Great interest was shown in the description of Dr E. W. MacKie (Hunterian Museum, Glasgow) of his excavation of a stone platform near the large standing stone at Kintraw, Argyll. This, according to the theories of A. Thom, was the observation point of the megalithic midwinter solstice observatory in prehistoric times. Unfortunately, no artefacts were found but a petrofabric analysis of the stones of the platform is demonstrably similar to a platform known to be man-made and quite dissimilar to natural ones.

SOLID STATE

In Two Dimensions

from a Correspondent

A CALCULATION by Novaco (*Phys. Rev. A*, **7**, 678 ; 1973) provides strong support for an earlier suggestion that a single layer of helium atoms, adsorbed on a smooth surface at low temperature, behaves as a two-dimensional solid.

An adsorbed atom (adatom) is strongly bound to the surface of another material (substrate) by the so-called Van de Waals force of attraction. The adatom therefore finds itself trapped in a two-dimensional world where, if the substrate is smooth, it is entirely free to move in any direction parallel to the surface, but where motion in the third dimension, perpendicular to the surface, is rigorously forbidden. When many adatoms coexist on the same substrate, the normal concepts of kinetic theory may be expected to apply: each atom will possess a certain average speed, dependent on the temperature, and atoms will frequently collide with each other, exchanging energy and momentum ; but all these processes will be occurring in two dimensions rather than the normal three. The sole function of the substrate is that of constraining the assembly to remain in two dimensions, it being regarded otherwise as completely inert.

Several different substrate – adatom combinations have now been studied, but particular attention has centred on helium adatoms because the Van de Waals force between a pair of helium atoms is so small that a low density assembly can be expected to behave as an ideal two-dimensional gas, a situation which is relatively easy to tackle theoretically. At higher densities, the adatoms, being more closely packed on the substrate, will have less freedom to move about, and so might perhaps be expected to form a two-dimensional solid. This latter point is by no means obvious, however, for three-dimensional helium does not solidify, even at zero temperature, unless a substantial external pressure is applied.

Very striking demonstrations of the general validity of these ideas have been achieved by Dash and his colleagues at the University of Washington, who have measured the heat capacity of helium adsorbed on a form of graphite at temperatures of a few K. This substrate has the advantage, in addition to being very smooth, that a small volume of the material presents an exceedingly large area of surface for adsorption: their 12 cm^3 cell contained more than 200 m^2 of graphite surface. The heat capacity of the substrate was therefore considerably less than that of the adsorbed film, which could then be measured with impressive precision. In earlier investigations they were able to demonstrate that, at low (that is, submonolayer) coverages, the helium atoms indeed display many of the properties predicted for two-dimensional gases, but their most recent work (Bretz, Huff and Dash, *Phys. Rev. Lett.*, **28**, 729 ; 1972) concerns the situation where the substrate is, in effect, completely covered with helium. To their surprise, they found that the heat capacity passed through a very sharp maximum at a temperature which depended on the two-dimensional density of the monolayer.

They tentatively attributed this phenomenon to a melting process: at temperatures well below that of the peak, the atoms would all be localized in some sort of two-dimensional lattice ; whereas, above the peak, they would be able to move about freely, forming a two-dimensional liquid. Just as in the case of three-dimensional helium, the melting point would move to higher temperatures if the density of the two-dimensional solid was increased by adding extra adatoms, consistent with the experiment. A surprising feature of their results was that, at temperatures well below the peak, the heat capacity of the two-dimensional solid corresponded to that of three-dimensional helium at a pressure of several hundred atmospheres. This seemed remarkable at first sight, for the "actual" pressure (that is, that of the real three-dimensional vapour in equilibrium with the adsorbed film) was negligibly small. A plausible explanation was put forward, however, in terms of the very strong attractive force between adatom and substrate, which might be able to pull many additional helium atoms down onto the surface even though it meant compression of an already complete monolayer.

Novaco has now put this suggestion to the test, theoretically, by calculating the densities and corresponding heat capacities which would be expected at very low temperatures, if the monolayer were indeed a close-packed two-dimensional solid. That his calculated values are in satisfactory agreement with experiment is encouraging evidence in support of the model. Unfortunately, the heat capacity measurements yield no information on the two-dimensional lattice structure and, indeed, cannot show unambiguously that the monolayer is solid rather than liquid. Novaco points out that a neutron scattering experiment, now in the planning stage, may perhaps yield definitive answers to these questions.

Radio Emission from Supernova 1970g

SUPERNOVA 1970g was a type II event which occurred in the external galaxy M101. In next Monday's *Nature Physical Science* (May 21) Goss and colleagues report observations of the supernova remnant made with the Westerbork Synthesis Radio Telescope (WSRT) at 21 cm and 6 cm and with the Max Planck 100-m instrument at 2.8 cm.

The observations were carried out during late 1970 and early 1971. Mapping at 21 cm took place during November, December and January ; the resolution of the final map is 25 arc s × 30 arc s. Better resolution is achieved at 6 cm, of course, but at that wavelength the source was viewed only for one period of 12 h on January 26, 1971. But this observation does reveal a source of about 4×10^{-3} f.u. at the position of the supernova. The 2.8 cm observations, on the other hand, show no emission above 6×10^{-3} f.u. at the position of the supernova remnant.

Studies of the radio emission from this supernova are handicapped by its proximity to NGC5455, an HII region. But between December 1970 and December 1971 the emission from that part of the sky increased by 6×10^{-3} f.u. ; HII regions do not usually vary over that sort of timescale, and Goss *et al.* conclude that the variable radio emission may represent the first stages in the development of a radio emitting remnant.

Curiously, the observations reported now indicate a strong flux at 21 cm in February 1972, when Gottesman *et al.* (*Astrophys. J.*, **174**, 383 ; 1972) noted a disappearance of the source at 11 cm. Taking both observations at face value, this poses serious problems in defining a spectral index for the source.

As yet, it is too early for the observations of this young supernova remnant to provide convincing support for a unique theoretical model. The mechanism is probably non-thermal, but the radiation could be coming either from a region surrounded by the ejected material (perhaps even from a young central pulsar) or from outside the supernova shell and still produce the observed characteristics.