values of p_V/p_b are observed in Cygnus and Cepheus-Cassiopeia; for longitudes $140° < l^{II} < 216°$ the ratio is higher than that in Cygnus, although the largest value of p_V/p_b is found in Sagittarius.

There are two possible explanations to account for the variation of the extinction curves. At a given wavelength the cross-sections of interstellar elongated particles (aligned by a magnetic field) are different for different orientations; it has been predicted[12,13] that the ratio $\frac{\text{UV slope}}{\text{BV slope}}$ of the extinction curve would be dependent on the angle of viewing and that this dependence would be related to polarization relative to extinction. Observation has not confirmed these predictions. The other possibility is that the composition and size distribution of interstellar dust grains could be different for different parts of the galaxy. If the relative number of large particles is increased, it is to be expected that a decrease in the ratio $\frac{\text{UV slope}}{\text{BV slope}}$ of the extinction curve will be related to the shift of the maximum polarization towards longer wavelengths and to an increase in the value of the ratio of total to selective absorption. Some confirmation of these predictions is afforded by our results and those of Serkowski.

McCuskey[14] has found that the obscuration in the anticentre region is not very high and has concluded that there is a real deficiency of stars there. But he assumed a ratio of total to selective absorption $R = A_V/E_{B-V}$ close to 3. A much higher value of R, or the addition of much grey obscuring matter in an anticentre cloud, would lead to underestimation of the total obscuration. This in turn would cause the distances of the stars to be overestimated and produce a spurious reduction in star density in the region. It may be significant that the volume density of stars derived by McCuskey drops suddenly at $l^{II} = 140°$, the contours of equal surface density being almost radial to the Sun at this galactic longitude. This is true even for *F*0–*F*5 stars within 500 pc.

A high value of R, or grey obscuration, implies a cloud of particles with large sizes, and this may indicate that the grain temperature in the cloud is very low so that grains that were initially small have grown into large agglomerations. Such a low temperature has interesting consequences in terms of the formation of molecules and the fragmentation and condensation of the cloud.

A discontinuity at $l^{II} = 140°$ has been found to occur sharply in the apparent distribution of *OB* stars[15] and to be inclined at about 45° to the Galactic Equator. A survey of a region 2° in radius centred on $l^{II} = 140°$, $b^{II} = 0$, and including UBVI photometry and polarization measures of all stars in the region brighter than about $B = 16$, is being undertaken at this observatory.

M. T. BRÜCK
J. G. IRELAND
K. NANDY
V. C. REDDISH

Royal Observatory, Edinburgh.

Received April 16, 1968.

1 Reddish, V. C., *Nature*, **213**, 1107 (1967).
2 Becker, W., *Z. Für. Ap.*, **58**, 202 (1964).
3 Westerhout, G., *Maryland–Greenbank Galactic 21-cm Line Survey*, first ed. (University of Maryland, 1966).
4 Nandy, K., *Pub. Roy. Obs. Edin.*, **3**, 142 (1964).
5 Nandy, K., *Pub. Roy. Obs. Edin.*, **5**, 13 (1965).
6 Nandy, K., *Pub. Roy. Obs. Edin.*, **5**, 233 (1966).
7 Nandy, K., *Pub. Roy. Obs. Edin.*, **6**, 25 (1967).
8 Nandy, K., *Pub. Roy. Obs. Edin.*, **6** (in the press).
9 Whitford, A. E., *Astron. J.*, **63**, 201 (1958).
10 Underhill, A. B., and Walker, G. A. H., *Mon. Not. Roy. Astro. Soc.*, **131**, 475 (1966).
11 Reddish, V. C., *Pub. Roy. Obs. Edin.*, **6**, 15 (1967).
12 Greenberg, J. M., and Meltzer, A. S., *Astrophys. J.*, **132**, 667 (1960).
13 Wilson, R., *Mon. Not. Roy. Astro. Soc.*, **120**, 51 (1960).
14 McCuskey, S. W., *Astrophys. J.*, **123**, 458 (1956).
15 Sim, M. E., *Pub. Roy. Obs. Edin.*, **6** (in the press).

BL Lac identified as a Radio Source

I WISH to draw attention to the fact that a new position ($\alpha_{1950} = 22^h\ 00^m\ 38^s{\cdot}9 \pm 0^s{\cdot}7$, $\delta_{1950} = +42°\ 02'\ 09'' \pm 9''$) and optical identification[1] of the radio source *VRO* 42.22.01 (ref. 2) determined with the Algonquin Radio Observatory 150 ft. telescope places it coincident with the irregular variable star *BL Lac*. *BL Lac* was discovered by Hoffmeister[3], and varies from the thirteenth to sixteenth magnitude with fluctuations of large fractions of a magnitude in a few days[4]. A finding chart is published by Hoffmeister[5]; the position of the variable in the chart by Semakin[4] seems to be slightly in error. Examination of a glass copy of the National Geographic Society and Palomar Observatory Sky Survey at the Dunlap Observatory shows marginal nebulosity about the star. The optical properties of this object combined with its radio polarization and unusual microwave spectrum[1] make it outstandingly interesting.

JOHN L. SCHMITT

David Dunlap Observatory, University of Toronto, Richmond Hill, Ontario, Canada.

Received April 24, 1968.

1 MacLeod, J. M., and Andrew, B. H., *Astrophys. Lett.* (in the press).
2 MacLeod, J. M., Swenson, jun., G. W., Yang, K. S., and Dickel, J. R., *Astron. J.*, **70**, 756 (1965).
3 Hoffmeister, C., *Astron. Nachr.*, **236**, 233 (1929).
4 Semakin, N. K., *Variable Stars* (Moscow), **10**, 283 (1955).
5 Hoffmeister, C., *Sonneberg Mitt.*, No. 17 (1930).

Cosmological Significance of Time Reversal

A RECENT attempt by Stannard[1] to explain the apparent overthrow of parity in the long-lived kaon experiments suggested the possibility of an unseen component of the universe in which matter was of opposite time sense to that in the observable universe.

Beginning with this idea, a cosmological model with interesting symmetry properties suggests itself. Drawing on the well known model of Hoyle, a newly created particle of matter is followed as it is gradually accelerated by the cosmological expansion of the universe. I am suggesting that at some point in this acceleration the particle undergoes a transition in time sense and that simultaneously the other two parameters of the CPT theorem of particle physics, that is, parity and charge, will also be conjugated. For example, an electron with time sense +1 and parity even will become a positron with time sense −1 and parity odd. According to Stannard's treatment, this particle, having reversed its time sense, will no longer interact with particles of a positive time sense and therefore will no longer be detectable in the part of the universe consisting of matter with a positive time sense.

Let the particle be embedded in a system which is undergoing a gravitational collapse; furthermore, let all particles in this system undergo the CPT reversal at nearly the same time, that time being coincident with the occurrence of the Schwarzschild singularity, that is, the point at which the limiting radius, $R = GM/C^2$, is reached. Seen from outside the collapsing system, there will be no effect, but the mass inside the singularity, rather than being lost or excluded from the universe as was necessary in previous treatments of collapse, is merely shifted from one phase of the universe to another. With the occurrence of time reversal the gravitationally contained mass reverses from a contraction to a violent expansion; this expansion takes place in a Minkowski space which is the conjugate of that in which the contraction occurs.

CPT reversal inside a gravitational singularity is believed to be a relevant issue for at least two reasons: (1) it is felt that the unique "closed-system" environment of a collapsed system is more likely to be conducive to such a reversal than any other environment; (2) it is felt that gravitational collapse is an inevitable and cosmologically very significant event in the dynamic character of mass in the universe.

Consider a galaxy being accelerated away from an observer under the general cosmological expansion. With what mass will the system be observed to be gravitationally cohesive ? It seems reasonable that, although the members of the galaxy are at rest relative to each other, an observer with whom the galaxy is in relative motion will see them gravitate according to their relativistic mass. A compensating time dilation will also be involved and this will prevent any increase in the observed acceleration which they show for each other; however, this only applies in the directions perpendicular to the velocity, for along the direction parallel to the velocity a contraction of space exactly compensates the time dilation. This indicates that such a galaxy, assuming an initial spherical distribution of mass, will become, relative to a distant observer, more and more disk-like and dense as it approaches the speed of light. As the density of the disk increases it would seem that a phenomenon not dissimilar to the spherical gravitational collapse of Schwarzschild will inevitably commence. This phenomenon depends on the relative velocity, and thus the position of the observer, and it is one which is obviously reciprocal, that is, a second observer, who was on the collapsing galaxy, would observe the galaxy, of which the first observer was a part, to be undergoing collapse.

The following picture emerges. (1) Matter is being created or transferred to the observable universe (which at any position is one-half of the total universe) which maintains a constant density. (2) The universe appears to be in a state of expansion and matter, which attains a relative velocity near that of light, is observed to pass through a gravitational singularity at which time it undergoes a complete CPT reversal. (3) After the reversal, the singularity commences the time reversal of gravitational contraction (that is, gravitational expansion) and continues back to the pre-galactic stage. (4) This process continues until at some time, determined by the probability of the transition and coinciding exactly with the rate of matter transferral necessary to maintain a constant density in both time-sense sectors of the universe, the particles from the singularity revert to their original time sense, thus (1). This re-entry process would observationally be similar to the matter creation of Hoyle.

The advantages of such a theory are apparent. (1) It is no longer necessary to think of the entropy of the universe as a quantity asymmetrical with respect to time reversal, for indeed it is now constant and the idea of the universe ultimately "running down" is not required. (2) Quasi-stellar objects can be rationalized in terms of the tremendous output of energy from the collapse process. According to Schwarzschild's spherical model, half the mass of the system is radiated in this process. Their apparent non-uniform distribution in the universe is accounted for by their observational nature, thus saving the credibility of the cardinal cosmological principle of homogeneity. (3) The preponderance of matter over antimatter in the observable universe is counter-balanced by the preponderance of the latter over the former in the non-observable, time-reflected universe, adding another note of symmetry to the model. (4) An observer anywhere in the universe (even inside what Earthbound astronomers will term quasars or beyond this in the time-reversed phase of the universe) will be confronted with the same general physical picture of the universe. (5) The paradox presented by the apparent approach of galaxies to the velocity of light due to the cosmological expansion, with the ultimate demand for infinite energy expenditure, is hereby avoided; before ultimate velocity is reached, the accelerating matter is excluded from that phase of the universe in which it is subject to the cosmological expansion. (6) The model contains essential elements of both steady state and big-bang cosmological models.

With respect to observational work reported on quasi-stellar objects, it is interesting to note that (*a*) their puzzling luminosity–velocity distribution could be a result of non-spherical galaxies going into collapse in various orientations, and (*b*) a quasar might be observed to expand at a velocity greater than the speed of light because the phenomenon might first occur at the dense core of a galaxy (creating an observable quasar with small angular dimensions) and then progress to the edges, although there would be no propagating wave exceeding the classical limit.

KARY MULLIS

Department of Biochemistry,
University of California, Berkeley.

Received February 21; revised April 24, 1968.

[1] Stannard, F. R., *Nature*, 211, 693 (1966).

Ordovician Conodonts from New Zealand

UNTIL recently only Devonian conodonts have been known from New Zealand[1], but Ordovician conodonts have now been discovered in the north-western part of the South Island. They seem to be the most southerly Ordovician conodonts yet recorded.

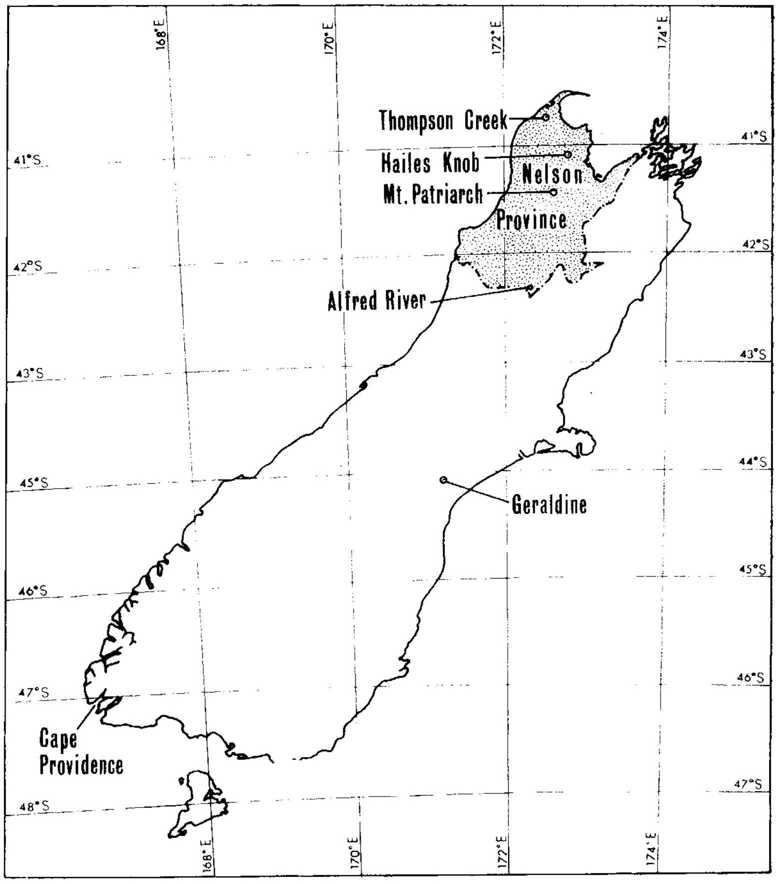

Fig. 1. Map of South Island showing the position of Nelson Province.