ing features. For one thing, Feig says, one segment of the exchange protein encoded by the gene turns out to have an unexpected resemblance to a sequence found in the proteins encoded by two other oncogenes, designated *dbl* and *bcr*. What's interesting about that is that last year, Richard Cerione of Cornell University and his colleagues showed that the *dbl* protein is itself an exchanger for a member of the *rho* subgroup of GTP-binding proteins, which are distantly related to Ras and thought to be involved in assembling the network of protein filaments that give cells their shape. Feig's protein may therefore be a "two-headed exchanger," Cerione says, that can connect Ras and *rho* protein activities. That might help explain, for example, the changes in shape that cells undergo when stimulated by growth factors.

What's more, both the Feig and Lowy groups find that the new Ras exchanger is made only in brain cells. Since Ras proteins themselves are made in all the cells of the body, it would seem that there are additional exchangers for Ras in other tissues, Feig says. And indeed, David Bowtell of the University of Melbourne and his colleagues have just cloned two genes, which are the mouse equivalents of the fruit fly exchanger gene designated *sos*. And these are not only different from the one discovered by the Feig and Lowy groups but, Bowtell says, "They're expressed everywhere we've looked so far." In addition, still another oncogene, called *vav*, encodes a protein product that also has Dbl- and Bcr-like sequences and might therefore be another exchanger for the *rho*-like proteins.

The new findings should give cell biologists a much more complete picture of how Ras is regulated, and perhaps about its interactions with other signaling molecules as well. In fact, the results could have a bearing on the way that people view signaling pathways. "People used to think in terms of linear [signaling] paths, but it's probably going to be a lot more complicated than anyone imagined," says Cerione, referring to the possibility of connections between proteins such as Ras and Rho. But they will have to do a lot of hard work to sort out the precise functions and interactions of all the exchange proteins they are identifying.

One of the immediate goals will be to find out whether growth factor receptors activate the Ras exchanger, as is now generally assumed. "They [the exchangers] certainly activate Ras," McCormick says. "The question is, How are the exchangers activated?" He points out they don't necessarily have to be activated by the receptors since the receptors might also stimulate Ras activity by preventing the stimulation of its GTP breakdown by GAP.

Nevertheless, researchers, including Lowy's group and also that of Tohru Kamata of the NCI-Frederick Cancer Research and Development Center, have circumstantial evidence that growth factors, such as nerve growth factor, work by increasing Ras exchanger activity. The exchanger protein structure itself isn't providing any clues about any potential interactions between the exchangers and growth factor receptors, however. "As far as I can tell from the sequence, there are no direct connections to the receptors," Feig says. That suggests, he says, that another protein will have to relay the receptor signals to the exchanger.

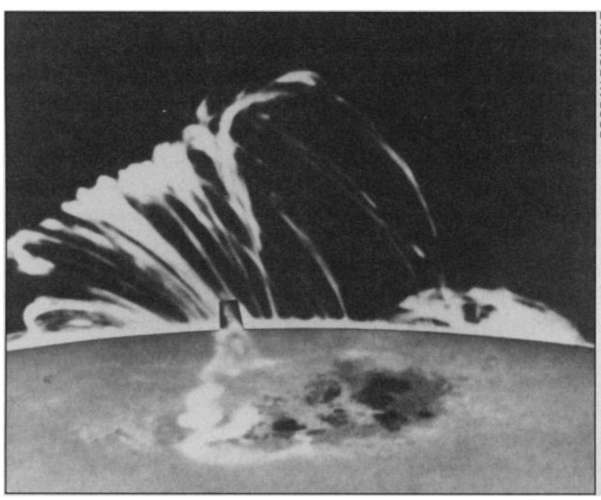
Of course, having the exchanger proteins in hand should make it easier to answer the questions about exchanger functions, since it will now be possible to make specific antibodies that can be used to follow more directly what happens to the exchanger proteins when growth factors interact with their receptors. But whatever the outcome of such studies, from the work already done, it's clear that studies of exchange proteins for Ras and its relatives are moving into a new, high-growth phase.

–Jean Marx

SOLAR PHYSICS

GRO Shows Particles in a Magnetic Trap

When the sun erupts in a solar flare, a surge of gamma rays accompanies the visible brightening and the bursts of charged particles. During the intense solar flares of 1991, those gamma emissions nearly blinded the sensitive eyes of the orbiting Gamma-Ray Observatory (GRO), designed to pick up trickles of gamma photons from the edges of the universe, says University of New Hampshire solar physicist James Ryan. But the versatile Comptel and Egret detectors aboard the orbiting observatory not only withstood the heat of last year's biggest solar flares; they also brought back a major discovery—a "gamma-ray afterglow" that persists after the flare is over. The afterglow, solar physicists say, offers a clue to the still mysterious nature of solar flares.


BOGDAN ROMPOLT

All bottled up. Bright gases in the solar corona trace magnetic loops that confine charged particles.

The GRO instrument observed persistent gamma rays from two flares, both in June of 1991. While the flares appeared to last for just minutes in visible light, the gamma rays kept coming out for 5 hours from one flare and 90 minutes from the other. This afterglow, says principal investigator Ryan, shows that protons accelerated by the poorly understood process of a flare get trapped by magnetic fields in the sun's atmosphere.

The trapping, he thinks, takes place in giant magnetic "bottles" formed by magnetic force lines coiled into a slinky some 15 times the diameter of Earth. After bouncing "zillions of times" through the coils, says Ryan, the particles slowly leak out, colliding with other particles in the solar atmosphere and generating the afterglow.

Scientists already knew that loops in the sun's magnetic field can channel particles accelerated during solar flares. But the long-lasting trapping was a surprise, says Ryan. Theorists had first proposed that magnetic confinement might play a role in flares back in the 1960s, says solar astronomer Carol Jo Crannell of the NASA Goddard Space Flight Center. The original idea was that the trapping causes flares: Somehow the magnetic bottles break open, releasing the particles and setting off a blast of other particles and radiation. "People tried to discredit that by showing the trapping couldn't occur," Crannell says. "Jim [Ryan] showed that the trapping can and does happen," even though the findings don't support the idea that the opening of the magnetic trap causes the flare. If that were the case, GRO would have seen the gamma rays—a sign of the trapping—before each flare, not afterward.

The observations may, however, provide a clue to the origin of at least one component of flares proper. Besides generating a gamma afterglow, the trapping may also cause the gamma-ray emissions during the main part of a flare, says Ryan, as trapped protons slowly leak out the bottom of the loops.

"We are understanding how they [solar flares] behave," says Ryan. But scientists still have no idea what makes these particles suddenly start whirling through the magnetic slinky in the first place, he admits. "Our understanding is surprisingly meager."

–Faye Flam