protein glycosylation should be demonstrated in more widely utilised cell lines transformed *in vitro* by viruses. The most convincing demonstration would be with temperature-sensitive viral mutants in which the transformed state can be expressed or suppressed rapidly by altering temperature. The only published study of lectin-binding to proteins of viral transformants may show similar alterations in WGA binding, but quantitation was not performed (Burridge *Proc. natn. Acad. Sci. U.S.A.* **73,** 4457; 1976).

Other important future work obviously includes identifying the structural basis of the altered lectin binding of the 100 K protein, and investigating whether these changes are directly responsible for any aspect of malignancy.

Is the 100 K protein a known plasma membrane protein? The authors speculate that it is the insulin receptor. However, it could be a recently isolated membrane protein of 97,000 daltons that is induced in some transformed cells secondary to glucose deprivation (Shiu, Pouyssegur, & Pastan *Proc. natn. Acad. Sci. U.S.A.* **74,** 3840; 1977; Pouyssegur & Yamada *Cell* **13,** 139; 1978).

The possible benefits from the unequivocal identification and isolation of a general membrane marker for malignancy might include simpler diagnosis of the disease, immunotherapy directed against the marker, and a clue to the mechanisms of malignancy. However, at present the evidence for this marker is not unequivocal, and the history of other proposed membrane markers for malignancy suggests that exceptions may be found. Regardless of the final verdict, studies of the changes in glycosylation of this 100,000 dalton glycoprotein should provide useful information about the process of malignancy. □

Cosmic heresy?

from P. C. W. Davies

SINCE burning at the stake is now out of vogue, it will be interesting to see how the Establishment responds to a radical new model of the Universe proposed by George Ellis. For he does not merely tinker with the currently fashionable big-bang cosmic scenario, he goes the whole way and abandons the entire conceptual and philosophical foundation of modern cosmology.

Returning to a pre-Hubble, some would say pre-Copernican, picture of the Universe, he describes in the current issue of *General Relativity and Gravitation* (**9**, 87; 1978) a model cosmos with the startling feature of being static. Since the discovery in the late 1920s by Edwin Hubble of a systematic redshift in the light from distant galaxies towards the red end of the colour spectrum, it has been universally accepted that this phenomenon is due to a more or less uniform overall expansion of the Universe, resulting in a general, rapid, recession of all galaxies away from one another.

It has always been realised, however, that a redshift of light can have another cause—gravity. When light climbs away from a massive gravitating object it loses energy, a depletion which shows up as a loss of frequency (colour shift). This explanation for the galactic redshift has always been ruled out because it is asymmetric: light falling towards a mass acquires a blueshift. As we see only redshifts whichever direction we look in the sky, the only way in which this could be consistent with a gravitational explanation is if the Earth is situated at the centre of an inhomogeneous Universe. This is precisely what Ellis suggests.

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Actually there is a subtlety. Imagine a static blob made up of galaxies, with a high concentration near the centre and a more sparsely populated periphery. An observer at the centre would see blueshifts as the light from the galaxies near the edge fell inwards. However, the possibility of curved space provided by Einstein's theory of relativity enables the 'edge' to bend around on itself and form another centre, or rather a sort of 'anticentre' in a higher-dimensional version of the antipodes. At the anticentre an observer would see only redshifts. It is here that Ellis conjectures the Earth may reside.

The idea of a privileged cosmic location for man has been anathema to scientists ever since Copernicus showed the Earth is not at the centre of the Universe but revolves round the Sun. All subsequent astronomical discovery has appeared to confirm the fact that we inhabit an unremarkable region of the cosmos, and that as successively larger regions are surveyed by our telescopes, they sample what always appears to be a typical portion of the whole. Now Ellis is suggesting that this assumption is more a philosophical prejudice than a result of hard scientific evidence. In his new model, the Earth does indeed reside near the ('anti')centre, but for biological reasons rather than theological ones. He argues that the physical conditions near the centre, particularly the prevailing temperature, are especially favourable for life to evolve, so it is no surprise that we find ourselves in such a special location. (After all, we are not surprised to be living on the surface of a planet, even though most of the Universe is empty space.)

But that is not all. The other centre is not merely more densely populated with galaxies: the concentration of matter there is so great that the curvature of space rises without limit. Indeed, our cosmic antipodes is inhabited by that ultimate nightmare of physics—a naked singularity. This is a region where space comes to an end and causality breaks down. According to Ellis, the naked singularity is what astronomers have up to now mistaken for the big bang—a sudden cosmic creation event, 15 billion years ago. In the new model, the singularity is not a past boundary of time, but a permanent feature, marking a boundary of space.

Not only does the Ellis Universe contain this bizarre structure, but the singularity actually plays an indispensible role as a sort of cosmic recycling mechanism. As galaxies burn out, so their material falls towards it, to be replaced by fresh hydrogen spewed outwards. In this way, the singularity continually rejuvenates the Universe, endowing it with unlimited longevity.

The idea is reminiscent of the late lamented steady-state theory, except there is no necessity here for the continual creation of more and more matter to 'top up' the Universe as it expands. Moreover, the Ellis model does not suffer from the major defect of the steady-state: its inability to account for the cosmic background heat radiation, widely presumed to be the last fading glow of the primaeval fire. This radiation, first detected in the mid-1960s, has a temperature of a mere 2.7 K, and apparently bathes the whole Universe. It is considered to be the best evidence that there really was a hot big bang. Now Ellis conjectures that this thermal radiation comes not from any primaeval phase, but from the intensely hot material which shrouds the singularity.

The essence of Ellis's argument is that the currently available data about the structure and evolution of the Universe on a large scale are quite consistent with the picture of a static inhomogeneous Universe observed from a very special location. One major difficulty seems to be stability. A good way of viewing the model is to think of the fiery singularity as located (appropriately enough!) at the 'bottom' of the Universe, while our own elevated location is at the 'top'. The question is, could we remain perched precariously over such a great mass concentration without the whole Universe collapsing under its own gravity down into the singularity, like a gigantic house of cards?

A further problem concerns the precise details of the recycling mechanism, whereby the heavy elements (ashes of the stars) are flushed down towards the singularity and the replacement light elements, such as hydrogen, which are used to build up new generations of stars, drift up towards us.

Needless to say there are also a number of philosophical problems. Naked singularities are usually regarded as a serious disease in physics, something to be avoided at all costs. Most relativists support Roger Penrose's idea of a cosmic censor who always clothes singularities inside black holes, where they cannot influence the outside world. In the Ellis model the singularity—by definition a lawless and unpredictable creature—is contrived to drive, ultimately, all the organised activity in the Universe.

There is also the curious problem of why, if the Universe is infinitely old and life is concentrated in our particular corner of the cosmos, it is not inhabited by technological communities of unlimited age. Is technology recycled too? In a cryptic footnote to his paper Ellis comments that it may be desirable to find a compromise model Universe, incorporating features both of the standard expanding model and his own new ideas.

In spite of all the difficulties, this remarkable new slant on the cosmic structure and organisation serves at least as a reminder that the conceptual basis of modern cosmology can be widened. Perhaps the Copernican revolution is over? □

Superfluid ^{3}He at Manchester

from P. V. E. McClintock

Now that the superfluid phases of liquid ^{3}He (discovered at Cornell University in 1972) are no longer quite such a novelty, it seems timely to pause, take stock of what has been achieved and consider how best to tackle the substantial problems still remaining. It had always been clear that a number of the early experiments paid insufficient attention to characterising the textures exhibited by the (highly anisotropic) superfluids; and it was entirely fitting, therefore, that a recent meeting on superfluid ^{3}He at Manchester* should have been notable for people's concern about how to predict and control the textures taken up by the liquid under different sets of experimental conditions.

D. Bailin (University of Sussex) described the ways in which topology could contribute to an understanding of the textures and transitions between them. Although he sought to emphasise that because one does not feed very much information into a topological analysis one cannot reasonably expect to get much out again in the way of quantitative conclusions, it became clear in the course of his talk that a good deal of insight may nonetheless be gained by this approach.

One method of controlling the texture experimentally lies in careful choice of the shapes of the surfaces with which the liquid comes in contact: it was reported that the Sussex NMR experiments were being conducted on liquid held in fine tubes 1 μm in diameter; whereas, at Orsay, the liquid was contained within a stack of 0.4 mm Mylar plates. Other factors affecting the texture were the applied magnetic field, which was easy to control, and heat flow, which was not. The effect of a flow of heat was expected to be quite complicated and it could even give rise to 'dynamical textures', that is, textures which vary systematically with time, according to J. R. Hook (Manchester University). It seemed very likely that the long lived periodic motions observed earlier by J. C. Wheatley and his coworkers at La Jolla were a consequence of this effect.

J. D. Reppy (Cornell University) described recent high precision experimental results obtained at Cornell using what amounts to a modified Andronikoshvili apparatus: an inverted torsion pendulum whose hollow interior could be filled with liquid ^{3}He. By measuring changes in the characteristic frequency and damping coefficient attributable to the ^{3}He, values could be deduced for the average viscosity and superfluid density, and interesting comparisons could then be made with viscosities measured by a completely different method employing a vibrating wire.

Summing up and pointing towards possible future developments, A. J. Leggett (Sussex University) discussed some of the puzzles still being posed by superfluid ^{3}He. Coping effectively with textures presented severe theoretical difficulties, and he enthusiastically endorsed an earlier remark by Hall to the effect that hoping to predict textures from the equations of superfluid hydrodynamics was almost as ambitious as expecting to be able to predict the weather by solving the Navier-Stokes equations! An experimental approach was best in the first instance, and he went on to discuss the techniques, such as ultrasound, already available as well as an interesting, and as yet unproven, idea involving possible reflection of quasiparticles when they enter regions where the energy gap, relative to their direction of motion, is decreasing. Other important but unresolved puzzles included: the absence of the electric field effect (electric fields had been expected to orientate the l vector, but experimentally they apparently failed to do so); the magnitude of the A-phase liquid's intrinsic angular momentum (a bucket of initially normal liquid ^{3}He should start to rotate when cooled into the superfluid A-phase, but how fast?); anomalous differences between static and NMR measurements of the B-phase magnetic susceptibility; and the range of validity of the (so far, remarkably successful) 'giant diatomic molecule' picture of the superfluids. The latter model has, of course, recently received something of a boost through Leggett's own successful use of it for predicting, correctly, that the A-phase would be weakly ferromagnetic. □

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*Held on 28 April.

More puzzles about the early Solar System

from M. Edmunds

THE determination of the relative abundances of isotopes in meteorites continues to produce unexpected results. A particularly copious and fruitful source of this early Solar System material has been the meteorite from Allende in Mexico. The relatively high abundance of ^{26}Mg, the decay product of ^{26}Al, in some aluminium-rich minerals in this meteorite has already prompted suggestions that heavy elements freshly made in a supernova explosion were incorporated into solid material during the formation of the Solar System (see *News and Views* **267**, 393; 1977). Anomalies in the isotopic

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