may respond to the host environment by producing stress proteins," says Young, "and that these proteins can be important immune targets." It seems that once the pathogenic organisms become embroiled in the immune defenses—being engulfed by macrophages, for instance—they respond to the stress by boosting the production of this special suite of proteins, which is present under normal conditions. Ultimately, the stress proteins become presented as major antigens in the immune response.

The Whitehead results seem to crystallize fragments of data from other laboratories, specifically indicating that the production of stress proteins by pathogens may be a common activity during infection, and thus present common targets to the immune attack. One possible consequence of this is that immunity engendered by exposure to a stress protein antigen from one pathogen might confer immunity to an unrelated pathogen. This could explain "the observation that, for many pathogens, only a fraction of infected individuals actually acquire clinical disease," suggest Young and his colleagues.

Bacterial stress proteins therefore look like potential candidates for making subunit vaccines that might be effective across a wide spectrum of pathogens, albeit on a limited degree.

"Immunization with conserved protein antigens, whether during natural infection or during vaccination, might also have negative consequences," caution Young and his colleagues. Such consequences derive from the close structural similarity between the stress proteins produced by the pathogens and those produced by the host. Because the host's immune system has self tolerance to its own stress proteins, it might fail to recognize the pathogen's proteins as foreign. Worse, repeated presentation of a pathogen's stress proteins might break through the established tolerance, thus precipitating an autoimmune reaction.

The same line of reasoning leads Young to suspect that natural infections will occasionally break natural tolerance, causing an autoimmune response against the host's stress proteins and others with which they cross-react. In work on adjuvant arthritis in rats (an experimental model of rheumatoid arthritis), Cohen and his colleagues demonstrate the involvement of one known stress protein, known as 65K. Preliminary work on humans runs along the same lines. ■

ROGER LEWIN

ADDITIONAL READING

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Einstein's Impossible Ring: Found

A phenomenon first predicted by Albert Einstein in 1936, and then dismissed by him as something that would be hopeless to look for, has now been found. Astronomers conducting a survey of radio sources at the Very Large Array near Socorro, New Mexico, have discovered an object in the constellation Leo that has been imaged into a complete ring by the gravitational lensing effect.

"Of course, we'd all heard of Einstein rings," says team member Jacqueline Hewitt of the Haystack Observatory in Massachusetts. "But when I saw it come up on the computer screen, I thought at first it was a problem with the [VLA's image analysis] software."

It was not. Yet her skepticism was understandable. Gravitational lensing is what happens when light or radio waves from a distant galaxy or quasar pass by a massive foreground object on the way to Earth: the object's gravity deflects the radiation and thus produces one or more distorted images of the source. A number of such images have actually been found during the past decade. As Einstein himself pointed out, however, the image can only form a complete ring if the source and the lensing object are precisely aligned—which seems absurdly improbable.

Except that there it was on Hewitt's computer screen—radio source MG1131+0456, a tiny oval about 2 arc seconds across with elongated bright spots at either end. In subsequent observations, Hewitt and her colleagues were able to rule out the possibility of its being a supernova remnant or any other such ring-like structure. Moreover, they obtained optical images of a candidate for the imaging mass: a 22nd magnitude object whose shape and other characteristics are those of a large elliptical galaxy.

So are we now to accept the ring as a wildly improbable event that just happened to come true? Not really, says Hewitt. Einstein tacitly assumed that both the foreground and the background objects would be point sources. "But after the fact I calculated the probability of finding a lensing mass in front of an *extended* object," says Hewitt, "and I realized that it was not all that improbable." Indeed, she says, "if you try to reconstruct the original object, you get a rather ordinary-looking radio galaxy—a bright, compact core with two lobes of emission on either side." The lensing object would be sitting in front of one lobe, thus spreading the light out into a ring. And it would likewise split the image of the compact core into the two bright spots. The source's second lobe can be seen as a region of faint emission just to the outside of the ring. ■ M. MITCHELL WALDROP

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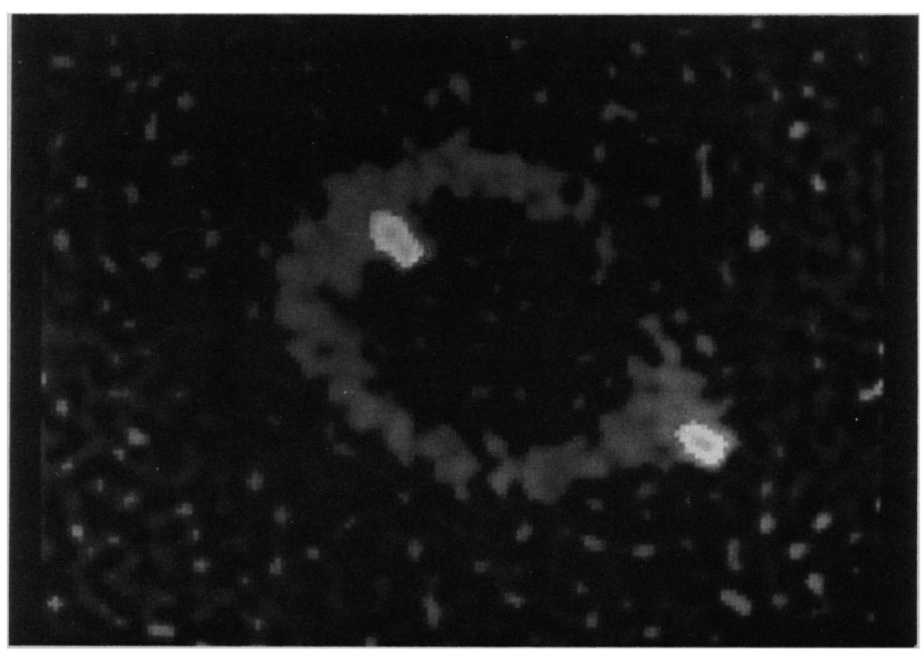

National Radio Astronomy Observatory

MG1131+0456—an Einstein ring.