LETTERS TO THE EDITOR

A FUNDAMENTAL RESULT FOR ROTATING RECTANGULAR CARTESIAN FRAMES

In the following is reported a result for a rectangular cartesian frame rotating uniformly with respect to another having the same origin. Although it is simple and interesting it is far from obvious and does not seem to have attracted any attention so far.

Let O-xyz be a frame with respect to which $\dot{x},\dot{y},\dot{z}$ are the velocities and $\ddot{x},\ddot{y},\ddot{z}$, the accelerations of a particle at time t. Let O-XYZ be another frame with respect to which $\dot{X},\dot{Y},\dot{Z}$, $\ddot{X},\ddot{Y},\ddot{Z}$ can be similarly defined. At the instant when the three pairs of axes Ox, OX, Oy, OY and Oz, OZ coincide let one set rotate about the other with constant angular velocity (p, q, r). It can then be verified that

$$(\ddot{x}-\ddot{X})(\dot{x}+\dot{X})+(\ddot{y}-\ddot{Y})(\dot{y}+\dot{Y})+(\ddot{z}-\ddot{Z})(\dot{z}+\dot{Z})=0$$

This implies that *the vector representing the relative acceleration is perpendicular to the vector representing the mean of the velocities.* The verification is made immediate when, for example, one puts

$$X = \dot{x} + qz - ry,$$

$$\ddot{X}=\ddot{x}+2q\dot{z}-2r\dot{y}+pqy+prz-x(q^2+r^2)$$

etc.

The above property came to my notice while Prof. V. V. Narlikar and I were investigating a relativistic problem of rotation.

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January 1, 1947.

ULTRA-VIOLET BANDS OF THE MERCURY IODIDE MOLECULE

The two band systems of the mercury iodide molecule in the region λ 2240-λ 2100, reported by Prilheshejewa[1] and designated by us as the G and H systems,[2] have been newly measured. They consist of about 50 and 25 band heads, definitely degraded to the red. A complete vibrational analysis of the two systems has given the following constants:

		G system	H system
ν_e	=	45542·4	47110·2
ω'_e	=	88·0	97·1
$\chi'_e\omega'_e$	=	0·2	1·65
ω_e''	=	125·7	125·3
$\chi_e''\omega_e''$	=	1·2	1·15

The two systems have a common final level which is known to be the ground state of the molecule. The H system presents an interesting case of predissociation similar to that observed in the β system of NO or the Fourth Positive system of N_2. It consists of just just three v'' progressions of bands with $v' = 0, 1$ and 2, and the bands show an abrupt termination, those with higher values of v' being absent altogether.

A full report of the work will be published shortly.

Andhra University, Waltair,
January 9, 1947.

K. R. Rao.
C. Rama Sastry.

1. Prilhesh-jewa, *Phys. Z. Sowjet.* 19[illegible], 1, 1[illegible]9.
2. Rao, K. R. and others, *Ind. Jour. Phys.*, 1944 **18**, 323.

TEMPERATURE AND PRESSURE VARIATION OF HEAT CONDUCTIVITY OF LIQUIDS ON OSIDA'S THEORY

ARGUING from a model of liquid structure similar to that proposed by Andrade[1] in his theory of viscosity of liquids, Osida[2] deduced,

$$K = 4k\,\nu/\sigma \qquad \text{(i)}$$

in which K is the coefficient of heat conductivity of the liquid, k the molecular gas constant, ν the vibration frequency of the liquid molecules, and σ the mean inter-molecular distance.

Temperature increases σ. From Einstein's well-known expression[3] for ν, *viz.*,

$$\nu = C \times 0{\cdot}77 \times 10^{12}\sqrt{T_m/MV^{2/3}} \qquad \text{(ii)}$$

where C is a constant, T_m the melting-point on the absolute scale, M the molecular weight, and V the molecular volume $N\sigma^3$, it follows that

$$\nu \propto 1/\sigma\,;$$

that is, an increase in σ (as a result of temperature rise) is accompanied by decrease of ν. Such a conclusion was arrived at by Macleod[4] from considerations of free space in liquids. A negative temperature coefficient for K is therefore to be anticipated. This result, obtained from theory, is in agreement with the findings of Bridgman[5] in the case of all liquids, except water, which has a positive temperature coefficient. The behaviour of liquid metals also falls in line with the above deduction.[6]

Bridgman[5] has shown that K increases with pressure, the effect being greater for more compressible liquids, and at 75° than at 30° C. Further, the temperature coefficient of all liquids at pressures above 3,000 kg./cm.^{2} is positive. The effect of pressure is to reduce σ causing thereby an increase in ν. The increased conductivity of liquids under pressure is thus explained with more compressible liquids, and at high temperatures, the reduction in σ due to a certain pressure will be more marked than with less compressible liquids and at low temperatures.

The high conductivity of water is due to its associated nature. In associated liquids, apart from the propagation of heat by collisions as postulated by Osida,[1] an addtional factor is the following: When an associated complex arrives at the hotter part of the liquid as a consequence of irregular heat movements, it partially dissociates into smaller units; conversely, when these smaller units come into the colder parts they partially renuite. Since dissociation is accompanied by heat absorption and reformation of complexes by generation of heat, this process would enhance the thermal conductivity. An additional factor is the greater vibration frequency of the smaller units formed in the process. Due to the formation of such smaller units with greater ν at higher temperatures, water has a positive temperature coefficient of conductivity. The positive coefficient of all other liquids, above 3,000 kg./cm.^{2}, investigated by Bridgman[5] might be due to the formation of complexes at such high pressures.

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January 27, 1947.

1 Andrade, E. N. da C., *Phil. Mag.*, 1934 **17**, 497. 2 Osida, I. *Pro. Phys. Math Soc. Japan.* 1931, **21**, 353 3. Einstein, A. *Ann. der Phys.* 1911 **34**, 170; 1911. **35**, 679 4 Macleod, D. B. *Proc. Phys. Soc.*, 1938 **53**, 788. 5 Bridgman, P. W, *Proc. Amer. Acad.*, 1923-24. **59**, 141. 6. Konno, S, *Tohoku Univ. Sci. Reports*, 19 9, **8**, 169; Mohanty, S. R., *B.H.U. Journ*, 1946, **9**, 17-32. 7 Mohanty, S. R, *Proc. Indian Sci. Cong*, 19.7, **3**, *Phys. Sec.*, **8**.

THE VISUAL SHAPE OF THE OVERCAST SKY

THE problem of the apparent shape of the cloudy sky is one of much interest in meteorological optics. This was partially investigated by Miller and Neuberger[1] in the case of skies covered with 90 per cent. or more of clouds based below 10,000 feet. Their results lead to the surprising conclusion that the half-arc angle[2] decreases with increasing cloud-height; in other words, the sky appears to become flatter with increasing cloud-height. No explanation has so far been suggested for this anomaly. It was felt desirable to examine whether this conclusion holds for overcast skies, whose ceiling lies above 10,000 feet. In view of the uncertain influence on the half-arc angle of differential illumination of the clouds when they are cumuliform,[3] measurements were made by the author only when the skies were totally overcast with the *stratiform* type of medium and high clouds based above 10,000 ft. In this note are reported the results of those measurements. An attempt has also been made to offer a possible explanation for the observed anomaly.

The method of determination of the half-arc angle is the same as described in a previous communication.[4] In order to obviate the effect of partial illumination and differing visibility on the half-arc angle, all measurements were made at about noon-time when the sun was near the zenith and under conditions of good and nearly identical visibility of 20-25 miles. Eight measurements were made at a time in four different directions free from orographic elevations and their mean was adopted as the representative value.

The results reproduced in Table I are the means of a number of representative values for skies overcast with stratified clouds of

TABLE I

Kind of cloud	Average height of base in ft.	Half-arc angle in deg.	Ratio OH/OZ
Thick Altostratus	10 000	27.1	2·73
Thin Altostratus	13,000	26·6	2·80
Thick Cirro stratus	17,000	26·2	2·85
Thin Cirro stratus	22,000	25·4	2·97