uptake greater than 4 per cent or 0·4 μmole Ca^{2+}/gm. dry wt. cells might have been detected. This would represent an accumulation greater than 125 times the supernatant concentration, with no extra added calcium and no accumulation with 100 μM Ca^{2+} added. This is based on a total cell volume of 2·67 ml./gm. dry wt. (the cell pad volume 3·61 ml./gm. (ref. 5) less 26 per cent interspace volume for close-packed spheres[6]). As the counts of supernatants and controls agree closely, it is probable that uptake was much less and the accumulation without added Ca^{2+} was as low as ten-fold.

(3) That calcium is not needed as such, but in media containing chelating agents, for example, amino-acids, displaces another cation that is required.

There is some support for the third possibility, for experiments with two different media and three strains of *Staphylococci* have shown that Fe^{2+} is as effective as Ca^{2+} in promoting growth. However, for equal effects on growth, equimolar concentrations of them are needed[7], and as the relative affinity of chelates for Fe^{2+} is very much greater than for Ca^{2+}, this makes displacement by Ca^{2+} doubtful. It is more probable that Fe^{2+} and Ca^{2+} are required for enzymes on alternative pathways.

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[1] Gorini, L., and Audrain, L., *Biochim. Biophys. Acta*, **6**, 477 (1951).
[2] Shooter, R. A., and Wyatt, H. V., *Brit. J. Exp. Path.*, **36**, 341 (1955).
[3] Rochford, E. J., and Mandle, R. J., *J. Bact.*, **66**, 554 (1953).
[4] Haines, R. B., *Biochem. J.*, **27**, 466 (1933).
[5] Mitchell, P. J., *J. Gen. Microbiol.*, **9**, 273 (1953).
[6] Conway, E. J., and Downey, M., *Biochem. J.*, **47**, 347 (1950).
[7] Wyatt, H. V., Ph.D. thesis, University of London (1957).

Fixed Pathogenic *L* Forms of *Agrobacterium tumefaciens*

UNSTABLE *L* forms of *Agrobacterium tumefaciens* (strain *B*.38) induced by glycine have been described by Rubio-Huertos and Desjardins[1]. In the present work two strains, *A.T.B.* and *A.T.* isolated from grapes, were grown in agar plates with 4 per cent glycine, where they readily formed typical *L* colonies. These were transferred simultaneously at intervals of 2–3 days to new plates of agar–glycine and glucose–agar without glycine. On the fiftieth transfer no reversion to the normal bacillary form was observed even after 32 further transfers in medium without glycine. The fixed colonies, formed by spherically dense elements, have the same macroscopical appearance as the normal colonies of *A. tumefaciens* grown in the same medium and have lost the typical features of the *L* colonies.

The fixed spherical forms were observed using both light- and electron-microscopes (Fig. 1); they appear to have a definite plastic membrane similar to the *L* forms, more dense cytoplasm and a slime layer; they are also of a more regular size, 0·5–0·8μ, unlike the unstable *L* colonies formed by elements of very different sizes.

Inoculations with the fixed forms of small plants of *Phaseolus vulgaris* gave a positive pathogenic response, and the same type of spherical forms were recovered from the tumours.

The crown-gall tumours induced by spherical forms are of the same size and similar macroscopic appearance as those induced by the normal bacillary parental strains of *A. tumefaciens*.

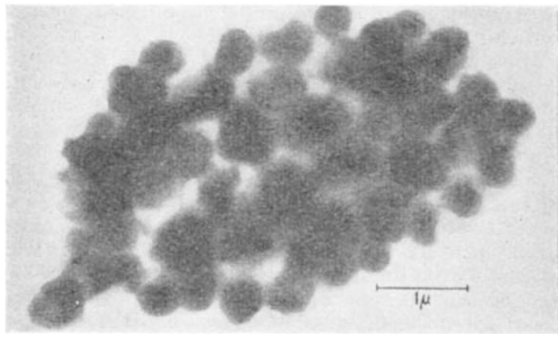

Fig. 1. Electron micrograph of fixed spherical elements of *A. tumefaciens*

The pathogeneity of unstable *L* forms could not be proved here because only normal bacillary forms were recovered from the tumours induced by inoculation with these unstable forms. The pathogeneity of *L* forms has been reported in animal pathogen bacteria (Lavillaureix[2], Rubio-Huertos and González[3]), but the pathogeneity of the fixed spherical forms of *A. tumefaciens* is the first case, so far as we know, for plant pathogens.

Comparative tests for sugar fermentation, and other physiological essays revealed that there is no difference between the fixed spherical forms and the normal parental strains.

The pathogenic spherical elements forming the fixed colonies fulfil all the requirements stated by Klieneberger-Nobel[4] for *L* forms except in the macroscopical morphology of their colonies. Thus it is difficult to say if they are real *L* forms or an induced spherical mutant of the normal parental strains.

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[1] Rubio-Huertos, M., and Desjardins, P. R., *Microbiol. Espan.*, **9**, 375 (1956).
[2] Lavillaureix, J., *C.R. Acad. Sci., Paris*, **239**, 1155 (1954).
[3] Rubio-Huertos, M., and González, Vazquez C., *Ann. N.Y. Acad. Sci.*, **79**, 626 (1960).
[4] Klieneberger-Nobel, E., in *The Bacteria*, **1**, 382 (Academic Press, New York, 1960).

PSYCHOLOGY

Auditory and Visual Interaction in Man

SOME characteristics of auditory and visual interaction were studied in 36 normal young adult subjects, using a method based on recognition of repetitions. This method extends and complements procedures developed by Averback and Sperling[1], Broadbent[2], and Shepard and Teghtsoonian[3].

The stimuli used were supra-threshold ½ sec. auditory and visual presentations of randomly selected numbers from 1 to 7 and 10 to 17. The subjects were presented with 32 short groups of 9 sequential displays, one display every 2 sec. Each display consisted of the simultaneous auditory and visual presentation of two different numbers. Four of the last eight displays of each group contained either a visually or an aurally presented number which was a repetition of a previous presentation within the same group. Repetitions followed two