Finally, what of TRF[4]? After many years of difficulty, created in part by the ability of factors like IL2 and the B cell growth factor to replace T cells indirectly, assays which clearly distinguish between IL2 and TRF are now in hand. And the take-home message is that, indeed, TRF exists[12]. It acts at the time when B cells, having undergone clonal expansion following antigenic stimulation, are to begin secreting high levels of immunoglobulin. Then, as proposed years ago by Dutton and colleagues, TRF can replace T cells in switching on a high level of immunoglobulin synthesis. Using spleen cells thoroughly depleted of T cells (this requires treatment of the donor animal with anti-thymocyte serum, in addition to the more common treatment with anti-Thy-1 antibody *in vitro*), Swain and co-workers have demonstrated synergy between IL2 and TRF in generating plaque-forming B cells. The role of IL2, although not yet delineated in this system, may be related to its ability to induce T cell functions early (proliferative phase). The relationship to the newly described B cell growth factor awaits further experiments. In both cases, a clearer understanding of the roles of several lymphokines now exists, and perhaps more important, the tools and approaches necessary for more sophisticated analysis are evident.

An indication of future directions is given by a current report describing a start on molecular biological studies of IL2. Given several T cell tumour lines which can be induced to generate high levels of IL2 (several thousand times the amounts produced by normal lymphocytes), it has been possible to follow the lead of workers in the interferon field, by looking for mRNA coding for the lymphokine, and then attempting to clone its complementary DNA. The EL4 variant cell line originally described by Farrar and colleagues at NIH[13] does indeed contain demonstrable IL2 mRNA. The poly $(A)^+$, 11-12S RNA derived from PMA-stimulated cells of this line, injected into *Xenopus laevis* oocytes, directs the synthesis of biologically active IL2[14]. Similar results have been obtained by Gillis and colleagues in Seattle. The next phase of work clearly will involve molecular biological approaches. With venture capital panting for release, one may also expect that the term 'growth industry' could soon apply to lymphokinology in more than one way. □

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A new view of supernova remnants in the Magellanic Clouds

from David Clark

FEW areas of astrophysics have not seen major changes following the highly successful Einstein X-ray observatory mission. The impact on the study of supernova remnants (SNRs) has been particularly impressive. When a massive star dies as a supernova, a shock wave is driven outwards from the site of the explosion, sweeping-up and heating interstellar gas to the millions of degrees required for thermal X-ray emission — so forming an extended X-ray remnant with characteristic peripheral brightening. Gas cooling behind the shock may be seen to radiate optically, and SNRs may also be detected at radio wavelengths. The radio emission is non-thermal, produced by fast electrons trapped in the interstellar magnetic field compressed by the expanding shock wave.

Because X-ray astronomy is a comparatively young science, pioneering surveys of SNRs in our own Milky Way, and its closest galactic neighbours, the Magellanic Clouds, were carried out in the radio and optical. Within the Galaxy more than 120 extended non-thermal radio objects were identified as SNRs. Detectable optical nebulosity was found only in the 30 closest of these because of the obscuring effect of dust permeating the plane of the Galaxy. A common characteristic of the optical remnants was recognized — the intensity of the red line emission associated with singly ionized sulphur with respect to the intensity of the red hydrogen Balmer line was very much greater in the shock-ionized plasma of SNRs than in photo-ionized nebulae. The combination of non-thermal radio emission and strong sulphur emission was taken to be a unique signature of SNRs, and was used to detect remnants in the Magellanic Clouds and other nearby galaxies.

The pioneering survey of SNRs in the Magellanic Clouds by Mathewson and Clarke in Australia in 1973 used the radio/optical technique described above. The survey identified 14 remnants in the Large Magellanic Cloud (LMC) and 3 in the Small Magellanic Cloud (SMC), and was assumed to be almost complete (although a few other ring-like nebulosities seen in a deep optical survey of the Clouds by Davies and co-workers in 1976 were proposed as possible remnants). That assumption has been shattered by the X-ray survey of the LMC completed by Einstein and recently reported by Long, Helfand and Grabelsky (*Astrophys J.* **248**, 925; 1981). Einstein detected X-ray emission from 13 of the known 14 LMC remnants, plus 12 other objects which are certain SNRs (5 of which were also in the Davies *et al.* list), plus 25 further objects which are possible SNRs on the basis of existing X-ray data.

The implications of these new discoveries are very significant. They seriously question the sole use in extragalactic SNR surveys of the traditional radio/optical SNR detection technique as it revealed perhaps just one-quarter of the LMC population of remnants. Optical nebulosity associated with many of the new remnants showed sometimes no sulphur emission — sometimes no hydrogen emission. The new detections allow the supernova rate in the LMC to be lowered to perhaps one per century, contrasting with earlier estimates of one per 400–900 years. But most significant, the major population of LMC SNRs now identified in X rays and optically are found to be radio 'sub-luminous'; this result must call into question many of the studies of remnant evolution, distribution, ages, birth rates, distances and so on in our own Galaxy since such studies are based almost entirely on radio data. The new uniform LMC sample of SNRs should prove invaluble in future studies of remnant evolution at all wavelengths.

Observations of the six brightest LMC remnants using the solid-state spectrometer on Einstein are to be published shortly. These too show unexpected results. Four of the six display characteristic thermal spectra expected for shock-heated interstellar material; but the other two show non-thermal spectra suggestive of continued energy input. This is the case for the well known SNR the Crab Nebula, which in addition to emitting non-thermal X rays is brightest at its centre rather than peripherally, the emission being driven by an active pulsar. One of the LMC remnants, going by the rather unspectacular name of N157B, also shows unusual central brightening (as Australian radioastronomers showed several years ago) and mimics the Crab Nebula in other ways, including the non-thermal X-ray emission. It is the first Crab-like remnant detected in another galaxy, and must represent a prime site for the detection of the first extragalactic pulsar. □

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