

## How to give a galaxy a black eye

THE 'Evil Eye' or 'Black Eye' galaxy (NGC4826) owes its ominous form and name to a remarkable and complex dynamical structure, R. Braun, R. A. M. Walterbos and R. C. Kennicutt Jr report on page 442 of this issue. Like other spiral galaxies, NGC4826 contains a disk of stars which all rotate in the same direction about the centre of the galaxy. However, the band of gas and dust that gives NGC4826 its Evil Eye rotates in the opposite direction to the stars, quite unlike the gas motion in normal galaxies. Encounters between the rotating and counter-rotating gas clouds would quickly suppress the counter-rotating component within one galactic revolution (100 million years), so that the Evil Eye is clearly in a transient state of affairs.

Most probably, the Evil Eye represents the aftermath of a recent collision between NGC4826 and a smaller, gas-rich galaxy. The smaller galaxy would have collided with NGC4826 on an orbit that was retrograde with respect to the stars in the spiral, leaving gas and dust spread out in a counter-rotating disk. We know that the galaxy that collided must have been considerably smaller than NGC4826 because the disk of NGC4826 is still present; disks are very fragile dynamical systems and are easily disturbed and destroyed by tidal encounters with galaxies of comparable mass.

Even minor encounters with galaxies as small as 5–10 per cent of the

disk's mass can thicken the disk by a factor of two or more. Spiral galaxies, with their fragile stellar disks, have been nurtured in parts of the Universe that are quiet backwaters, free from significant encounters. The sensitivity of the disks to even minor encounters implies that for at least the past 5–10 billion years the immediate environment of spirals has been free from small objects on orbits that would penetrate the disk.

If cosmological 'N-body' models of the growth of galaxies are correct, then all galaxies grew by a process of

agglomeration. This agglomeration must have ceased sufficiently long ago for spirals to have since formed their disks. Unusual recent events like the collision that gave rise to the Evil Eye afford us an ideal opportunity to study the types of encounters that were once common when the large galaxies were first assembled.

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is that immunity to malaria is largely stage-specific: a vaccine against the liver stage might prevent the infection from developing, but the link with severe malaria is not obvious, given that by definition this is associated with the blood stages. Nevertheless, the systematic approach adopted by Hill and his colleagues has identified a potentially useful antigen and it must now be considered as a candidate for inclusion in a cocktail vaccine.

This is a good time to take stock of the way in which the development of a malaria vaccine is likely to go. The dominant repeat region of the sporozoite protein (CSP) seems to have had its day, but the possibility of hindering the invasion of host hepatocytes by immunizing against the sporozoite antigens involved in cell recognition<sup>8</sup> is a possibility, although several epitopes will probably have to be neutralized to prevent invasion entirely. Despite the fact that few antigens specific to the liver stage have yet been recognized, the liver stage is

now an obvious target, and interest in these molecules will increase when other groups take up the approach of identifying antigens targeted by CTL. The blood stages still remain the principal target and, in this context, the recent results of Manuel Patarroyo's synthetic vaccine trials in Colombia are interesting. Out of 185 service personnel treated with a vaccine that elicited an antibody-mediated immune response, only 2 became infected after duty in a malarious zone, compared with 9 out of 214 placebo controls<sup>9</sup>. Although it is difficult to justify the claim of 60–80 per cent efficacy on these figures, they do suggest that the vaccine could be having some effect.

Perhaps this is also the time to look at the successes, both theoretical and practical, already achieved and to view the future realistically. There are direct comparisons in other fields: for example in infections with human immunodeficiency virus, some feel that the prospect of a vaccine is improbable<sup>10</sup>, whereas others

accept that although there is a long way to go, much can be learned from 'first generation' vaccines<sup>11</sup>. What happens in the field is more important than what happens in the laboratory, and obtaining clues from HLA associations is a good way to begin. □

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