choline mixed with the diet. Six hours later the animals were killed, and the liver phosphatides extracted and fractionated.

It can be seen that the increase in the specific activity is confined to the lecithin fraction.

In order to compare the effect of ethanolamine feeding with choline feeding, 24 rats were given the high fat diet for six days and injected with radiophosphate on the seventh, as before, but 8 rats received 50 mgm. of choline by stomach tube and 8 rats received 50 mgm. of ethanolamine similarly. The total phosphatides were prepared from the livers and their activity measured.

This experiment was repeated, except that the ethanolamine dose was reduced to equimolar proportions to the choline, namely, 30–50 mgm., and the control group received 1 ml. of distilled water by stomach tube. The phosphatides were fractionated.

TABLE 3

Group	Specific activity: Total phosphatide	Lecithin	Cephalin
1. Control	0·43		
Choline	0·67		
Ethanolamine	0·70		
2. Control	0·39	0·44	0·35
Choline	0·52	0·57	0·43
Ethanolamine	0·69	0·57	0·77

It can be seen that the ethanolamine in both the experiments caused a rise in the specific activity, and therefore in the phospholipid turnover, similar to or greater than that produced by choline, the effect of each base being greatest in the phospholipid fraction of which it was a constituent.

As ethanolamine has no lipotropic action[3,4], it would seem unlikely that choline exerts its lipotropic activity by stimulating phospholipid turnover, unless lecithin plays a much more active part in fat metabolism than cephalin. In view of the similar rise in the specific activity of lecithin and cephalin from fasted to fed rats, this seems improbable. Chaikoff[1] found that methionine, which is lipotropic, caused a rise in the specific activity of liver phospholipids, but he also found that cystine and cysteine, which are negatively lipotropic, produced a similar rise. He suggested that this discrepancy was due to the short duration of the experiment. The same criticisms could be levelled against the results recorded here, but as the effect of choline on the rate of phospholipid turnover is itself lost after 12 hours, and the comparison of lipotropic and non-lipotropic factors was carried out under identical conditions, this seems scarcely justifiable. It would be desirable to extend this work with larger numbers of animals, but the results show that there is no correlation between the lipotropic activity of choline and ethanolamine, and their ability to stimulate phospholipid turnover in the liver.

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The Matter-Radiation Cycle in the Cosmos (and the Second 'Law'): the Sun's Equilibrium

If one scrutinizes the chances of radiation, such as arises even in the observable part of the cosmos, escaping sufficiently to leave as low a temperature for interstellar matter as the 3·2° A. estimated (or even as the temperature of the earth)—on the supposition that nothing but heat (or re-radiation) is produced—one finds that it cannot possibly do so.

Knowing the fraction of a cross-section of the whole that is occupied by nebulæ (some 10^4 light years in virtual radius and 2×10^6 light years apart), and using the very low estimate of 20 per cent absorption in crossing a nebula (it is an average 60 per cent for the unusually large galaxy, at the sun's very eccentric location), it is found that the fraction of radiation penetrating to 5×10^8 light years, the limit of present well-defined observation, is about 0·997, and certainly cannot be as near unity as, say, 0·99999. But 0·997 corresponds to an interstellar temperature of $6{,}000 \times \sqrt[4]{1 - 0{\cdot}997}$, or about 1400° A., and even 0·99999 to 340° A. (Since photographs by the 100-inch reflector show objects that are likely to be nebulæ similarly distributed to a few times 5×10^8 light years, the case is actually stronger than this—observationally; hypothetically, it is stronger again, for one cannot easily think of space, whether infinite or in some way bounded, as unpopulated.)

Therefore, unless we wish to indulge in speculations about some entirely intangible third form of mass, we are forced to conclude that the trapped radiation is converted, mostly in the denser 'shells' of gravitationally and radiatively balanced matter between the stars, into more matter, such as returns to the stars in the manner known of as 'accretion'. Evidently a surface phenomenon, this is easily shown to occur at a rate far too small to be observed in the laboratory, namely, at some 4×10^{12} gm. per sec. in contact with, roughly, 10^{33} gm. After all, why should not a change that occurs at extremely high temperatures be capable of reversal at lower temperatures (one can add, speculatively, possibly at superconduction levels) ?

It should be clearer than it is that the second 'law' of thermodynamics, of no account in the microcosmos, is only an appearance in the 'mesocosmos' (where we reside), which is counteracted in the macrocosmos of gravitational 'supremacy', a matter first evident in Jeans' ·'gravitational instability'. Dean Inge had no need to write as virtually despairingly as he did in "God and the Astronomers".

A conclusion to be drawn from this is that an average star, such as the sun is providentially ('teleologically' is very like a synonym), tends to keep constant mass, although in the fashion, *cet. par.* (that is, apart from more 'teleology'), of unstable equilibrium; for accretion is proportional to $(\text{velocity})^{-3}$ and velocity is proportional to $(\text{mass})^{-1/2}$.

The subject will be discussed at more length in another place.

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