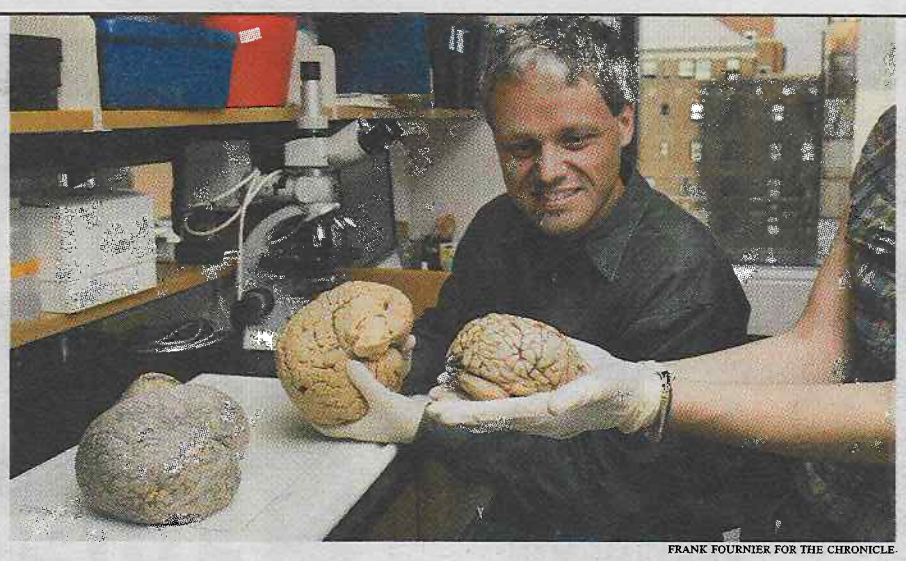
NOTES FROM ACADEME *By Erik Vance*

The Man With the Brains



FRANK FOURNIER FOR THE CHRONICLE

Patrick R. Hof, a professor of neuroscience at the Mt. Sinai School of Medicine, in New York, enthusiastically oversees an extensive collection of animal brains, including those of killer whales, seen on the desk and in his hands here, and gorillas, one of which is the smallest brain, on the right.

LISTENING TO PATRICK R. HOF talk about animal brains is like listening to a child recite his Christmas list.

"I don't have a hippo brain," he says wistfully. "I would like to have a hippo brain."

Mr. Hof is a professor at the Mt. Sinai School of Medicine in New York, where he specializes in schizophrenia and illnesses of aging, like dementia. He is a trim man with small glasses and short gray hair. He speaks with a thick French accent, and his speech is peppered with the impenetrable vocabulary of a brain-anatomy lecture. But when he starts in about animal brains, his demeanor changes. His face lights up and his hands become animated.

"A scientist is always driven by curiosity. You just have to know. It's there for you to find out," he says. "I would literally look at *any* brain to see how it's built. It's fascinating."

Mr. Hof's bread and butter is his work with human brain anatomy and disease. But his passion is comparing brains across the animal kingdom. He says he has poked around in the brains of roughly a hundred different animal species, from the easily acquired (rats and horses) to the more exotic (giraffes and manatees).

Mr. Hof has a special affinity for the massive gray matter of marine mammals. At the department of neuroscience, he has one of the best collections of whale brains in the country. With a bit of pride, he says he maintains a collection of 30 types of cetacean brain, ranging from the two-pound brain of a common dolphin to the 17.5-pound brain of a sperm whale. The collection gives Mr. Hof the ability to peruse the cerebrums of most major whale families as if they were books in a library.

At the end of last year, using his unique collection of brains, Mr. Hof discovered in large whales a special brain cell called the spindle neuron. Until then scientists thought only humans, gorillas, and certain chimpanzees had spindle neurons, which may be an important component of consciousness. Scientists still don't know what role the neuron plays in the brain but suspect it has something to do with social behavior or decision making.

Next to his lab is Mr. Hof's refrigerated storage room, a meat locker crammed with brains. Most are innocuous enough—dull beige lumps of tissue in small jars (though one is still waiting to be taken out of the monkey head where it resides), and larger brains in plastic garbage cans of chemical preservative.

But considering the prestige of Mr. Hof's collection, "the vault," as he calls it, is smaller than one would expect: just the size of a walk-in closet. It turns out that getting ahold of whale brains is tricky business.

"I may wait 10 years before I get a right-whale brain," he says. "When they beach and die, the brain may be in better shape or worse shape. It's logistically complicated."

Logistically complicated is an understatement. In another building not far away, Joy S. Reidenberg, an associate professor and expert in whale necropsy, explains that the bigger the whale is, the harder it is to get brains for Mr. Hof. Most usable whale specimens have washed up on shore, and by the time Ms. Reidenberg arrives and hacks down to the brains, they will have cooked in their own insulation at temperatures up to 140 degrees.

However, sometimes dead whales turn up in port, stuck on the bow of a cargo ship like an insect on a car grill. Ms. Reidenberg says most times the captain of the boat does not even know they are there. If Ms. Reidenberg is lucky, she can get the whale into a Coast Guard dry dock, like a boat that needs maintenance. Luckier still, she will have the 20-plus volunteers and backhoe she needs for a dissection. Even luckier still, she will have the eight to 10 hours she needs to get the head off, clean off the flesh, cut through a foot of bone, and tip the brain gently onto a tarp.

"A lot of this is a lot of good old-fashioned labor with a good old-fashioned wood saw, a big hammer, and a chisel," Ms. Reidenberg says. And then there's the smell. "Do you know what a spoiled roast-beef sandwich is like? Now imagine 65 feet of spoiled roast-beef sandwich."

In the end, only a few dead whales can yield a decent brain, and only a small fraction of those will have the right circumstances for retrieval. So, back in his laboratory, Mr. Hof says every brain is precious, as he slowly cuts into a beluga-whale brain one afternoon. He gently slices through the operculum (the outer few inches on the side of the brain), carefully exposing the insular cortex beneath (a knobbly layer near the bottom of the brain), while his students cluster around. As he picks stringy beige blood vessels out of the grooves like he was picking bits of broccoli out of his teeth, students point and comment on the differences from a human brain.

The bumps and valleys of a brain are as distinctive to Mr. Hof as feathers are from scales. For instance, while whales may not look like their landlocked relative, the cow, their brains are very similar. On the other hand, the brain of an aye-aye—an ancient primate of Madagascar—looks nothing like its cousins', with a brain more like a cat's than another primate's. Interesting, Mr. Hof says, since a carnivore's brain is set up to chase and catch prey, something most scientists think early primates did not do.

"It is really odd, and we are still trying to figure it out," he says of the googly-eyed creature. "It's a strange animal to begin with."

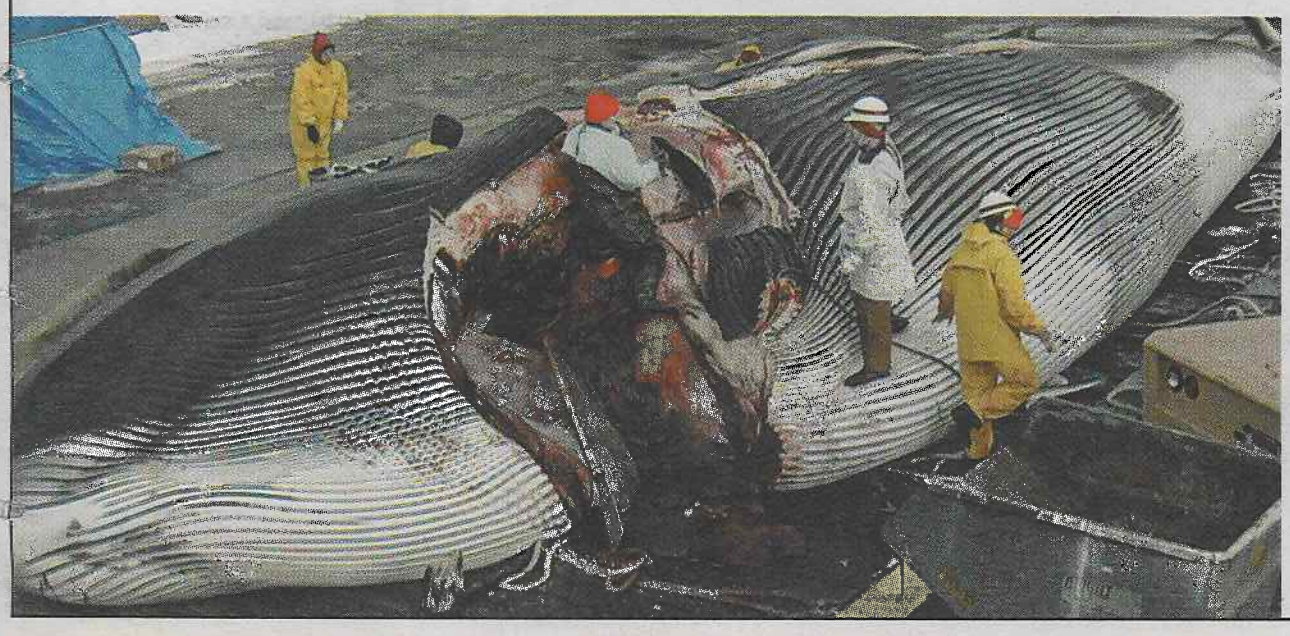
IT IS IN SUCH unexpected differences that scientists have the most opportunities to learn, says Mr. Hof. One of the best examples of that is the manatee brain, which appears as smooth as a cue ball for little apparent reason. Most brains are wrinkled with grooves of varying depths that create more real estate for neurons. Animals with deeper grooves have more surface area and are generally smarter. But the manatee, a relatively intelligent creature, doesn't seem to need the grooves. Reflecting on that, Mr. Hof says his work redefines the term "intelligence" for him.

"Intelligence is just what we consider it to be for ourselves as humans, but we should not apply it to other species," he says. "It doesn't mean anything. A rat can do a lot. But it does what matters to a rat. We do what matters to us."

Looking at brains, he says, evolution is not a ladder, with humans on top and everything else below, but a tree, with all its branches growing at the same speed. Dog brains have evolved to detect odors, whale brains to socialize and navigate through an underwater environment, and manatee brains to do—well, whatever it is a smooth brain does. Mr. Hof and another neuroscientist, John M. Allman, of the California Institute of Technology, are now looking for spindle neurons in elephants, another social animal with a large brain. Elephant brains can also be hard to come by, and most of the brains in the study are in Mr. Allman's laboratory.

Mr. Hof laments the difficulty he has getting exotic brains from zoos and marine parks, saying he is at the mercy of local pathologists.

"What happens when the rhinoceros dies? *I* want the brain. But will they give it to me? No," he says indignantly. "Shamu will probably get a burial or something."



Joy S. Reidenberg (in red cap), an associate professor at Mt. Sinai School of Medicine, makes the first cut into a fin whale on an Army Corps of Engineers dry dock. She will need a crane to move the head and another few hours to reach the brain.

BRIAN ABALLO, ARMY CORPS OF ENGINEERS