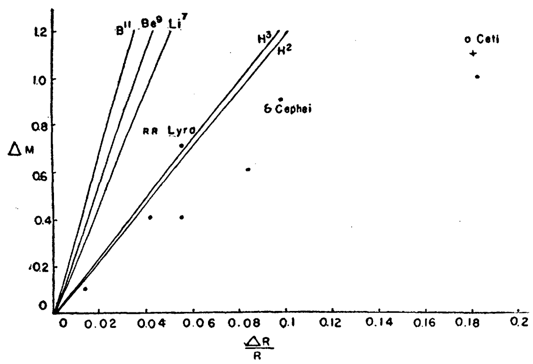

FIG. 1. Theoretical value of Δm for values of $\Delta R/R$. The observed values are shown for various stars.

the mean molecular weight; r' is the effective ratio of specific heats; β denotes the ratio of gas pressure to total pressure; and its value is given by Eddington's quartic relation. Equation (1) holds practically as long as $\Delta R/R$ does not exceed about $\frac{1}{5}$. It will be observed that the ratio L_1/L_2 does not depend on the concentration of the reactants concerned and is practically insensitive to likely variations in M and R. Taking $M=1.75\times10^{34}$ g and $R=2.02\times10^{12}$ cm (these values correspond to δ Cephei), we have

$$\Delta m \sim 2.4\Delta R/R. \tag{2}$$

The value of L_1/L_2 is not appreciably affected whether we take account of the variation of ϵ, the rate of energy generation per unit mass inside the star, or assume the central value ϵ_c to prevail throughout the stellar interior. The value given in Eq. (2) is based on the latter assumption. When the variation of ϵ is taken into account, we find, for example, for $\Delta R/R=0.1$, by a rapid numerical integration $\Delta m=2.5$, which may be compared with the value $\Delta m=2.4$ given by Eq. (2). In Table I, the relation between Δm and $\Delta R/R$ is given for the various reactions:

TABLE I. Variations of Δm and $\Delta R/R$ for various reactions.

$\Delta m \sim 12(\Delta R/R)$,	$H^2+H^1=He^3$
$\Delta m \sim 12(\Delta R/R)$,	$H^3+H^1=He^4$
$\Delta m \sim 24(\Delta R/R)$,	$Li^7+H^1=2He^4$
$\Delta m \sim 28(\Delta R/R)$,	$Be^9+H^1=Li^6+He^4$
$\Delta m \sim 32(\Delta R/R)$,	$B^{11}+H^1=3He^4$

The observed light variation cannot be identified with Δm because the observed variation will depend on the extent to which the rate of flow of radiation is affected by the variations in temperature and density accompanying pulsation. The total energy generated during a period would, of course, be equal to the total energy radiated per period. As the nuclear processes are far more temperature sensitive than opacity, the observed light variation will not exceed Δm; i.e., Δm prescribes the upper limit to the observed light variation.

In the figure, the observed values for Δm and $\Delta R/R$ are exhibited for Cepheid variables with periods ranging from 0.5^d to 35^d. These values have been taken from Russell, Dugan, and Stewart.[5] The theoretical relationship between Δm and $\Delta R/R$ is also shown in the figure for the various reactions. It is interesting to find that the observed (Δm, $\Delta R/R$) values lie below the theoretical lines for Li, Be, and B. This is, however, not true for the H^2 line, which is shown dotted in the figure, but as the Cepheids do not "live" on the H^2 reaction, the disposition of the H^2 line is not relevant for the Cepheids. The long-period variables, which presumably live on the H^2 reaction, should lie below the H^2 line, and this is the case for the typical long-period variable *o* Ceti for which the observed variation in radiometric magnitude is about 1.1^m and $\Delta R/R$ about 0.18. A detailed investigation will be published elsewhere.

[1] H. A. Bethe, Phys. Rev. **55**, 434 (1939).
[2] G. Gamow, and E. Teller, Phys. Rev. **55**, 791 (1939).
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[5] H. N. Russell, R. S. Dugan, and J. Q. Stewart, *Astronomy* (1938), p. 768.

Loss of Weight by Rotation

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IN an abstract of a paper[1] Charles T. Dozier analyzes the weight changes of an airplane in level flight according to whether it flies from west to east, or east to west at the equator, with valid conclusions. In view of his subsequent extension of the argument, it should be emphasized that level flight in this case is flight in a circular path —more particularly, a path whose projection on the equatorial plane of the earth is a circle. The particles of the rotating mass which he then envisages (a gyroscope at the equator with vertical axis) have, however, paths whose equatorial plane projections are not circles—they are straight lines! This makes quite a difference.

The astonishing conclusion reached by Dozier led me to set up and solve his problem. By writing down the Hamiltonian for a single particle of the rotating mass, and taking its derivative with respect to the distance from the center of the earth to the plane of rotation of the particle, I have calculated the instantaneous change in weight of the particle due to the combined earth and gyroscopic rotations. It consists of two terms. The first is the centrifugal force associated with the particle in its instantaneous position by virtue of the earth's rotation only, that is, as if the gyroscopic rotation were zero. The second term is dependent on the gyroscopic phase of the particle in a different way, but the variation is such, that in the course of one revolution of the gyroscope this term averages to zero.

It follows that the only loss of weight is the commonly accepted centrifugal one and that there is no such loss of weight by rotation as Dozier announces.

[1] C. T. Dozier, "Loss of Weight by Rotation," read by title at the January 19, 1945 meeting of the American Physical Society in New York City.