matters arising

Liquid drop model of elastin

We wish to show how the calorimetric observations of Weis-Fogh and Andersen[1] may be interpreted in terms of the classical theory of rubber elasticity. It was observed by Weis-Fogh and Andersen that when, for example, 1.33 mcalorie of work was done on a specimen of elastin immersed in water at room temperature, the heat evolved was 5.53 mcalorie: according to the theory of rubber elasticity the heat evolved should be close to 1.33 mcalorie. This experiment and others of a similar nature with water–ethanol solutions as solvent lead Weis-Fogh and Andersen to reject the classical theory[2] which they replaced by a two-phase model, the liquid-drop elastomer.

In approaching this anomaly we formulated the working hypothesis that the apparent conflict between the theory of rubber elasticity and the calorimetric experiments was due to the erroneous assumption that heat change due to the stress-induced absorption of solvent was negligible. If a specimen is immersed in a permeating solvent and elongated then it is to be expected that solvent will diffuse into the specimen so that the heat liberated will depend on the magnitude of the differential heat of dilution, $\overline{\Delta H}$ (ref. 3).

The most striking observation of Weis-Fogh and Andersen[1] is the systematic decrease in heat release for the elastin–water/ethanol system as the ethanol content of the solvent increases from 0 to 50%. At 20% ethanol the heat release equals the work done, in agreement with the theory of rubber elasticity. This can be explained in one way only, if our working hypothesis be correct. At 20% ethanol $\overline{\Delta H}$ must be zero: below 20% ethanol $\overline{\Delta H}$ must be negative and above 20% ethanol it must be positive.

In order to determine the magnitude of $\overline{\Delta H}$ it is necessary to determine three partial derivatives[3],

$$\overline{\Delta H} = -T\frac{(\partial f/\partial N)_{PLT}(\partial N/\partial T)_{PLe}}{(\partial N/\partial L)_{PTe}} \qquad (1)$$

in which f is force, P pressure, L length, T temperature and e signifies that the specimen is in equilibrium with a reservoir of diluent from which it has absorbed N mol. Of the three partial derivatives only one, $(\partial N/\partial T)_{PLe}$ can be measured easily. Both $(\partial f/\partial N)_{PLT}$ and $(\partial N/\partial L)_{PTe}$ can be measured but with greater difficulty. Since we required only the sign of $\overline{\Delta H}$ we measured $(\partial N/\partial T)_{PLe}$ and assumed $(\partial f/\partial N)_{PLT}$ to be negative and $(\partial N/\partial L)_{PTe}$ positive. This assumption is based on sound *a priori* arguments (the opposite assumption would be extremely rash) and is in accord with observation; for instance Abe and Prins[3] for the system water–polyvinyl alcohol. It follows then that $\overline{\Delta H}$ will have the same sign as $(\partial N/\partial T)_{PLe}$.

Measurements of $(\partial N/\partial T)_{PLe}$ on purified pig aorta at temperatures between 0° and 50° C, have shown that at 20% ethanol $(\partial N/\partial T)_{PLe} = 0$. Below 20% ethanol $(\partial N/\partial T)_{PLe}$ is negative and above it is positive. Thus $\overline{\Delta H} = 0$ at 20% ethanol and at this composition the system behaves as a classical elastomer in the calorimetric experiments. Full details of this work will be published in due course.

W. Grut
N. G. McCrum

Department of Engineering Science,
University of Oxford,
Parks Road,
Oxford OX1 3PJ, UK

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The Gibbs Fracture Zone

I wish to comment on the idea that the Gibbs Fracture Zone may be a westward projection of the Hercynian front into North America. Cherkis *et al.*[1] have argued in favour of a correlation between the Gibbs Fracture Zone and the late Palaeozoic Hercynian orogenic front.

Geophysical evidence[2] indicates that the Gibbs Fracture Zone extends from the Newfoundland continental margin near 52°N 47.5°W to a point west of Ireland, near 52.25°N 16°W. Off Newfoundland the fracture zone seems to be associated with a 200 km sinistral offset of the continental edge[3].

If Wilson's theory for the propagation of oceanic fracture zones from old lines of weakness in a formerly contiguous continental crust is applicable here, then an equivalent offset should be present in the European margin. Such an offset has not, as yet, been found. It is clear that one does not exist in the western margin of Porcupine Bank as implied by the argument of Cherkis *et al.*[1]. A possible site is near the mouth of Rockall Trough, but the shape of the continent–ocean boundary in this region is not well known.

Despite this lack of knowledge about the eastern end of the Gibbs Fracture Zone, it is instructive to follow Wilson's theory and see which predrift continental lineament aligns best with it. To do this, I have drawn Palaeozoic structural features of Newfoundland and the British Isles on a new reconstruction of the North Atlantic continents (Fig. 1). This reconstruction is more consistent with current knowlege of the structure of the Atlantic Ocean basin than is the reconstruction of Bullard *et al.*[5] which was apparently used by Cherkis *et al.*, after Hurley. The trends of the structures in Ireland are taken from Kennedy *et al.*[6]. The westward projection of the Hercynian front has not, to my knowledge, been defined by geophysical work, but in the Celtic Sea to the south, a west-south-west Hercynian trend may exist[7]. It is therefore possible that the front trends west-south-west. In the case of the Caledonoid lineaments there is some

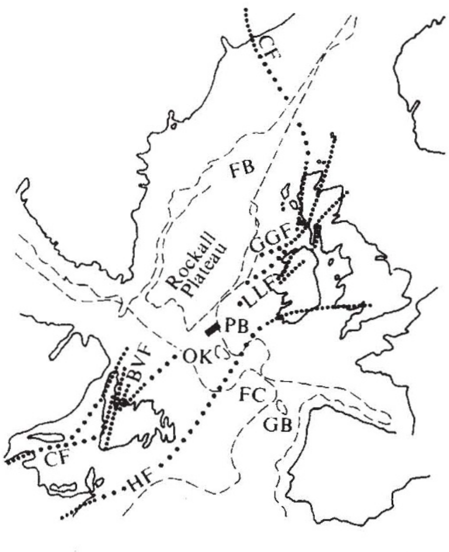

Fig. 1 A reconstruction of the North Atlantic continents (from Scrutton, R. A., unpublished) showing Palaeozoic structural lineaments. Closely dotted lines, well known trends; widely dotted lines, less well known or conjectural; solid rectangle, the position in which the Gibbs Fracture Zone developed during North Atlantic opening; FB, Faeroes Bank; PB, Porcupine Bank; OK, Orphan Knoll; FC, Flemish Cap; GB, Galicia Bank; CF, Caledonian Front; HF, Hercynian Front; GGF, Great Glen Fault system; LLF, Leck-Leannan Fault; BVF, Baie Verte Fold.