



# DIVER DOWN

Diving to depths that crush the human body with tonnes of pressure, free divers push themselves to extremes of endurance in search of records - and nirvana.

By DANIEL WEISS

PHOTOS: CORBIS

Beneath a Mediterranean sky, 25-year-old **Guillaume Néry** floats on his back a few hundred metres off the coast of southern France. The sea is calm this July morning, and the sound of the ocean in his ears concentrates his mind on the challenge he's about to attempt: to dive deeper on a single breath and his own power than any human has done before. ¶

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aking a deep breath, Néry fills his oversized lungs with 8 litres of air, then takes a series of big gulps to pack in another 1.5 litres. He rolls over and, eyes closed to help him concentrate, plunges beneath the surface. Legs and torso undulating like a dolphin, he powers himself down with a massive monofin. As he descends, pressure builds on his lungs, compressing them so much that when he reaches a depth of 45 metres he is no longer buoyant and spears easily down through the water. When he reaches his goal, 113 metres, the pressure of more than 12 kilograms per square centimetre (around 12 times normal pressure), has shrunk his lungs to the size of oranges.

Néry opens his eyes and grabs a tag from the base of the guide rope to validate his feat, flips and kicks upwards, gazing into the dark blue immensity. The colour of the water grows richer, morphing into a deep indigo. Then it turns bright aquamarine as he swims





towards the light and the pressure on his lungs gradually relaxes.

Some 25 metres from the surface, four safety divers wait to accompany him on the last, most dangerous portion of the dive. Acknowledging them with a small smile, he powers on, swimming until he is buoyant enough to coast the final 5 metres to the surface. He's been underwater for 2 minutes and 45 seconds.

At the surface, he grins broadly at an official in a support boat to indicate that all is well. He now holds the world record for constant weight freediving.

"When I dive as deep as possible, it's like discovering a new world, like when humans went to the moon," Néry says.

#### Diving Times

Freediving - diving without breathing apparatus - has a long history. Stealthy freedivers have taken part in military operations since at least the 5th century BC when, according to the Greek historian Thucydides, Athenian divers disabled underwater barriers designed to impede their warships.

Spear fishermen and pearl divers throughout Asia have harvested under-sea treasure and food for thousands of years on the strength of their breath

alone. Among the hardest of these underwater hunter-gatherers are the *ama* and *haenyo*, female divers of Japan and Korea respectively, who repeatedly descend up to 20 metres in water as cold as 10 degrees Celsius to collect delicacies such as abalone and sea urchin from the ocean floor.

Physiologists have long been fascinated by freedivers' ability to withstand extreme conditions. A study of the *haenyo* conducted before they started wearing wetsuits in the early 1970s found that the women could consistently keep warmer in winter waters than non-divers.

Freedivers like Néry, who test their physical limits for sport rather than necessity, develop their abilities through hard, prolonged training. When Néry started freediving as an eager 15-year-old, his greatest challenge was trying to remain calm to keep his metabolism low. "The most important thing in freediving is to be as relaxed as possible," he says. "I try not to think, which is impossible, but I try to focus only on my feelings and my body and to be in the moment. It's like meditation."

Freedivers exploit an automatic reflex of the body similar to that of marine mammals such as whales and seals, which can descend hundreds

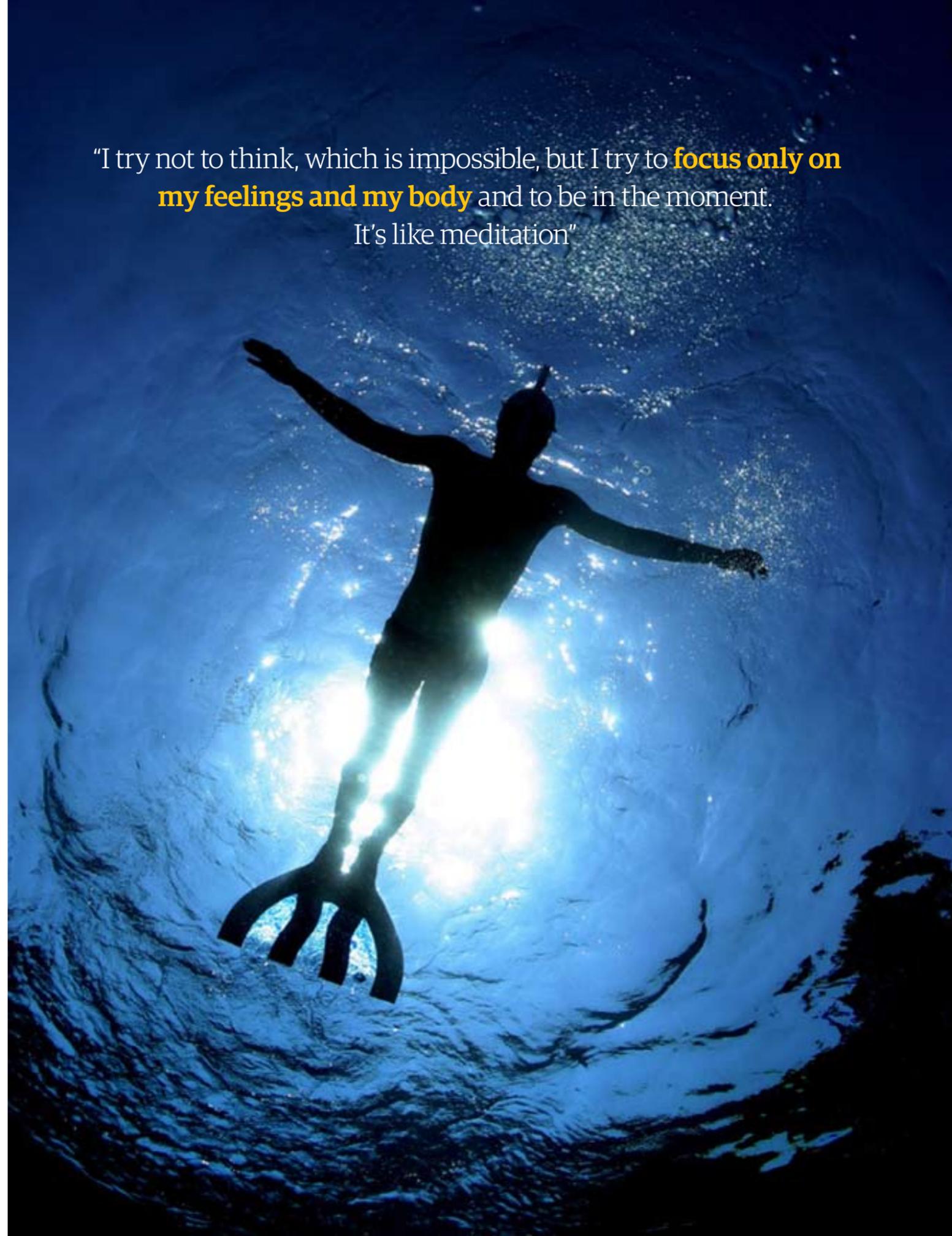
Around **100 freedivers** test their limits simultaneously off Sharm El Sheikh, Egypt (above). **Guillaume Néry** practices before his record attempt (opposite). **Female ama freedivers** collecting pearl oysters from the seabed in **Japan in 1959** (below).



PHOTOS: ALAMY; FRANCK SEGUIN/CORBIS; GETTY IMAGES

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of metres for up to an hour on a single breath. This dive reflex, which kicks in when a person's face is submerged in water, causes the heart rate to slow and blood flow to be diverted away from the extremities and towards essential organs such as the lungs and the brain. As a diver goes deeper, his spleen contracts, injecting oxygen-rich red blood cells into circulation, allowing him to stay underwater longer. Néry says he has further developed his dive reflex by taking practice dives with his lungs empty, which forces his body to conserve oxygen. "You feel your heart rate going down," says Néry, "and you feel more and more comfortable."

But the extremes of pressure in deep water are anything but comfortable. At sea level, the weight of the atmosphere presses on the body at 1 kilogram per square centimetre. Below the surface, another kilogram per

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On the rocky coast of Nice, France, Néry suits up and **straps on his monster monofin** before the dive, an experience he compares to "meditation."

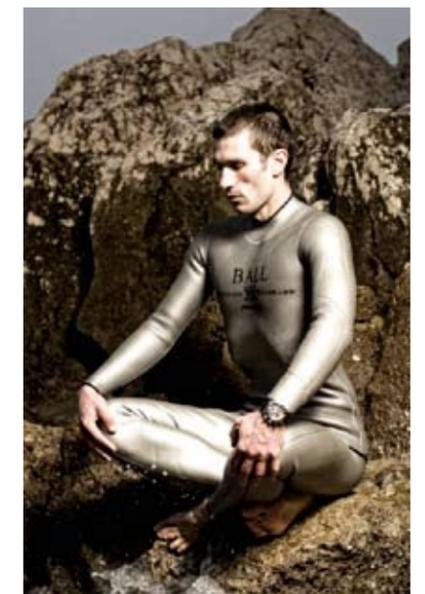
PHOTOS: FRANCK SÉGUIN/CORBIS; GETTY IMAGES; EDDY BRIERE



square centimetre of pressure is added for every 10 metres of depth. Just 10 metres underwater, the pressure on a diver's eardrums is painfully strong and must be countered by equalising the pressure in the middle ear.

Approximately one in ten people, including Néry and many other elite freedivers, can easily do this by forcing air through the Eustachian tubes that connect the mouth to the middle ear. Others must blow hard against nostrils clamped shut with industrial-strength nose clips, a feat that requires extra energy and concentration. Many of the freedivers who turn back before reaching their target depth do so not because they are running out of oxygen, but because the pressure on their ears is too painful to bear.

For Néry, the challenge is to retain enough air in his lungs to counter the pressure at great depths. Early in his



career, he had to abort about half of his dives due to lack of air for equalising. After working extensively on his swimming technique and anaerobic endurance, he now abandons less than one in ten dive attempts.

The intense pressure also means freedivers must have incredibly flexible diaphragms, chests and rib cages. At depths below 40 metres, the pressure grows so strong that plasma from the blood is sometimes forced into their lungs. Some people can handle this phenomenon, others can't. Néry, of course, can. "When I am so deep, I feel the huge pressure on my body, but I don't need to breathe. It's like being in space. It's like flying."

Elite freedivers test their limits slowly, increasing their target depths by increments of just a metre or two at a time to guard against catastrophe. Still, they sometimes run so low on oxygen during the final moments of their ascent or after surfacing that they black out. As long as safety divers are on hand to make sure the diver doesn't inhale any water, most say there is little danger or even discomfort.

"It's actually pretty pleasant," says Canadian freediver Mandy-Rae Cruickshank, who has blacked out 12 times in her career. "You're on your way up and all of a sudden you have this wild dream and then you're on the surface. It looks horrible to the people watching. Your eyes are still open, but slightly rolled back. Your lips are blue. You look like you're dead."

According to Peter Lindholm, a physiologist at Sweden's Karolinska Institute, there is no evidence of any lasting brain damage from holding the breath or even from passing out. During a blackout, blood continues to circulate and is still about 45 percent saturated with oxygen, more than enough to sustain body tissues.

### The Air that they Breathe

As freedivers push themselves to ever greater depths, the list of dangers increases. Nitrogen, which makes up 78 percent of the air we breathe on earth, becomes mildly narcotic to humans under pressure. Folk wisdom among



Mandy-Rae Cruickshank glides towards a target that will confirm her dive depth. Herbert Nitsch (bottom) dives to **214 metres** to break the no-limits freediving record in 2007.

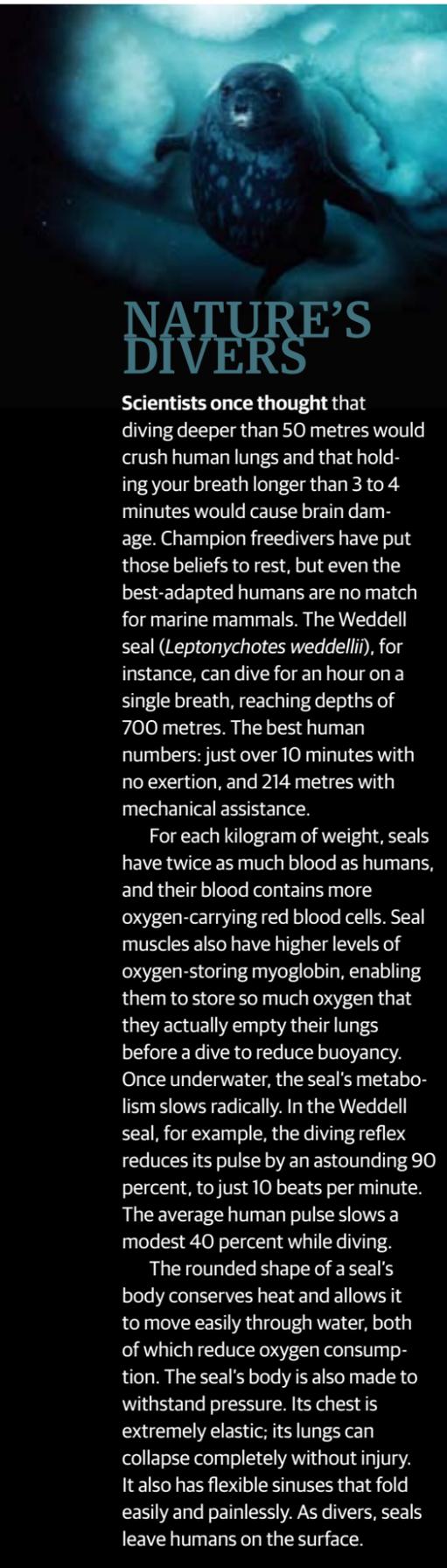
divers holds that once they descend below 20 metres, the feeling is the equivalent of consuming one stiff drink for every additional 10 metres of depth. This effect is commonly called nitrogen narcosis.

Divers can resist nitrogen narcosis with practice, but Néry describes it as an unexpected ally as well as a problem. At its most powerful, it can warp vision and thoughts, but in milder forms it makes Néry feel safe and protected, as if "surrounded by cotton."

No-limits divers - those that use a weighted sled and airbags to increase the rate of descent and ascent - risk "the bends" if they surface from too deep, too quickly. The bends, or decompression sickness, occurs when nitrogen that was forced into body tissue at depth forms into bubbles if the



PHOTOS: COURTNEY PLATT; CORBIS; FRANCK SEGUIN/CORBIS; ALAMY



## NATURE'S DIVERS

Scientists once thought that diving deeper than 50 metres would crush human lungs and that holding your breath longer than 3 to 4 minutes would cause brain damage. Champion freedivers have put those beliefs to rest, but even the best-adapted humans are no match for marine mammals. The Weddell seal (*Leptonychotes weddellii*), for instance, can dive for an hour on a single breath, reaching depths of 700 metres. The best human numbers: just over 10 minutes with no exertion, and 214 metres with mechanical assistance.

For each kilogram of weight, seals have twice as much blood as humans, and their blood contains more oxygen-carrying red blood cells. Seal muscles also have higher levels of oxygen-storing myoglobin, enabling them to store so much oxygen that they actually empty their lungs before a dive to reduce buoyancy. Once underwater, the seal's metabolism slows radically. In the Weddell seal, for example, the diving reflex reduces its pulse by an astounding 90 percent, to just 10 beats per minute. The average human pulse slows a modest 40 percent while diving.

The rounded shape of a seal's body conserves heat and allows it to move easily through water, both of which reduce oxygen consumption. The seal's body is also made to withstand pressure. Its chest is extremely elastic; its lungs can collapse completely without injury. It also has flexible sinuses that fold easily and painlessly. As divers, seals leave humans on the surface.



Support boats surround Néry during preparation for a record attempt.

diver ascends too rapidly, potentially crippling or even killing him.

While setting the current no-limits record of 214 metres in June 2007, Austrian freediver Herbert Nitsch had to make several stops during his ascent to allow for gradual decompression. It's a risky process. Two elite freedivers - Audrey Mestre in 2002 and Loïc Leferme in 2007 - died when equipment failure left them stranded too deep to make it to the surface alive.

### Ever Deeper

Although there must be limits to how deep humans can dive on a single breath, Lindholm predicts that records will continue to fall.

"I'm not sure what the limits will be," he says. "With the sport gaining popularity, we will find more people with a genetic predisposition for it."

For Néry, being part of the close knit freediving community is one of the sport's attractions. "At competitions, one of our favourite things is to talk and to exchange knowledge," he says. They talk about how to train, what their experiences were, what techniques they use. "Ah, you tried that! How did it work?" somebody might ask. But since freediving is such a young discipline, no one really knows the best way to train.

Cruickshank has tried sleeping in a special low-oxygen tent, like those used by mountain climbers, to help

her body adapt. New Zealander William Trubridge, who holds the world record of 86 metres for diving without fins, has completely stopped aerobic exercise and does all his endurance training underwater. His goal is to discourage his body from constructing capillaries in his extremities that might hoard precious blood away from his core organs during a dive.

Néry, on the other hand, incorporates into his training regime a variety of aerobic activities, including off-season snowshoeing and cross-country skiing. "Every freediver has to go on his own quest, his own search," he says. "This is a part of the game that is very interesting." ■

**Cautionary**

With careful safety procedures, freediving is relatively safe; without them, it can be highly dangerous. One seemingly sensible practice that can be particularly deadly is hyperventilating (breathing rapidly in and out) before a dive.

Hyperventilating reduces the level of carbon dioxide in the blood and, since the build-up of carbon dioxide is necessary to trigger the body's breathing reflex, it makes you feel that you don't need to breathe. Even as you run dangerously low on oxygen and approach the state where you are likely to pass out underwater, you feel fine.

If you want to try freediving for yourself, the best approach is to seek out an established training course or club, and do not under *any* circumstances try to free dive on your own.