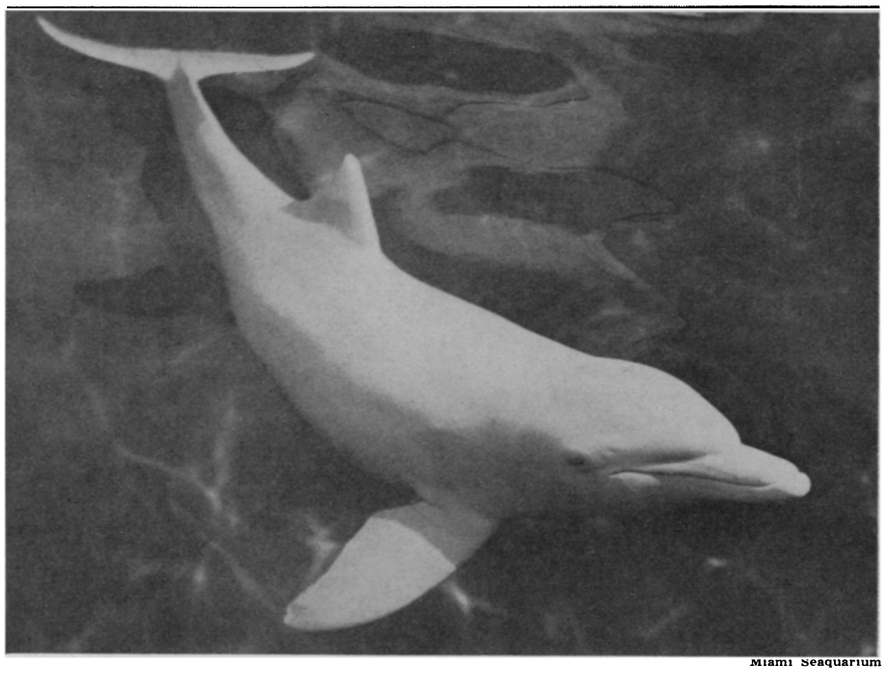
Mind-mapping the Dolphin

The remarkable dolphin, who some say can talk and whose built-in sonar is better than any submarine's, is having his brain mapped—as the Navy looks on.



Miami Seaquarium

The late Carolina Snowball, only albino bottlenose dolphin ever caught.

The first complete atlas of the brain of the bottlenose dolphin, a member of the Cetacean family that includes the great whales and porpoises, is scheduled for publication next year. The event will mark a research milestone as the first such effort with a creature having a brain larger than that of man and of equivalent complexity.

The work will be some 650 pages, including 300 anatomy plates of the dolphin brain in serial section, plus about 150 plates showing the tissue structure of the cerebral cortex, thalamus and nuclear formations of the brain stem and cerebellum. The text will be in three languages: English, French and German.

For some years, American and foreign publications have devoted substantial space to dolphins. It was claimed that they possess an IQ rating of around 100, that men were on the very brink of communication with them. They were declared capable of being trained to run errands during deep sea probes, to recover lost treasure and equipment and to find oil and mineral deposits—among other things. It's a wonder, in fact, that the grinning mammals weren't credited with inviting scientific friends to cocktails and dinner.

Some remarkable fact, however, has been mixed in with the fantasy.

Dolphins, especially the bottlenose, Tursiops truncatus, do possess a deeply puzzling sort of intelligence still only vaguely understood, certainly unusual in the animal world. They do master cunning tricks, perform remarkably in aquariums, show an uncanny friendliness and cooperation with humans.

Dr. J. C. Lilly, a noted dolphin researcher and head of the Communication Research Institute in Miami, Fla., —home base for the brain atlas project—has for years been working on communicating with dolphins, convinced that at least some crude form of contact may some day be possible. Naval technicians have reportedly trained some to carry lines in their teeth from one vessel to another, and other discoveries are being made by the Navy behind a secrecy stamp.

Dolphins, oddly, are believed to be relatives of the bovine family, which includes cattle and oxen, who millions of years ago transferred to the sea. "By studying the specialized brain of the dolphin from the comparative anatomical and physiological viewpoints," says Dr. P. J. Morgane, director of the atlas project "it's possible to trace adaptation to the aquatic environment imposing radically different sensory-motor requirements from terrestrial conditions."

The atlas is intended to serve as a source of documentation for comparative anatomists, physiologists, zoologists, neurologists and paleoneurologists. Its morphological information will make it possible, for the first time, to carry out controlled experimentation on an animal having a brain larger than man's. "This has important implications," Dr. Morgane says "in regard to the study of the intelligence of these animals and their complex vocalizing and sonar capabilities."

The text of the brain atlas is not yet available, but it appears unlikely that, aside from purely medical findings, it will deal to any extent with these "important implications" involving intelligence, vocalizing and sonar capabilities, which happen to be vital. A few years ago it was widely reported that Dr. Lilly had succeeded in getting dolphins to mimic certain English words; unfortunately this resulted in facetious speculation, and the Communication Research Institute has since been reluctant to discuss its work with outsiders, though the atlas is undoubtedly partly aimed to further these studies.

The dolphin's normal body functions also hold other deep riddles.

Research on the brain atlas has disclosed the relatively small importance of dolphin aquatic vision. Their optic nerves contain only 115,000 fibers compared to 1.2 million in man. But their known acoustic capabilities compensate for this.

Dolphin hearing is probably the most sensitive known despite the fact that their ear openings are only about 1/50th of an inch in diameter. Their acoustical system evidently extends into other parts of their bodies.

Sensitivity of sound detection is, in turn, a critical part of sonar, the eyes and ears of all submersible vehicles, and vital to all navies. It operates by continuous transmission of sound waves through water at up to 5,000 feet per second, catching the echoes when objects are encountered.

Existing manmade sonar locates and plots object distance by the time re-

quired for sound waves to go out and return. It's efficient in this respect, but limited in identification. The metallic tone created by contact with a submarine or ship hull is almost identical with that produced when the sound waves strike a whale. Identification of other objects is equally difficult.

For some time there's been reason to believe that a dolphin's sonar is far more sophisticated, infinitely more selective. This could be of inestimable military importance, since submarines with nuclear missile capabilities may well hold the decisive balance of power in any major conflict. There is reportedly evidence that the mysteriously functioning dolphin sonar system not only can distinguish between a living ocean denizen, a reef, a log or a ship, but that it can also approximate exact size and distance within its operating range. U. S. Naval research on dolphin sonar is being intensively pursued; the British Admiralty has a similar program; undoubtedly so do the Russians.

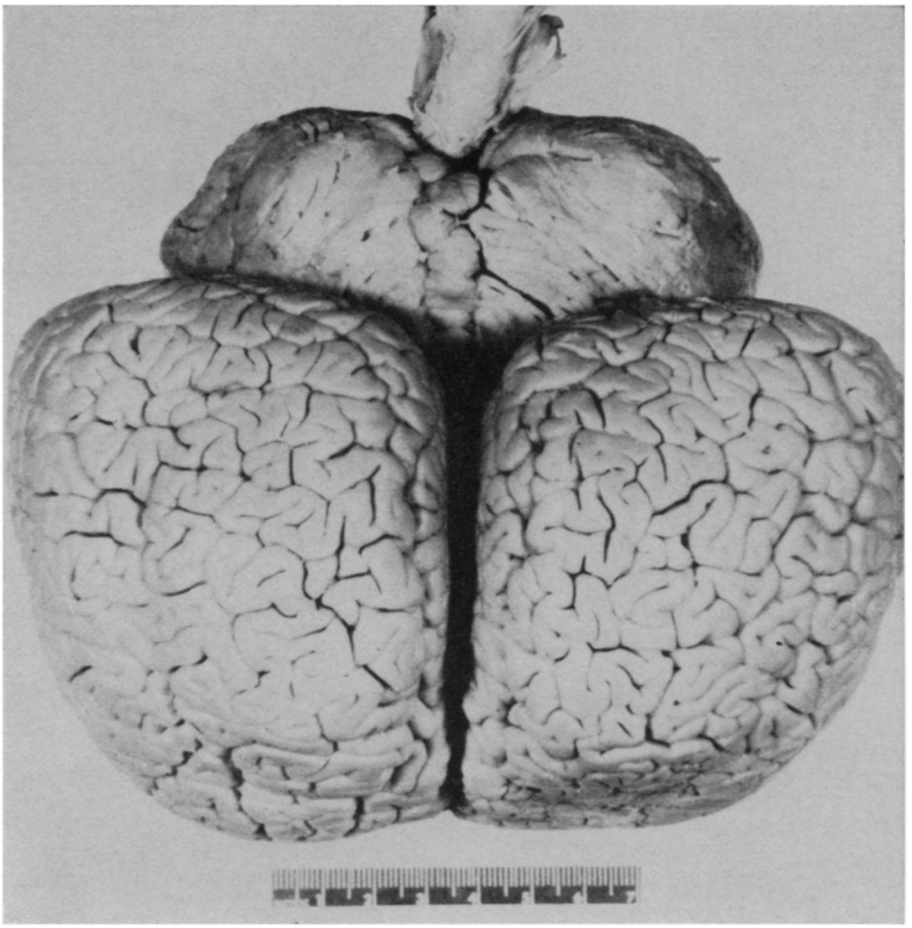
Another important field involves the dolphin's ability to move through water at top speed hour after hour with minimum muscular effort. Planes in flight buck heavy atmosphere; ships fight water density, hulls slowed by friction and drag. Dolphins have a complex body system that overcomes this, a phenomenon known as "laminar flow."

The secret is largely centered in the animal's streamlined body contour. However, the loose, rubber-like outer skin has also been found to play an important part in the process. There's also evidence that dolphins employ a complex, brain-controlled system that compensates for varying water density, pressure, temperature, salinity, and wave and current action.

Unlocking this riddle would mean greater speed for ships, submersibles, torpedoes—and speed translated into seconds in this nuclear missile age could spell the difference between life or death for ship crews, as well as concentrated land populations.

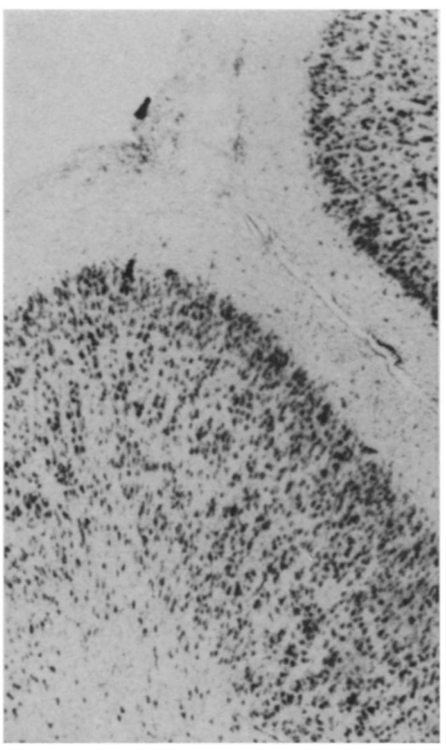
The enormity of the effort going into the atlas, which so far has taken four years, is evident in the fact that preparation has already included cutting some 15,000 whole brain sections. Every fifth one was stained for myelin sheaths and every adjoining fifth section for nerve cells and glial nuclei. These involved use of some 6,000 mounted slides.

Adult, newborn and fetal dolphin specimens were used. In addition, for comparative studies, dissections and gross surface analyses were carried out on the brains of humans and monkeys; cats, dogs and cows; sperm, beluga and fin whales; the Amazonian River dolphin and the common porpoise. *Lee Gebhart*



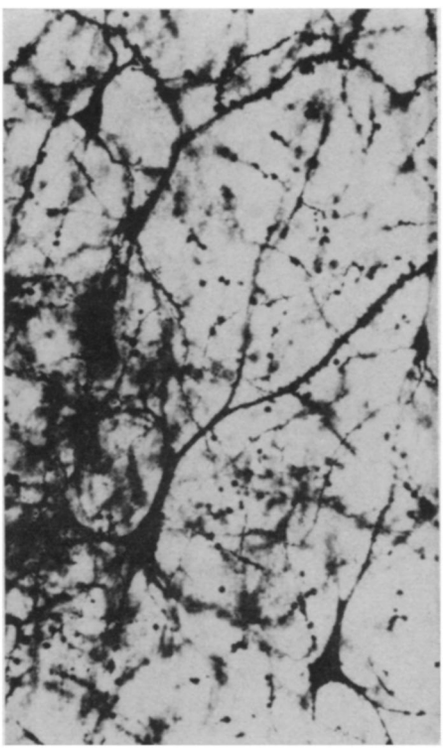
George Musil

Some seven inches (18 cm) across, the dolphin brain is highly sophisticated.



George Musil

Layering of cortex reveals quality.



George Musil

Elaborate cell structure in cortex.