

## LETTERS TO THE EDITOR

### L-SHELL PHOTOELECTRIC CROSS-SECTIONS FOR LOW ENERGY GAMMA-RAYS IN LEAD

RECENTLY, efforts have been made by a number of workers<sup>1-11</sup> to get information about the photoelectric interaction cross-section of radiation of various energies in different atoms and angular distribution of photoelectrons from different atomic shells. While there is a reasonably good agreement between theory and experiment for K-shell electrons, the data for L-shell electrons are scanty and it is difficult to draw definite conclusions. The methods<sup>6-10</sup> used so far for the determination of L-shell cross-section depend upon the measurement of the absolute intensity of photoelectrons produced by known flux of radiation of given energy. These methods suffer not only from the inherent difficulties encountered in high resolution and low intensity measurements of electrons but are also based on the controversial assumption<sup>8</sup> that the angular distribution of the photoelectrons from L<sub>I</sub>, L<sub>II</sub> and L<sub>III</sub> subshells is the same. In order to overcome these difficulties and avoid the uncertainties involved in the measurement of the absolute yield of low intensity photoelectrons from different L subshells, we have measured the intensity of fluorescent L X-rays that follow the photoelectric interaction and, using the known values of fluorescent yield, calculated the L-shell photoelectric cross-sections. Gamma-rays of energies 84, 145 and 279 keV from Tm<sup>170</sup>, Ce<sup>141</sup> and Hg<sup>203</sup> sources were collimated on a thin lead target and the L-shell fluorescent X-rays were measured with a calibrated proportional counter. Using the method similar to the one reported earlier<sup>13-14</sup> L-shell photoelectric cross-sections for lead were determined and the results are reported. The experimental details will be published elsewhere. The errors quoted are due to statistics of the measurements as well as uncertainties present in the other factors involved in the measurement. It may be noted that Compton scattering from L-shell electrons will also contribute to the fluorescent L X-rays. Its contribution should be subtracted before a comparison is made with theoretical predictions. The probability of secondary ionization<sup>15</sup> of L-shell by photoelectrons is  $\sim 10^{-4}$  and can be safely

neglected, considering the uncertainties present in the measurements. The results are shown in Table I.

TABLE I

Energy in keV	Experimental value	Schmickley Pratt	Matese-Johnson	Alling-Johnson
84	479.4 ± 40	462	499	560
145	106.5 ± 13.9	103	113	127
279	16.3 ± 2.1	17.2	17.97	20.41

Our results contradict Alling-Johnson values showing that the screening effects for L-shell are quite significant, hence cannot be neglected.

Punjabi University, Patiala, December 7, 1970. MOHANJIT SINGH. B. S. SOOD.

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### A METHOD OF ASSIGNING THE VIBRATION BANDS BY PROGRESSIVE ISOTOPE EXCHANGE

ASSIGNMENT and nature of the amide bands in infra-red spectra of amides has been discussed by various workers.<sup>1-5</sup> Hadzi and co-workers<sup>6</sup> have studied the infrared spectra of alkyl and aryl hydroxamic acid and have proposed the assignment of some bands. A new method based on differential rate of hydrogenation of assigning the bands is proposed in the present study. This is applied to benzohydroxamic acid which has CO-NH-OH grouping resulting in modification of some assignments.

Benzohydroxamic acid was deuterated by repeated exchange with heavy water. Progressive rehydrogenation was done by exposing samples to controlled atmosphere with 60% R.H. for various periods. Spectra were recorded in KBr pallet. All operations were done in a dry box in nitrogen atmosphere. Typical spectra are reproduced in Fig. 1. The relative intensities of the bands were measured by using the carbonyl band at  $1650\text{ cm}^{-1}$  as internal standard. This band was found to be insensitive to deuteration. The comparison is made of the ratios of the intensity of the band to the band at  $1650\text{ cm}^{-1}$ . These are plotted in Figs. 2 and 3.

Hazdi *et al.* have observed three bands in  $3\mu$  region in all hydroxamic acid. These bands in benzohydroxamic acid according to previous workers as also according to present work are at  $3340$ ,  $3080$  and  $2770\text{ cm}^{-1}$ . Since at high temperature in  $\text{CCl}_4$  solution, a sharp band at  $3450\text{ cm}^{-1}$  develops and  $3340\text{ cm}^{-1}$  disappears, the new band is assigned to monomeric NH stretching whose frequency falls to  $3340$  on intermolecular bonding. Since monomeric OH stretching band is not observed even at high temperature, it is strongly intramolecularly bonded and the band at  $3080\text{ cm}^{-1}$  is assigned to OH stretching. The third band at  $2770\text{ cm}^{-1}$  is assigned to OH by previous workers, but it

is shown to be due to NH from the following considerations.

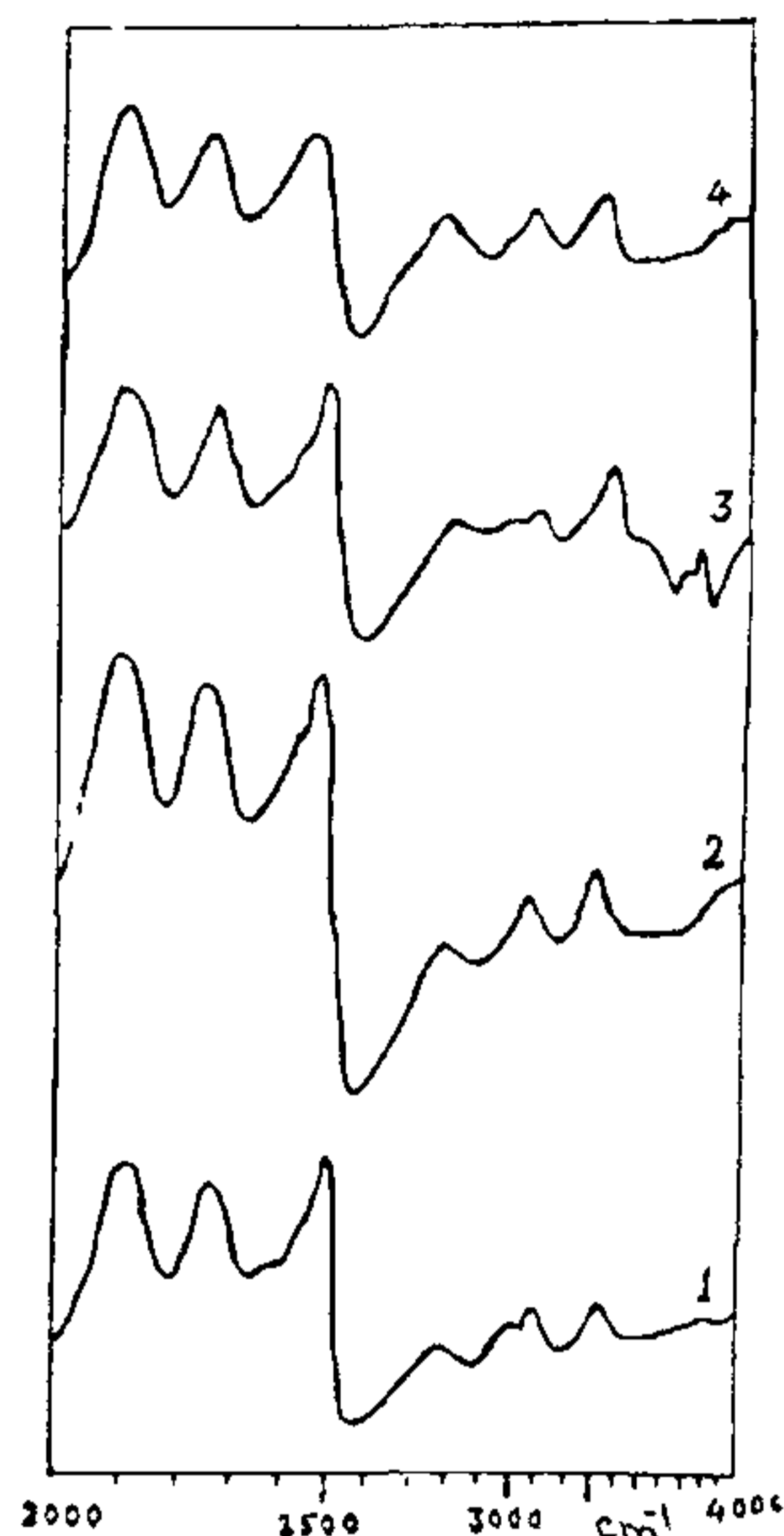


FIG. 1. Infra-red spectra of benzohydroxamic acid (1) deuterated sample and rehydrogenated sample exposed for (2) 20 min., (3) 2 hrs. and (4)  $7\frac{1}{2}$  hours.

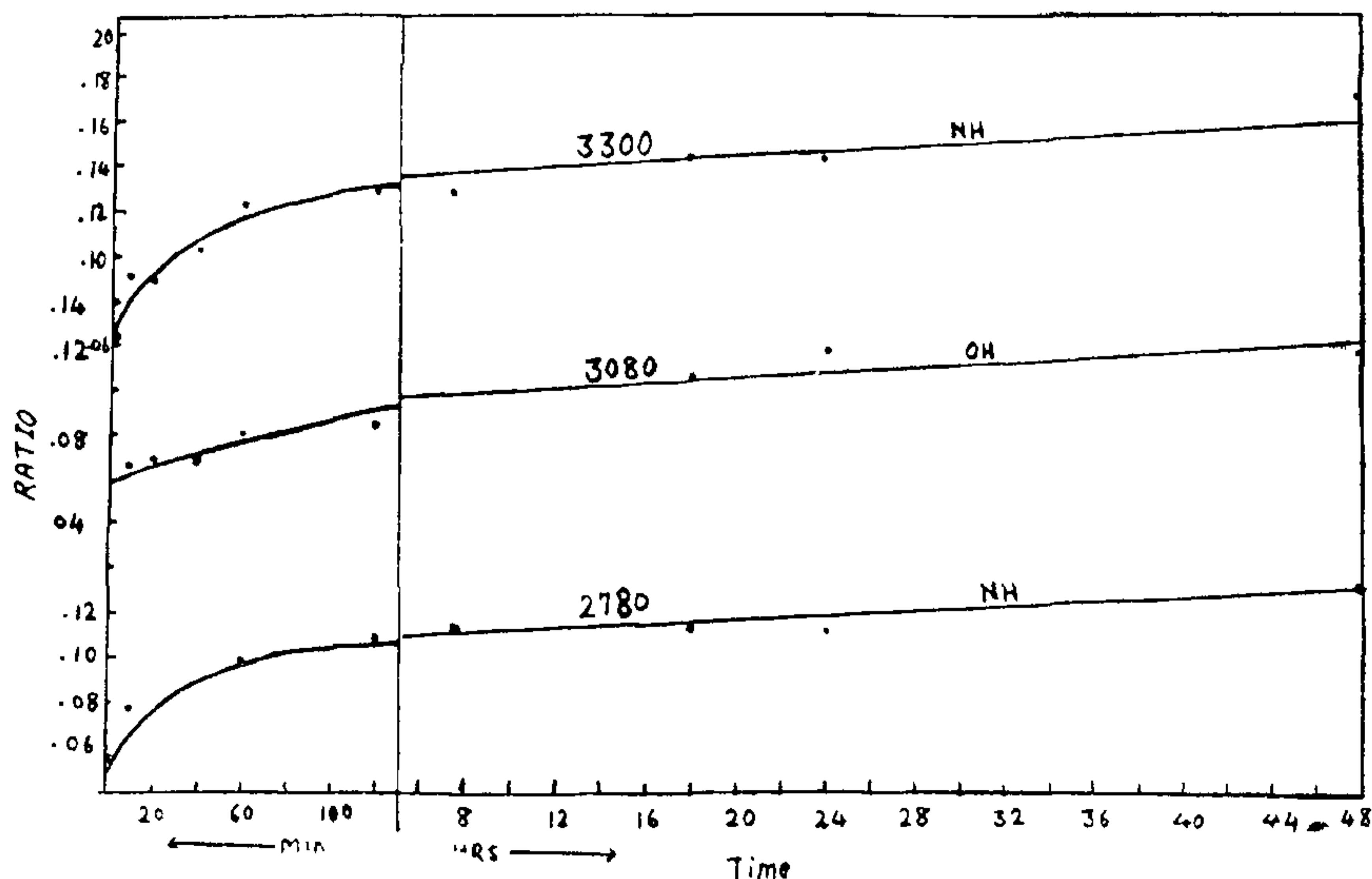


FIG. 2. Change of intensity of bands in proton region.

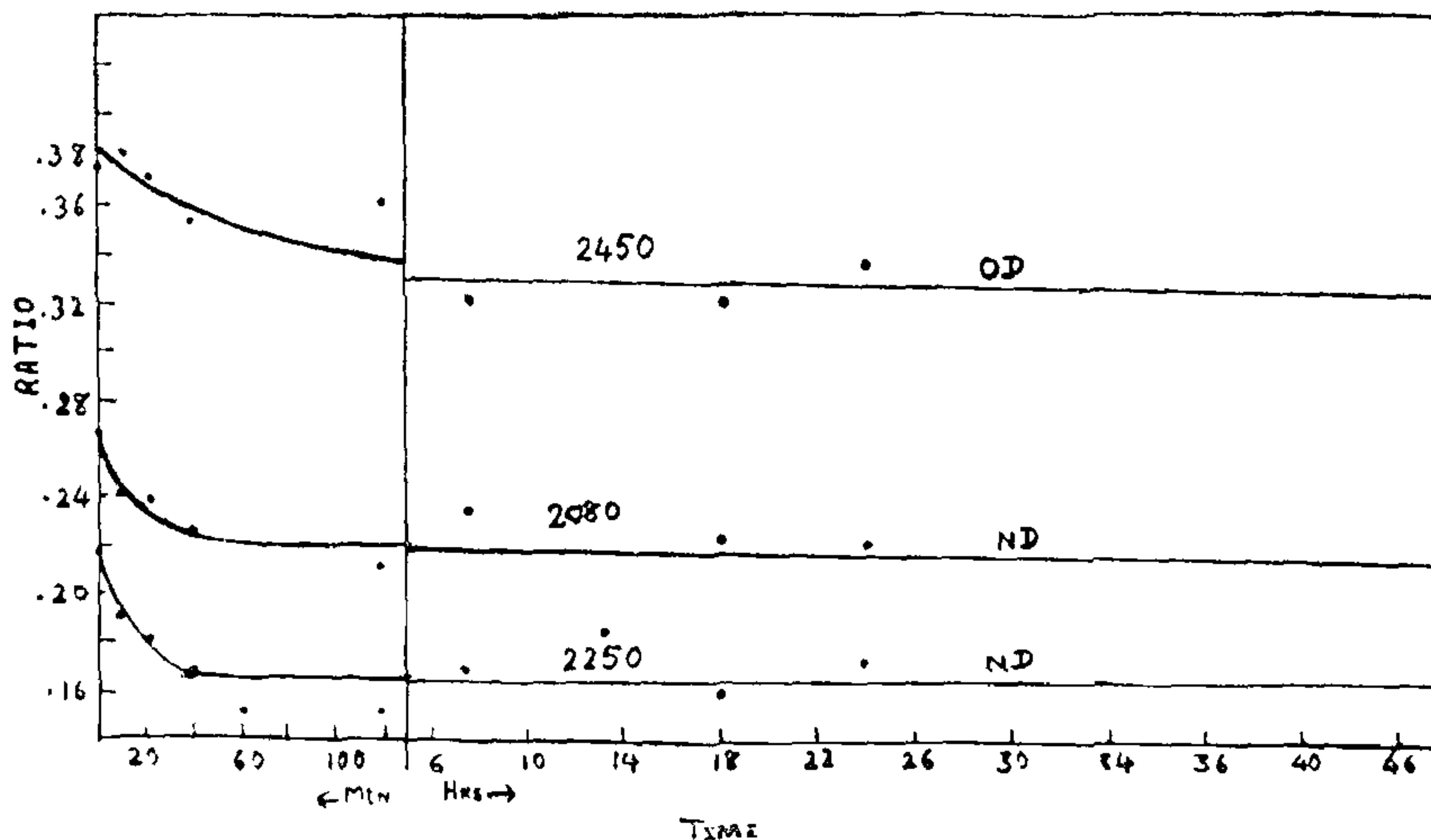


FIG. 3. Change of intensity of bands in deuterium region.

In completely deuterated benzohydroxamic acid, three bands are observed in ND, OD stretching region at 2450, 2250 and 2080  $\text{cm}^{-1}$ . During rehydrogenation, these bands lose intensity and bands in proton region gain intensity, the rate of gain or loss of intensity being a measure of the rate of rehydrogenation of the group responsible for the band. In the present case, it is observed that there are two types of curves specifically in initial position both when the loss of intensity of one set of bands and gain of intensity in another set of bands is plotted. The bands 3340 and 2770  $\text{cm}^{-1}$  show a faster rise and 2080 and 2250  $\text{cm}^{-1}$  faster fall of intensity than the bands 3080 and 2450  $\text{cm}^{-1}$  respectively. This shows that rates of rehydrogenation are different for the ND and OD groups and that 3340 and 2770  $\text{cm}^{-1}$  bands arise from one group and 3080  $\text{cm}^{-1}$  from the other group. Since 3340  $\text{cm}^{-1}$  is assigned to NH from independent evidence, the first two bands are assigned to NH and the band at 3080  $\text{cm}^{-1}$  to OH group. This method could be applied since there is a measurable difference in the rate of rehydrogenation of the two groups. A similar study of other bands affected by deuteration does not show a marked difference possibly because these involve mixed vibrations.

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### MULTIPLE PRODUCTION OF ANTIBIOTICS: DISTRIBUTION PATTERN

DIFFERENT species of micro-organisms and variants of one and the same organism may produce, depending upon the cultural conditions, antibiotics similar in their chemical and biological properties. On the other hand, one and the same micro-organism may produce antibiotics differing in their chemical and biological properties, again depending upon the cultural conditions.<sup>1</sup> This may result in the rediscovery of one and the same antibiotic from different sources. A modified Poisson distribution has been shown to be a good fit for the frequency of such rediscoveries.<sup>2</sup> In the present note, we show that the modified Poisson distribution is a good fit for the pattern of multiple production of antibiotics by two groups of micro-organisms: (1) Actinomycetales; and (2) Algae, fungi and lichen,