have to account for the different physical conditions required by these three regimes of continuum emission.

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[1] Neugebauer, G., Oke, J. B., Becklin, E., and Garmire, G., *Astrophys. J.*, **155**, 1 (1969).
[2] Grader, R. J., Hill, R. W., Seward, F. D., and Hiltner, W. A., *Astrophys. J.*, **159**, 201 (1970).
[3] Holt, S. S., Boldt, E. A., and Serlemitsos, P. J., *Astrophys. J. Lett.*, **158**, L155 (1969).
[4] Peterson, L. E., and Jacobson, A. S., *Astrophys. J.*, **145**, 962 (1966).
[5] Riegler, G. R., thesis, Univ. Maryland (1969).
[6] Buselli, G., Clancy, M. C., Davison, P. J. N., Edwards, P. J., McCracken, K. G., and Thomas, R. M., *Nature*, **219**, 1124 (1968).
[7] Ables, J. G., *Astrophys. J. Lett.*, **155**, L27 (1969).
[8] Mark, H., Price, R. E., Rodriques, R., Seward, F. D., Swift, C. D., and Hiltner, W. A., *Astrophys. J. Lett.*, **156**, L67 (1969).
[9] Westphal, J. A., Sandage, A., and Kristian, J., *Astrophys. J. Lett.*, **154**, L139 (1968).
[10] Holt, S. S., and Cline, T. L., *Astrophys. J.*, **154**, 1027 (1968).
[11] Riegler, G. R., and Ramaty, R., *Astrophys. Lett.*, **4**, 27 (1969).
[12] Lewin, W. H. G., Clark, G. W., and Smith, W. B., *Canad. J. Phys.*, **46**, 409 (1968).
[13] Overbeck, J. W., and Tananbaum, H. D., *Astrophys. J.*, **153**, 899 (1968).
[14] Lewin, W. H. G., Clark, G. W., and Smith, W. B., *Astrophys. J. Lett.*, **152**, L55 (1968).

Possible Pulsar Formation Mechanism

PACZYNSKI has shown in some unpublished work that all stars in the interval $3{\cdot}5\ M_\odot \lesssim M \lesssim 8\ M_\odot$ form degenerate carbon–oxygen cores ($M \sim 1{\cdot}4\ M_\odot$) which converge to the same central conditions before undergoing carbon ignition. The luminosities of these stars also converge, indicating that their cores are all essentially identical. Gunn and Ostriker (unpublished) have shown that the minimum mass for pulsar parent stars is about 4 $M_\odot$ with a maximum parent mass of about 10 $M_\odot$. Their study also indicates that the parameter $B = B_1 a^3 \sin \alpha I^{-1/2}$ (B_1 is the initial magnetic field, a is the neutron star radius, α is the angle of inclination between the rotation and dipole axes, and I is the moment of inertia) varies only slightly among the fourteen pulsars the period of which has been observed to change, and for which B can thus be determined.

An immediate identification of Paczynski's cores as the nearly unique structure preceding the pulsar phase is disallowed by the work of Arnett[1], however. Arnett has concluded that the detonation of carbon in a core similar to those of Paczynski leads to complete disruption of the star, leaving no remnant whatsoever. But Arnett's conclusion that carbon ignition will lead to carbon detonation and disruption of the star is based on a consideration of time dependent convection. Considering the circumstantial evidence about the parent stars of pulsars and the inherent uncertainties in any theory of convection, it is worthwhile to consider an alternative mode of evolution.

If convection can prevent carbon detonation, the resulting non-violent carbon burning in the core will yield a composition predominantly of oxygen and magnesium. Paczynski finds that the carbon ignition occurs at $\rho \sim 3 \times 10^9$ g cm^{-3}, but the core will continue to grow due to the helium-burning shell. At $\rho \sim 4 \times 10^9$ g cm^{-3}, ^{24}Mg undergoes rapid electron capture which will render the core dynamically unstable and cause it to collapse in the manner envisaged by Finzi and Wolf[2]. The subsequent behaviour of the collapsing degenerate core should be quite similar to that calculated for collapsing white dwarfs by Hansen and Wheeler (ref. 3 and unpublished work), who find that, on collapse, oxygen is ignited in the centre of the star and a detonation wave propagates out through the collapsing core. The attendant shock wave should violently eject the loosely bound hydrogen envelope ($M \sim 2$–$6\ M_\odot$).

The core will not explode because of beta processes on the matter which is left in nuclear statistical equilibrium after the oxygen is detonated at a central density of $\sim 10^{11}$ g cm^{-3}. Barkat *et al.* (unpublished) have shown that, at such high densities, the time-scale for the pressure to return to its pre-detonation value is $\lesssim 10^{-3}$ s due to beta processes. Approximately 10^{-2} s is needed for adiabatic expansion of the core before even the outer layers reach escape velocity. The core will thus collapse toward a neutron star state. All excessively neutron-rich elements should be swallowed with the core, circumventing an abundance problem noted by Arnett[1].

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[1] Arnett, W. D., *Astrophys. Space Sci.*, **5**, 180 (1969).
[2] Finzi, A., and Wolf, R. A., *Astrophys. J.*, **150**, 115 (1967).
[3] Hansen, C. J., and Wheeler, J. C., *Astrophys. Space Sci.*, 3, 464 (1969).

East Canary Islands as a Microcontinent within the Africa–North America Continental Drift Fit

Dash and Bosshard[1] have reported, on the basis of seismic reflexion and refraction profiling, that the five western islands of the Canary archipelago lie on normal oceanic crust. On the other hand, Lanzarote Island and Fuerteventura Island and Concepcion Bank (constituting the eastern group) seem to rest on continental or sialic crust. They suggest that a fault lies parallel with and westward of Fuerteventura, eastward of which the sediments on the sea floor are 6 km thick. Rothe and Schmincke[2] further support this interpretation by suggesting that the western islands are typical oceanic volcanic cones built from sea-floor vents. In contrast, sedimentary strata in the eastern group show strong geological affinities to mainland Africa.

We report here an independent test supporting this interpretation. Considering our pre-continental drift closure of the North Atlantic Ocean, we find that the Lanzarote–Fuerteventura–Concepcion Bank block may be readily interpreted as a sialic microcontinent (that is, a detached sialic fragment) which, after small strike-slip translation, fills the most prominent gap in the Africa–North America fit.

Our North America–Africa fit is presented as Fig. 1, and an explanation follows. It is a computerized best fit based on the criterion of smallest average misfit by a method which has already been described in detail[3,4]. The total misfit (both overlap and underlap) is 105,000 km^2, or an average misfit of 33 km over the 3,000 km long sectors of the continental margins matched.

We used the 1,000 fathom isobath as delineating the actual limit of the continental block, which is most logical for fitting purposes as this contour approximates one-half the isostatic freeboard of continents[5]. Where the 1,000 fathom isobath is not on the continental slope or departs radically from the shallower portion of the slope, we have used an inferred position (shown by dashed lines in Fig. 1) by extrapolating the average declivity of the continental slope. Justification for this procedure is that the 1,000 fathom isobath is more likely to be displaced than are shallower isobaths by post-drift modifications