after they enter the cell? They discovered that the receptors and ligands accumulate in sacs inside the cells which have been called "endosomes" or "receptosomes." There the receptors and ligands have an acid bath and the ligand separates from its receptor. Then, in many cases, the ligand goes to the lysosome where it is digested and the receptor goes back to the cell surface.

At the same time as cell biologists were studying how receptors get into endosomes, David Neville and his associates at the National Institute of Mental Health (NIMH) began to explore how proteins get into the cytosol, which is the main body of the cell and the place where proteins are made. Certain poisons, such as ricin and diphtheria toxin, kill cells by stopping protein synthesis and these poisons are so powerful that only one molecule of them is lethal to a cell. Neville's idea was to link the A chain of diphtheria—which is the part that kills cells—to human placental lactogen, a polypeptide hormone.

It took Neville and his associates Tamin Chang and Alice Dazord 4 years to make a hormone-toxin molecule, but when they tried it out in 1977, they found that it did not get into the cytosol of cells. This raised the possibility that either the diphtheria receptor or the diphtheria B chain is necessary for the toxin to get in.

By this time, the stage was set for researchers to try to develop immunotoxins. They were able to make monoclonal antibodies that specifically recognize molecules on cell surfaces and they were beginning to realize how toxins get into cells.

Among the researchers who have used this new knowledge are Neville and Richard Youle of NIMH. Reasoning that the A chain of ricin, like the A chain of diphtheria, may not by itself get into cells to kill them, they attached the entire ricin molecule to monoclonal antibodies to T cells. These immunotoxins get into T cells and kill them. But since they use the entire ricin molecule, the ricin itself can recognize its receptors on cell surfaces and so can get into other kinds of cells. In order for this immunotoxin to be specific for T cells, it is necessary to block the ricin receptors on other cell types. This is easy to do in vitro, the NIMH scientists report, because, as Youle and Gary Murray discovered, the sugar lactose blocks the ricin receptors. All they have to do is bathe the cells in lactose.

There is an immediate clinical use for these ricin immunotoxins in bone marrow transplants. Patients with leukemia

Neptune Ring Fades Again

The wave of new planetary ring discoveries that seemed to be sweeping the solar system has again petered out short of Neptune, the outermost major planet and the last of the four Jovian planets still lacking a known ring system. A group of astronomers suggested last year that they may have detected a ring of Neptune in 1968 without recognizing it at the time, but a thorough search this June as a faint star passed behind the planet has eliminated the possibility of any but the faintest Neptunian rings. An absence of rings would make the odd Neptune system odder still.

As Neptune crept slowly toward a faint star on 15 June, astronomers positioned from Tasmania to Taiwan strained to detect the slightest flicker in the brightness of the star that might signal its passage behind a ring. They found nothing. They are still refining their analysis and reducing the maximum opacity of any undetected rings, but they are now sure of several things. James Elliot of the Massachusetts Institute of Technology, whose team observed June's stellar occultation from the Kuiper Airborne Observatory flying at 12,000 meters over the western Pacific, says that they could have detected a ring four times more opaque than the least opaque of Uranus's narrow rings. Further analysis should half this upper limit. Even flying above much of Earth's atmosphere, Elliot could not have detected rings as wispy as Jupiter's, which is about 1000 times less opaque than Uranus's most diffuse ring.

Observers are also confident that they probed close enough to Neptune to rule out any ring like the one tentatively proposed last year by Edward Guinan and his colleagues at Villanova University. They reported a recently recognized dip in brightness recorded just after a 1968 Neptune occultation (*Science*, 9 July 1982, p. 143). If a ring caused the dip, it would extend from 4,800 to 11,100 kilometers above the planet. No observed occultation had probed that close to the planet until last June. Elliot is confident that in June they probed within 1000 kilometers of the top of the atmosphere in the plane of any equatorial rings. And they could not have missed any dip in brightness as large as the apparent 1968 dip. Guinan now presumes that a thin passing cloud produced their brightness dip; other possible explanations are highly unlikely.

If Neptune had no rings at all, it would be strange indeed. It would be the only ringless planet of the four gas giants, although it and Uranus are nearly identical in size and mass. The Neptune system already includes the solar system's most elongated satellite orbit—Nereid's steeply inclined orbit carries it 10 times farther out than its closest approach to Neptune. It also has the only large inner satellite, Triton, that orbits in the direction opposite to the rotation of its planet or in a plane steeply inclined to the planet's equator. This unique satellite system has prompted speculation that some intruder, perhaps a tenth planet, wandered through the Neptune system, disrupted the motions of its satellites, and even tossed a third satellite out of the system that became the planet Pluto. Dynamicists have raised various objections to the intruder theory, but whatever produced this irregular satellite system, the reasoning goes, may have denied Neptune its rings.

There is still one tantalizing hint of possible Neptunian rings. On 24 May 1981, Harold Reitsema and his colleagues at the University of Arizona detected a dip in the combined brightness of a star and Neptune as the two passed each other in the sky. Apparently, something near Neptune, presumably a satellite, totally blocked the light of the star. If it was a third satellite and it orbits in the planet's equatorial plane, it is at least 180 kilometers across and was 50,000 kilometers above the planet. The chances of catching a lone satellite in front of the star were slim, perhaps 1000 to 1. That has prompted speculation that there are many more small, inner satellites. Around all three of the ringed planets, such moons shape and even rejuvenate rings. Is Neptune the exception? The next decade may tell. Although there are no predictions yet, Neptune could occult a much brighter star, allowing detection of fainter rings. Space Telescope will also make more sensitive searches after its launch in 1986. And Voyager 2, with luck, will encounter Neptune in 1989.—RICHARD A. KERR