Nerves follow a sticky route

As an animal develops, nerve cells often grow along tortuous paths to reach their targets. Following the appropriate route is critical if cells are to make the complex pattern of connections required for normal brain function and control of the body's muscles. What guides this highly specified growth? A cell surface substance, called nerve cell adhesion molecule (N-CAM), is the leading candidate in several cases, including the growth of nerve cells from eye to brain and the growth of other nerve cells to muscle contacts, scientists reported recently at the meeting in Anaheim, Calif., of the Society for Neuroscience.

Molecules of N-CAM have been found on the surface of muscle cells, nerve cells and glial cells, which are associated with nerve cells. N-CAM is also present on developmental precursors to these cells. The molecule, described earlier by Gerald Edelman and colleagues at Rockefeller University in New York (SN: 12/4/82, p. 359), contains a binding site for another N-CAM molecule, and thus it provides a means for the adhesion between cells with N-CAM on their surfaces.

A variety of experiments suggest that a pathway studded with N-CAM guides the growth of nerve cell processes, called axons, from the chick eye to its brain, report Urs Rutishauser and Jerry Silver of Case Western Reserve University in Cleveland, Ohio. The leading surface, the growth cone, of the axon contains N-CAM, as do portions of neuroepithelial cells, which later differentiate into glial cells. Even before any nerve cell processes arrive, the pattern of N-CAM-studded neuroepithelial surfaces closely mimics the route the earliest axons will take in the nerve and brain. In contrast, a region through which axons never grow, the boundary between the areas of the brain receiving visual and olfactory input, was seen to lack N-CAM, Silver reports.

To examine the function of N-CAM, the scientists used antibodies to block its activity. When they injected embryonic chick eyes with an antibody that binds to N-CAM, the axonal growth pattern changed dramatically, Rutishauser says. The axons normally found in a narrow band now were spread over the entire region. However, as the axons grew into areas beyond the region flooded with antibody, they reestablished an "almost normal position," Rutishauser says.

A similar role for N-CAM in eye-to-brain projections is described by Edelman, Scott E. Fraser of the University of California at Irvine and colleagues. They find that antibodies to N-CAM disrupt the pattern of connections in juvenile frogs, *Xenopus laevis*. The input to brain cells, as determined by analyzing brain cell activity, was most greatly altered when the antibody was injected into frogs whose nerves were regenerating after being crushed. However, normal juvenile animals also showed a decreased precision in the ordering of eye-to-brain projections after injection with antibody to N-CAM. In each case the pattern and precision of the projections return to normal after a few weeks, the Rockefeller scientists report.

Another instance where N-CAM appears to guide nerve growth is at nerve-muscle junctions, reports Joshua R. Sanes of Washington University in St. Louis. "Embryonic muscle has lots of N-CAM; innervated adult muscle has almost no N-CAM," Sanes says.

If the axon going to a muscle is cut, within two days the denervated muscle begins developing N-CAM over its surface, Sanes reports. He also finds, surrounding the denervated muscle, N-CAM in the extracellular spaces through which another axon must grow to establish a connection. "Gradients of N-CAM seem to lead to the muscle's synaptic [nerve junction] sites," Sanes says. Once a new axon innervates the muscle, the surface N-CAM again disappears.

Edelman summarizes: Cell adhesion molecules appear in definite sequences and are susceptible to biochemical signals. Perturbing this process leads to a loss of order in neural maps. —*J. A. Miller*

Multinational study for Japanese 'moon rock'

It was in December of 1969, mere months after Apollo astronauts had brought their first pieces of the moon to earth, that a team of Japanese scientists in Antarctica to study the icy continent's Yamato mountain range accidentally came upon and collected nine meteorite fragments. Four years later, another Japanese team in the same region found 11 more space rocks, and when the following year's expedition actually made a special effort to find meteorite-like fragments, the resulting take was more than 600.

Now the Japanese Antarctic meteorite collection includes some 5,000 samples, while about 2,000 more have been gathered by U.S. expeditions. Pristinely preserved by the dry cold, Antarctic meteorites have provided valuable data on planetary materials from beyond the earth; the field became abruptly more exciting last year when a U.S.-organized international consortium of scientists agreed almost unanimously that one such rock was in fact from the moon (SN: 3/26/83, p. 196). It was not that one more moon rock was such a big deal—most of Apollo's had barely been studied — but rather its demonstration that chunks could be driven all the way to earth from such a massive "parent body." That evidence seemed to at least ease a major problem confronting scientists who believe (for various geochemical reasons) that certain other Antarctic meteorites may be pieces of Mars.

Early this year, two other possibly lunar meteorites were identified, this time in the Japanese collection (SN: 8/4/84, p. 70), and those rocks still have significant contributions to make—notably to indicate that the arrival on earth of a single moon-spawned fragment was not merely an improbably rare fluke. "Statistically," notes James Arnold of the University of California at San Diego, "there's a huge difference between one and two," and showing that *two* chunks have gotten here from the moon would further raise the hopes of Mars-watching scientists who have no hand-delivered samples to study.

Now, Keizo Yanai and others at the Japanese National Institute of Polar Research have announced the formation of Japan's first international consortium to study an Antarctic meteorite. The consortium's subject will be the first-identified of the two possible moon rocks, a chunk known as Yamato 791197, and half of its 20 teams of researchers will be non-Japanese, with all but one of those from the United States. (A second consortium will focus on another example — Yamato 691 — that is almost certainly nonlunar, but which is of a type known as enstatite chondrites, "probably the best illustration," according to Michael Lipschutz of Purdue University in West Lafayette, Ind., "of the cross section of a parent body.")

A number of researchers from the United States have received Japanese meteorite samples in past years for individual or small-group study, but even some of those same scientists are now welcoming a chance at the unrestricted data exchange and general cross-fertilization that the consortium method has brought to space science since the days of Apollo and even before.

It is intended that the diverse teams will all present their results next March at the 10th anniversary gathering of Japan's annual Antarctic Meteorite Symposium in Tokyo (meanwhile, a consortium is already being considered for the other Japanese "moon rock"), but there have already been signs that Yamato 791197 "looks lunar." Several scientists agree that it has the proper visual appearance (the one U.S. example—Allen Hills 81005—was picked out for further study at a glance), and Robert Clayton of the University of Chicago has reported it to have the correct oxygen-isotope ratios. In addition, preliminary findings by J.C. Laul of Battelle Northwest in Richland, Wash., T. Fukuoka of Gakushuin University in Tokyo and Roman A. Schmitt of Oregon State University in Corvallis all "point to a lunar origin" on the basis of iron:manganese, chromium:vanadium and potassium: lanthanum ratios. —*J. Eberhart*