T Cells Suppress T Cells

WHAT shall we find in the pot at the end of the immunological rainbow? There will be T and B lymphocytes and their various subpopulations with a list of their differing properties and roles in immunity, a chemical wiring-diagram outlining the mechanisms involved in signalling the cells to "turn on" or "turn off" on encounter with antigen, and a map of the interactions between T and B cells and macrophages, with footnotes on how these operate.

That humoral antibody produced by B cells can specifically enhance or inhibit (depending on the circumstances) the responses of T cells and other B cells seems well established, and the notion that T cells specifically help B cells to make antibody is now part of immunological dogma. It has been demonstrated recently that T cells can suppress (specifically and nonspecifically) the response of B cells. Although the modulating activity of T cells on other T cells has been less actively studied, there is now compelling evidence that two subpopulations of T cells can act synergistically and specifically to produce a graft-versus-host response, and there is one report of thymus cells inhibiting the response of other thymus cells.

In this issue of *Nature* (page 227), Zembala and Asherson fill in what may be the final arrow in the interrelationship diagram, by demonstrating that peripheral T cells can suppress the response of other peripheral T cells. They have already shown that contact sensitivity to picryl chloride in mice (measured by ear swelling) is T cell dependent and can be suppressed specifically by pretreatment with picryl sulphonic acid. They have also shown that the suppression can be transferred by injecting lymphocytes from picryl sulphonic acid treated mice into normal recipients. Now they demonstrate that the suppressive activity of these cells can be abrogated by treatment with anti-θ serum and complement, which has been shown to kill T lymphocytes selectively. Although this establishes that the suppression is T cell dependent, it could operate through antibody secreted by B cells with T cell help. To exclude this possibility, Zembala and Asherson went on to show that suppressor cells can be generated by injecting normal thymus cells into lethally irradiated, syngeneic mice, which are then treated with picryl sulphonic acid, and the suppressor cells harvested from lymph nodes or spleen five days later. Although this strongly suggests that B cells are not involved in the suppression, one cannot exclude the participation of a small number of B cells contaminating the thymus inoculum or remaining in the irradiated host's spleen. More important, these experiments leave open the possibility that the T cell suppressor activity is indirect and mediated by a third party cell, such as a macrophage.

Thus it seems that T cells can specifically enhance and suppress the response of other T cells, just as they can B cells, but the mechanisms involved are unknown. In the case of T–B collaboration in humoral antibody responses it is known that the cooperative event(s) requires an antigen bridge between T cell receptors recognizing one determinant on the antigen and B cell receptors recognizing a different determinant on the same antigen. It is not clear whether T–T cell synergy or T cell suppressive effects have a similar requirement. It also remains to be determined whether T cell helping and suppression functions are the properties of the same or different subpopulations of T lymphocytes. M. C. R.

Earthquakes on the Move

TO the earth scientist, in recent years earthquakes have served as valuable markers of plate boundaries—regions where adjacent plates are in vigorous contact with each other. Typical velocities of relative motion are 1–10 cm yr^{-1}. Within the framework of plate tectonics there is a clear understanding of why they occur where they do, but the time element of earthquake occurrence is still very obscure. Some simple things can be understood. If strain has been unrelieved at a plate boundary for many tens of years then earthquakes are bound to ensue eventually, but there are no clues to exactly when simply from looking at past seismic history. On the other hand, it is also obvious that a really large earthquake will not be followed by another big one at the same spot for several years. But between these extreme and obvious statements lie the vast majority of quakes, the temporal pattern of which remains to be understood.

Of course, there may be no pattern to it at all. The process of initiating earthquakes could be entirely random, or at least too inscrutable for our present eyes. It could be related to extraterrestrial sources (such as tide generation) but a lot of work on periodicity has yielded nothing very convincing. What remains an attractive prospect for research is that in some sense earthquakes cause earthquakes. For example, a combination of elastic waves emerges from every quake and essentially redistributes strain throughout the whole Earth, although the strain changes at great distance may be one part in a billion or less. All parts of the Earth's surface are already under some strain and in places this may be near breakdown values, thus the passage of the elastic waves could temporarily raise the strain to breakdown. On the other hand the permanent strain change might bring the level somewhat closer to breakdown, increasing the long term probability of there being an earthquake.

One idea that has been gaining ground recently, however, is the hypothesis that seismicity migrates along faults with a speed somewhere between that of continent drift (cm yr^{-1}) and material rupture (km s^{-1}). In today's *Nature* (page 213) is a paper by M. D. Wood and S. S. Allen which brings some evidence to bear on this question of migration. A particularly active section of the San Andreas Fault south of San Francisco has been considered for a time span of forty years. There is a rather striking silence at the northern end of the section whilst earthquakes were occurring in the south in the 1930s. With time the activity moved to the north, and if the concept of migration velocity is a useful one, then a value of 3.3 km yr^{-1} could be assigned.

It is tempting to predict the time and location of the next earthquake, and Wood and Allen chance their arm that there will be a moderate sized event within the next few years north of the recent Bear Valley activity. This region of northern California, highly populated with seismologists and seismometers, is proving to be quite a testing ground for prediction. W. Ellsworth and R. Wesson have already predicted a location for a smaller earthquake using very different techniques. D. D.