

note (*loc. cit.*). The accuracy of this solution appears to depend primarily on the magnitude of the expansion coefficient  $\mu$  and is good, within this limitation, for very large values of the balloon amplitude: we are no longer tied to infinitely small amplitudes.

The value of  $\mu$  is commonly so small that, with appropriate corrections which will be self-evident from the equations, if  $r$  is the radius of the first 'neck' and  $R$  is the radius of the first balloon, then

$$\frac{P}{m} = \frac{2r}{\pi R^2}$$

Measurements of this 'drag ratio' are now in progress, using a coincidence method involving a specially constructed prismatic instrument which eliminates the slight sway inseparable from these whirling systems.

Very fine threads are found to give larger values of the drag ratio than coarse ones in approximately the ratio of their diameters, as might be expected. There appears to be a slight decrease in the drag coefficient with increased whirling speed, which is possibly due to increased air swirl in the system or a departure from the square law.

I hope shortly to give elsewhere a full account of these measurements and the derivation of these equations.

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July 3.

<sup>1</sup>Hall, H. W., NATURE, 138, 932 (Nov. 28, 1936).

#### Maintenance of the Pulsation in Cepheid Variables

THE oscillations induced in the principal modes of vibration of a star by a free oscillation in one of them, generally of the second order in the corresponding free amplitude, are unimportant unless magnified by resonance; so seems the evidence from Miss H. A. Kluyver's analysis<sup>1</sup>. Hence, the motion in a Cepheid variable may be closely approximated to by the superposition of the oscillations of two modes of vibration, a free one and a forced one with half the period.

The damping constant of this composite motion is a weighted mean of the constants referring to the components, the weight factors being proportional to the energies of the separate oscillations. As, excepting exact commensurability, the ratio of these weight-factors is proportional to the square of the free amplitude, the dissipation of the energy of the pulsation depends on this amplitude.

As regards the damping constants of the components of the motion, it is to be remarked that each is the sum of positive and negative terms; the positive terms result from the dissipation of energy in the outer part of the star, hence probably are much larger for the mode of vibration corresponding to the forced oscillation; the negative terms, resulting from the generation of energy, probably are of the same order of magnitude in both cases. Hence the possibility arises that the damping constant belonging to the free oscillation is negative and that

belonging to the mode of vibration in forced oscillation is positive.

If the damping constants in actual stellar conditions have values corresponding to the possibility referred to, then the star may adjust its amplitude in such a way that the damping constant of the composite motion is zero: the pulsation may be maintained indefinitely. If a state of affairs is assumed in which the amplitude is very small, then the negative dissipation of energy of the free oscillation intensifies the motion, until the positive dissipation corresponding to the induced vibration restores the balance: a permanent state of pulsation has been reached.

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<sup>1</sup>Bulletin of the Astronomical Institute of the Netherlands, 276.

#### Photo-decomposition of Aldehydes and Ketones

ALDEHYDES and ketones decompose in the gas phase in two main ways<sup>1</sup>. Type I, predominant with short chain compounds, may be represented  $RCOR' \rightarrow CO + (RR + RR' + R'R')$ . Type II, predominant with long-chain compounds, involves a cracking of the long hydrocarbon chain in a position  $\alpha - \beta$  to the carbonyl group, giving a lower carbonyl compound and an olefine.

We recently described<sup>2</sup> certain results obtained in a study of the photo-decompositions of such compounds in paraffinoid solution, in which circumstances both types of decomposition were found to occur, type I being subject to a marked temperature coefficient while type II is not.

These results have now been extended to other carbonyl compounds, and appear to be of general significance. Thus methyl ethyl and diethyl ketones in 10 per cent liquid paraffin solution show no appreciable photolysis at 20° C., but ready decomposition according to type I at 100°.

The products arising from the type I photolysis in all ketones studied in paraffinoid solution are modified in a very simple but profound way, for whereas in the gas phase a mixture of the three hydrocarbons  $RR$ ,  $RR'$  and  $R'R'$  together with an approximately equivalent volume of carbon monoxide is obtained, in solution the hydrocarbon products occupy more than double the volume of the carbon monoxide and consist only of the hydrogenated products of the alkyl radicals,  $RH$  and  $R'H$ . None of the  $RR'$  and  $R'R'$  hydrocarbons, previously found in the gas phase can be detected. It is clear that the free radicals disengaged in the photolysis must mainly react with the molecules of the paraffin solvent rather than combine together, as they do in the vapour. That this is substantially true is shown by the fact that an unsaturation develops in the paraffin solvent which, on removal of the carbonyl compound by distillation *in vacuo*, can be titrated with bromine water, and is equivalent in amount to the unsaturation which would be expected from the volume of the products. This suggests a continuous interchange of hydrogen atoms between paraffinoid free radicals and paraffin molecules, until two such free radicals meeting react to give an olefine and a paraffin by disproportionation.

With methyl ethyl ketone, the ethane produced is in excess of the methane, and this and a deficiency of carbon monoxide with reference to the total hydrocarbon produced has been correlated with the