

T Lymphocytes in Nude Mice ?

THE 'nude' mouse, homozygous for the gene *nu*, has been hailed as the ideal animal for studying the immunological consequences of athymia. Besides being topless and bottomless, it is generally considered to have, at the most, a minute and grossly abnormal thymus, and to lack thymus-processed ('T') lymphocytes. The article by Raff on page 350 of this issue of *Nature* therefore raises two important and related questions. First, are nude mice in fact totally devoid of T lymphocytes? Second, is the theta (*alias* Thy-1) alloantigen a genuine certificate of authenticity, conferred on no lymphocytes other than those which are passing through, or have graduated from, the thymic educational system?

What Raff has shown is that up to about 2% of lymph node and spleen cells from nude mice fluoresce when exposed to specific fluorescein-conjugated anti-theta antibodies. This proportion is very low in comparison with normal mice and implies that nudes possess perhaps 3% or less of the usual complement of theta-positive lymphocytes. The number of mice examined is small, but they come from three different sources, and comparable observations have been made in another laboratory (Lameline *et al.*, *J. exp. Med.*, **136**, 984; 1972).

The origin of the theta-bearing cells is still a matter for conjecture. The *nu/nu* thymus may perhaps show some transitory function in foetal life, allowing a few T lymphocytes to sneak through. Certainly, as shown recently by Pritchard and Micklem (*Clin. exp. Immunol.*, **14**, 597; 1973), nude mice possess progenitor cells which differentiate to thymocytes and functioning T lymphocytes in the environment of a grafted thymus. The possibility that T lymphocytes cross the placenta from the phenotypically normal (*nu/+*) mother is now open to test, since in germ-free or pathogen-free conditions *nu/nu* females can (contrary to previous belief) produce young. It is still not clear how much of the thymic educational process demands residential attendance within the thymus and how much can be achieved by postal tuition (thymic hormones or activation factors). Such factors would presumably cross the placenta more readily than cells.

This leads on to the second question. To rephrase it: is the theta antigen marker any use? As Raff makes clear, the antigen is not confined to thymocytes and T lymphocytes, but is present on epidermal cells, a component or components of the nervous system, and probably elsewhere. Apparently nude mice carry theta in these locations (Komuro and Boyse, *J. exp. Med.*, **138**, 479; 1973), and it is very unlikely that its appearance there depends on any thymic influence. By contrast, it is stated to be absent on lymphocytes of non-thymic lineage, and it is on this belief that its value as a marker depends. Boyse and his colleagues (most recently in *J. exp. Med.*, **138**, 1027; 1973) have found that theta may be induced to appear on the surface of previously negative cells (including *nu/nu* spleen cells) by a variety of *in vitro* tricks. These include brief exposure to thymus extracts of several origins, but also to other substances (bacterial endotoxin, polyadenylic-uridylic acid and cyclic AMP) whose relevance to the thymus is more debatable. So far, few functional tests on these induced cells have been reported. The modification of sensitivity to azathioprine in rosette-forming lymphocytes exposed to thymic factors

(Bach and Dardenne, *Immunology*, **25**, 343; 1973) may be a related phenomenon, but again the functional significance of the change is obscure. There is therefore no compelling reason at present to conclude that nude mice harbour any functional T lymphocytes.

Against the immunofluorescence data must be set experimental results from several laboratories, almost all of which suggest that thymus-dependent functions are absent. But it takes a refined experiment indeed to distinguish between profound depression and total ablation. For many purposes the distinction is probably not very important, but in situations where it may be critical one should, in the words of the old Scottish motto, 'gang warily'.

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Probing Lunar Carbon

CARBON compounds of biological significance have not been detected in lunar samples. Elucidation of the unusual chemistry of the element carbon in the non-biological lunar environment, however, continues to provide a fascinating challenge. Two of the analytical approaches which have been used to study the part per million concentrations of carbon present are pyrolysis and acid dissolution: pyrolysis gives a measure of total carbon without distinguishing its chemical state; acid dissolution measures the concentrations of gaseous hydrocarbons (CH_4 , for example) and carbide but gives no measure of total carbon. Both methods have shown that most of the carbon in lunar soil has derived from sources outside the Moon, principally implantation by the solar wind and, to a lesser extent, by impacting meteorites. Indeed, the amounts of carbon and its compounds give an indication of the degree of exposure of the constituent soil particles at the Moon's surface. The particles are carried through a cycling process of erosion and aggregation, mainly brought about by micro-meteorite bombardment. Large grains are eroded to smaller particles which are, in turn, aggregated into more complex grains, such as glass welded agglutinates. Carbon added from extralunar sources is originally accumulated at particle surfaces but, during aggregation, a proportion of the carbon species in the smaller particles is incorporated into the newly formed composite particles to give a volume-related carbon component.

In a recent issue of *Nature Physical Science* (**246**, 65; 1973), Desmarais *et al.* suggest that this volume-related component, measured by extrapolation of plots of total carbon against the reciprocal of particle radius, is a better indicator than total carbon of the time of exposure of a soil sample at the surface of the Moon. They believe that the rate of recycling by erosion and aggregation is faster than the rate of accumulation of carbon from outside the Moon and conclude that the carbon species found on the Moon are not directly relatable to source because of "blurring" caused by the rapid recycling process.

The outlook for the further unravelling of lunar carbon chemistry may not be as bleak as this hypothesis suggests, although the complete history of the constituent carbon atoms will probably never be known. Other lunar in-