which, having zero viscosity and entropy, is responsible for many of the remarkable phenomena associated with liquid helium. The proportion of superfluid varies from unity at 0 K to zero at T_λ.

Much interest has been attached to the behaviour of helium in confined geometries and, in particular, to the properties of adsorbed helium films held on glass or metal surfaces by the Van der Waals force. It is well known that superflow occurs readily in the relatively thick (100 atomic layers) films which occur in equilibrium under the saturated vapour pressure. An intriguing question arises, however, as to just how thin a helium film can be made before its superfluidity disappears and this is one of the problems to which Chester and Yang have addressed themselves.

Their apparatus consisted of a quartz crystal, 0.07 mm thick and 6.3 mm in diameter, vibrating in its thickness-shear mode such that the oscillations of the surface were parallel to itself. In this situation the characteristic frequency of the crystal is very sensitive to the mass of any material deposited on its surface and the mass of an adsorbate can be determined accurately by measuring the resultant drop in frequency. In the case of a helium film, however, only the normal fluid component is able to follow the oscillations of the crystal. The superfluid component, because of its zero viscosity, is not coupled to transverse oscillations of the surface, remains motionless and therefore does not contribute at all to the loading effect of the helium film. The technique thus enabled direct measurements to be made of the mass of normal fluid in the film, under various conditions of temperature and film thickness.

The film thickness at any particular temperature T was controlled by adjusting the pressure P of the helium gas surrounding the crystal and with which the film was in equilibrium. The mass σ_1 which was loading unit area of the crystal at first increased with P, suddenly fell by a small factor and then increased more slowly as P continued to rise towards the saturated vapour pressure, P_0. Chester and Yang interpret these results as indicating that at very small values of P (very thin films) the film displays no superfluidity; they attribute the abrupt drop in σ to the onset of superfluidity with an associated decrease in the effective mass loading the crystal; and they point out that the subsequent slower rise with P of σ_0 is to be expected, assuming that only the additional normal fluid will load the crystal. This interpretation is consistent with their earlier paper (*Phys. Rev. Lett.*, **29**, 211; 1972) with Stephens of the California Institute of Technology in which they presented preliminary data and, in particular, reported that similar measurements for an adsorbed film of ^{3}He, which is not a superfluid at these temperatures, yielded a monotonic dependence of σ_1 on P, from zero right up to P_0, with no sign of the features attributed to superfluidity in the present case of the ^{4}He films.

To deduce the proportion of superfluid component from the experimental values of σ_1 it was, of course, necessary to know the total mass σ per unit area of the film for any given values of T and P. By replotting their values of σ_1 against $(P/P_0)^T$ as abscissa, the authors have succeeded in generating a universal curve relating σ to P and T, as required. Each experimental curve started out from the origin along the universal curve and then, at some particular value of $(P/P_0)^T$, depending on T, started to deviate because of the presence of superfluid. By measuring the magnitudes of these deviations they were able to determine the mass σ_s of superfluid component per unit area corresponding to any particular value of σ, for a variety of temperatures.

After making additional assumptions, consistent with a number of earlier experiments, that the first adsorbed layer is solid, and that the second and subsequent layers are liquid of the standard density, the authors conclude that superfluidity does not occur in a helium film until between two and three atomic layers of liquid, depending on the temperature, have been deposited.

X-ray 'star' in Cygnus Loop

RAPPAPORT *et al.* report that they have detected a central 'hot spot' in the Cygnus Loop. This source, detected at X-ray frequencies during a non-dimensional scan from an Aerobee rocket on March 30, 1973, may be the stellar remnant of the supernova explosion, *Astrophys. J. Lett.*, **186**, L115; 1973). If so, it represents only the third definite identification of such a stellar remnant.

In a sense, this discovery completes a set of such identifications, for the central star in the Crab Nebula was first found with optical telescopes, and the equivalent source in Vela was first detected at radio frequencies, as the Vela pulsar. Both these other two objects, of course, have X-ray counterparts.

The best position quoted for the Cygnus object is $\alpha(1950) = 20\text{h}\ 49\text{m}\ 40\text{s}$; $\delta(1950) = 30°43'.5$. But the error box only marginally overlaps with that of the 'hot spot' reported by Stevens and Garmire (*Astrophys. J. Lett.*, **180**, L19; 1973), which lies distinctly off centre in the Cygnus Loop. The available observations are fitted by a black-body spectrum with temperature $1.9 \pm 0.6 \times 10^6$ K, and X-ray luminosity of 8×10^{34} erg, assuming a distance of 770 pc. It is interesting, as Rappaport *et al.* point out, that these parameters correspond to an object about 30 km across, in the right area for a neutron star. Also, there is some evidence of periodic variations of the source with a frequency of 16 Hz, again about right for a spinning neutron star.

Swings, roundabouts and Sco X-1

from a Correspondent

THAT there is a source mechanism which can give rise to periodic pulsed radiation in close, interacting binary stars is rapidly becoming an established observational fact. A wide range of apparently differing systems which exhibit a variety of pulsing behaviour are being found.

The regular periodic pulses observed in the X-ray systems Cen X-3 and Her X-1, superficially similar to the on-off, on-off radio pulses of pulsars, are now well known. The periods, of the order of a few seconds, are so short that it has become widely accepted that a highly compact neutron star must be involved (although while dwarf models cannot yet be ruled out—see *Nature*, this issue, page 333). The widely accepted explanation of these stable pulses is that they are produced by the infall of material, flowing from the normal stellar component, and accreting preferentially along magnetic field lines onto a neutron star companion. If the material is funnelled in this way onto the magnetic poles and the neutron star rotates with the required period of a few seconds, the observed X-ray pulses are, at least qualitatively, easy to explain.

In the case of the strongest compact X-ray source, Sco X-1, no such stable pulsing behaviour has been found, suggesting the absence of a strong magnetic field. But several claims have been made that weak periodicities of a transient nature can be observed, in particular in the optical region. These are the subject of a recent paper (Frohlich, *Mon. Not. R. astr. Soc.*, **165**, 313; 1973) which may help clarify the issue.

The optical counterpart of Sco X-1 is known to be a variable star exhibiting very rapid light fluctuations, and additional larger scale flaring on a timescale of a few hours. The apparently erratic optical fluctuations have been analysed by various investigators using power spectra and the so-called periodogram techniques in a search for evidence of