video camera attached to a Weddell seal. Biologists also use telemetry and satellite tracking to learn about the movements, behavior, and physiology of the seals in the sound. Although considerable hard work is required in the cold and the incessant wind to attach the necessary transmitters and recorders, afterward the scientists can make observations and analyze their data in the relative comfort of a warm hut.

It looks like Robo-Seal in some twisted science fiction movie, but in fact this Weddell seal has been outfitted with an extremely light-sensitive video camera. With images collected by this camera, biologists hope to learn more about how the Weddell seal forages for prey in the lightless depths of McMurdo Sound. A previously unknown behavior has already been revealed: cameras recorded seals exhaling bubbles into the under-ice platelet layer to flush out cryophilic fish, *Pagothenia borchgrevinki* (pages 46–47), which the seals quickly consumed. ¶ Other instruments record swimming speed, direction, depth, and time. With these, the scientists have determined that Weddell seals conserve energy and oxygen during a dive by allowing themselves to sink under the pull of gravity rather than swimming constantly toward the bottom.