

and extraordinary components¹⁶. The characteristics of F2-region TID's observed at Waltair have been reported in an earlier communication¹⁷. The results of F1-region TID's are too few to make any statistical comparison with the characteristics of F2-region TID's.

Theoretical studies have revealed that dynamical processes control TID production at F2-region levels whereas photoionization and chemical loss processes are the two important mechanisms for TID production at F1-region levels^{18,19}. It is also shown theoretically, that ducting, reflection of gravity waves due to temperature variations and the background winds play important role in the selection of propagating periods of internal atmospheric gravity waves from the ground to F-region heights²⁰⁻²². It would be very interesting if simultaneous observations of TID's at F1- and F2-region heights are made in view of the different mechanisms that control TID production and propagation of internal atmospheric gravity waves. Phase path technique, because of its sensitivity to the changes in the reflection height, promises to be a useful tool for such a study.

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FLUORESCENCE POLARIZATION SPECTRUM OF MERCURIDIBROMOSODIUM-FLUORESCEIN

IN a previous note the fluorescence polarization spectrum of rhodamine 6 G was reported¹. In continuation of this work, the fluorescence polarization spectrum of mercuridibromosodium-fluorescein is measured. This compound belongs to the same Xanthene group as rhodamine 6 G and its fluorescence polarization has not been investigated in detail so far. The experimental procedure adopted is the same as in the earlier work¹. The polarization of fluorescence was measured for two excitation wavelengths, 306 nm and 512 nm, at 25°C, for the concentration 1.1×10^{-5} g/cc in glycerol. The results obtained are given in Table I and shown in Fig. 1.

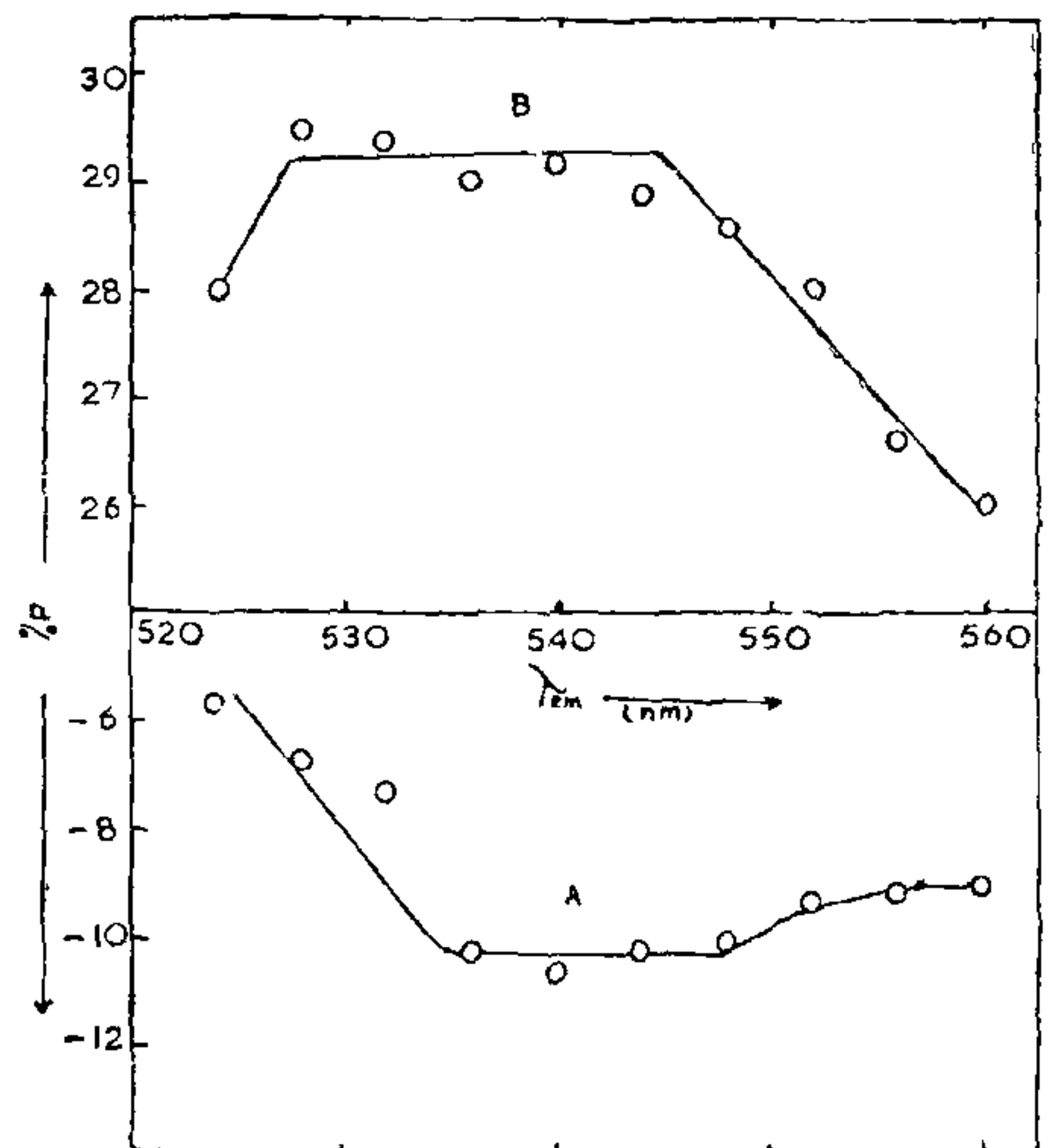


FIG. 1. Percentage polarization versus emission wavelength for (A) $\lambda_{ex} = 306$ nm; (B) $\lambda_{ex} = 512$ nm.

From Table I, it is seen that the polarization is positive for the longer excitation wavelength (512 nm) and negative for the other (305 nm). The excitation

TABLE I
Percentage polarization of mercuridibromosodium-
fluorescein in glycerol for conc. 1.1×10^{-5} g/cc

λ_{em} (nm)	%P for $\lambda_{ex} = 306$ nm	% P for $\lambda_{ex} = 512$ nm
524	- 5.6	28.0
528	- 6.7	29.5
532	- 7.3	29.4
536	-10.3	29.0
540	-10.7	29.2
544	-10.2	28.9
548	-10.1	28.6
552	- 9.3	28.0
556	- 9.1	26.6
560	- 9.0	26.0

by 306 nm takes the molecule to the second excited singlet state S_2 , which by the internal conversion gets down to the first excited singlet state ($S_2 \rightarrow S_1$) before the molecule returns to the ground state^{2,3}. If the exciting absorption and the fluorescence emission corresponds to different electronic transitions, sometimes the polarization of the fluorescence can become negative⁴. This can be explained in terms of a general model of fluorescent molecule, which consists of an emitting oscillator F and an absorbing oscillator A, which have different frequencies but are coupled to each other, so that light absorbed in A is reemitted by F. In a general case with arbitrary values of all amplitudes a_i and a_j ($i = 1, 2, 3$ and $j = 1, 2, 3$) and arbitrary values of the directional cosines β_{ij} , the equation for the degree of polarization takes the form:

$$p = \frac{3\beta^2 - 1}{3 + \beta^2} \quad (1)$$

where $\beta^2 = \sum_3^1 a_i a_j \beta_{ij}^2$. For the extreme cases of positive and negative polarizations $a_1 = a_2 = a_1' = a_2'$; a_3 and $a_3' > 0$ and $\beta_{33} = 1$ or $= 0$. The results obtained in the present case, interpreted on the basis of the above model, suggests that the transition moment of the main absorption band occurring around 512 nm is oriented parallel to the long axis of the molecule. The transition at shorter wavelength is oriented perpendicular to the long axis^{5,6}. It is also seen from the table that the observed polarization is higher for the first excited wavelength than the second. This may possibly be due to the fact that during the time, the higher level drops to the lower one, electron reorientation takes place causing depolarization. Also during this radiationless conversion ($S_2 \rightarrow S_1$), loss of orienta-

tion may occur by transfer to non-parallel dipoles thus resulting in depolarization. The observed polarization for the second excited state should therefore be less. From the table, the average value of polarization for $\lambda_{ex} = 512$ nm is $\sim 28\%$ but for $\lambda_{ex} = 306$ nm it is far less $\sim -10\%$.

It may also be noted that for both the excitation wavelengths, the polarization for the wavelengths in the emission band is almost constant, except at the edges. In a classical sense, this corresponds to one type of emission oscillator which could mean that for this concentration, the dye molecule in solution exists only in monomeric form.

The present investigation, therefore, suggests that

(1) There are two excited states for the dye molecule in the visible region—one corresponding to $\lambda_{ex} = 512$ nm and the other corresponding to $\lambda_{ex} = 306$ nm.

(2) The absorption and emission oscillators are parallel in the first excited state while perpendicular in the second excited state.

(3) Polarization for the first excited state is higher and positive while for the second, it is less and negative. Lower negative value agrees with the prediction of equation (1). Also lower negative value may be due to the reorientation of the dipole during the non-radiative transition.

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