

In addition to the peptide mapping studies, we found that the chromobindins were denatured and precipitated by heating to 100 °C for 10 min, a treatment we used to purify the particularly heat-stable light chains. Therefore, in addition to significant primary structural differences, the light chains have distinct physical chemical properties from the chromobindins. We conclude that adrenal medullary clathrin light chains have not been obtained in the *in vitro* affinity chromatography experiments.

Calmodulin is one of the chromobindin proteins that can be isolated by Ca²⁺-dependent affinity chromatography on chromaffin granule membranes². The hypothesis that calmodulin regulates the interaction of the other chromobindins with the membrane is supported by the observation that some of the chromobindins bind in a Ca²⁺-dependent manner to a calmodulin-Sepharose column⁵. As a more stringent test, we conducted affinity chromatography experiments with adrenal or liver cytosol on chromaffin granule membrane affinity columns in the presence of 100 μM trifluoperazine to antagonize calmodulin action. This drug blocked the binding of calmodulin to the affinity columns, but did not significantly alter the spectrum of other chromobindins obtained (Fig. 2). Therefore, calmodulin does not appear to be required for the recruitment of these other proteins to the membrane. The binding of some of these proteins to a calmodulin-Sepharose column may have been due to their ability to interact in a Ca²⁺-dependent manner with a hydrophobic surface, either on the calmodulin molecule, or on membrane lipid. The presence of calmodulin in the chromobindin class of proteins may reflect direct interaction with mem-

brane proteins, or an indirect interaction through the other chromobindins that does not influence the membrane binding properties of these proteins. Thus, with the exception of synexin which may initiate intermembrane contact and fusion¹⁰⁻¹², it is unclear what the roles of the membrane binding proteins we have characterized may be in the secretory pathway.

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A model for the cosmic creation of nuclear energy—a reassessment

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THIS letter included an unfortunate mistake which affects the loss of exergy in helium synthesis and hence the total exergy per nucleon. Naively one would expect the exergy per nucleon to be b_4 (the binding energy per nucleon in ⁵⁶Fe) apart from the loss due to helium formation. With a fraction γ_0 of neutrons immediately before the helium synthesis, this loss could be expected to be $2\gamma_0 b_3$ where b_3 is the ⁴He binding energy per nucleon. Thus for a cooling universe ($T \rightarrow 0$), the exergy per nucleon $E(T)$ would approach

$$E(0) = b_4 - 2\gamma_0 b_3 = 6.36 \text{ MeV} \quad (11^*)$$

instead of the result (11) given in our paper. The simple estimate (11*) turns out to be the right one.

Consider a mixture of four ideal non-degenerate gases (consisting of ¹H, ¹n, ⁴He and ⁵⁶Fe corresponding to $i = 1, 2, 3, 4$) in a volume V . Let n_i be the number of nuclei of the i th kind, so that in all there are $N = \sum_i n_i A_i$ nucleons. Since radiation dominates, equilibrium temperature and equilibrium pressure prevail, and the exergy per nucleon is purely 'chemical'.

$$E = \frac{1}{N} \sum_{i=1}^4 n_i (\mu_i - \mu_{i0}) = \frac{1}{N} \sum_{i=1}^4 n_i kT \ln \frac{n_i/V}{n_i^{(0)}/V}$$

Here μ_i is the chemical potential of nuclide i and μ_{i0} is its equilibrium value corresponding to an equilibrium density $n_i^{(0)}/V$. With

$$\begin{cases} P_i = \frac{n_i A_i}{N} \\ P_i^{(0)} = \frac{n_i^{(0)} A_i}{N} \end{cases}$$

the exergy may then be written

$$E = \sum_{i=1}^4 P_i \frac{kT}{A_i} \ln \frac{P_i}{P_i^{(0)}} \quad (2^*)$$

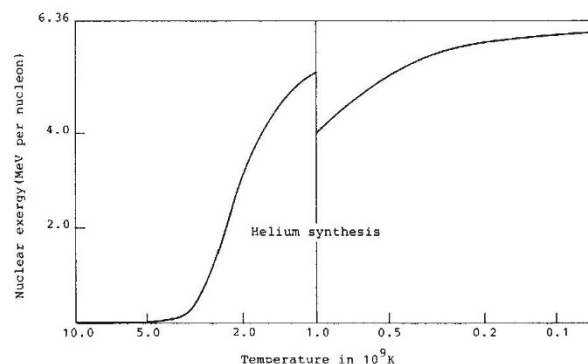
This equation differs from the equation (2) in the paper in that for each nuclide, T/A_i appears as an 'effective temperature', taking into account the reduced number of degrees of freedom of bound nucleons.

From the correct equation (2*) we obtain the correct expression for the exergy per nucleon after helium formation,

$$E(T) = \mu(T) - 2\gamma_0 b_3 - kT \ln \frac{2 \left[\kappa r \left(\frac{mc^2}{kT} \right)^{3/2} \right]^{1-3/2\gamma_0}}{(1-2\gamma_0)^{1-2\gamma_0} \gamma_0^{1/2\gamma_0}} \quad (10^*)$$

with $\mu(T)$ approaching b_4 for small T then (11*) obtains.

Figure 2 of the paper has to be modified, and the corrected Fig. 2 (below) shows the creation of exergy as given by (9) and (10*).



A couple of important references should also be added. Davis' book¹ on time asymmetry should have been referred to in the original paper. Frautschi's later paper² on negentropy in the Universe is also relevant. The model has been discussed by van Hove³ in connection to other time-asymmetric processes of the early Universe.

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