an additional diffusable antigen (Fig. 1). It is interesting that, when tissue cultures infected with *Besnoitia jellisoni* (obtained through the kind courtesy of Dr. J. K. Frenkel, University of Kansas Medical Centre) were tested, no antigenic cross-reactivity could be demonstrated between these two morphologically similar and taxonomically closely related protozoa. It has been found that 5% formalin and 50% glycerin did not inactivate the antigens and the test can be satisfactorily carried out on infected tissues preserved with these reagents.

The sera of experimental animals dying of infection with toxoplasma, when tested against immune rabbit serum, often gave two lines of precipitation (Fig. 2) demonstrating the presence of circulating soluble antigens probably absorbed from the extensive exudates which always are shown to contain a high concentration of diffusable antigens.

By application of the gel-diffusion technique, anti-toxoplasma precipitins could be demonstrated in the serum of different species of experimental and domesticated animals and the results so obtained bore a close correlation with those obtained by Sabin-Feldman dye test and the indirect hæmagglutination procedure of Jacobs and Lunde.[8] Precipitins appeared in the circulation within 7 days after artificial infection,

reached a peak within 14 days and persisted at a very high level at least up to 4 months and 10 days, the maximum period tested so far.

Save for the reports of O'Connor,[9,10] there is no reference in the bibliography on toxoplasmosis about the demonstration of precipitating antibodies to toxoplasma by diffusion. It is intended to use this method in investigating the antigenic composition of *Toxoplasma gondii* and its immunological relationship to other allied species of protozoa. It is also proposed to evaluate the diagnostic value of this method, on a comparative basis, to determine its usefulness in serological surveys of natural infection in the different species of wild and domesticated animals and birds in this country.

1. Finger, I., *Biol. Bull.*, *Wood's Hole*, 1956, **111**, 358.
2. Balbinder, E. and Preer, J. R., Jun., *J. gen. Microbiol.*, 1959, **21**, 156.
3. Ouchterlony, O., *Ark. For. Kemi Mineralogi Oct. Geolgi*, 1948, **26 B**, 1.
4. Mansi, W., *J. Com. Path.*, 1957, **67**, 297.
5. Jennings, R. K. and Malone, F., *J. Immunol.*, 1954, **72**, 411.
6. Cutchins, E. C. and Warren, J., *Amer. J. Trop. Med.*, 1956, **5**, 197.
7. Pande, P. G., Sekariah, P. C. and Ramachandran (Under publication).
8. Jacobs, L. and Lunde, M. N., *J. Parasit.*, 1957, **43**, 308.
9. O'Connor, G. R., *Arch. Ophth.*, 1957, **57**, 52.
10. —, *Amer. J. Ophth.*, 1957, **44**, 75.

SOLVENT EFFECTS ON THE DISPLACEMENT OF RAMAN AND ANTI-STOKES SPECTRAL LINES

MUCH interest is currently being shown in the effects of molecular interactions on the infra red absorption spectra of simple molecules. In two articles published in the *Proceedings of the Royal Society* (1957 and 1960) A. D. Buckingham has developed a simple theory of the effects of a solvent on the frequencies, intensities and the widths of the infra-red absorption bands of diatomic molecules. The interaction potential energy U is expanded as a power series in the normal co-ordinates and treated, with the anharmonicity, as a perturbation to the harmonic oscillator. The frequency shifts are shown to be related to the first and second derivations of U and the intensities found to be dependent on the derivatives of the dipole moment of the active molecule and its near neighbours in a small macroscopic sphere enclosing it.

In a recent paper (*Trans. Farad. Soc.*, 1960, **56**, 753) Buckingham has extended the theory to take account of the influence of the solvent-shift of the energy levels on the distribution of molecules in the vicinity of the active solute. A result of this is that in the Raman Spectrum of dissolved molecules, the Raman and anti-

Stokes lines should have slightly different displacements from the exciting line.

The Raman lines arise from the absorption of a photon from the monochromatic incident beam and the immediate emission from the virtual state so formed of a photon of lower energy leaving the molecule in an excited state. Similarly, the anti-Stokes lines correspond to an excited molecule absorbing a photon and emitting another of higher energy, the molecule undergoing a transition to the lower ground state. Since the ground state molecules and the vibrationally excited molecules favour different solvent structures around them, the interaction energies will be slightly different in the two cases. Thus the different solvent environments around ground state and excited state solute molecules lead to a small difference between the displacements of the Raman and anti-Stokes lines in the Raman effect of dissolved substances. As the difference is shown to be proportional to the square of the half-width of the band, it is only appreciable when the band is broad.