transferase activity, corresponding to 0.02–0.05% of the total cell protein added in the precipitation mixture. This amount of protein precipitate is also consistent with the level of enzyme protein estimated to be present in the extracts.

The existence of a high MW form of transferase in the malignant cell lines examined in this survey is a novel finding. Unfortunately this finding cannot be used to explain the multiplicity of forms observed by phosphocellulose chromatography of crude extracts[9,10] of other tissues for the following reasons: Both line 8402 and CEM-clone 10 exhibit two distinct enzyme activity peaks on phosphocellulose (Hassur, Chang and F.J.B., unpublished results) but only a single peptide is seen on the fluorograms in Fig. 1; both enzyme peaks are inhibited by anti-TdT. The existence of several ionic forms of transferase in a single MW species requires an explanation based on amino acid changes or other ionic substitutions. Similarly, several isoelectric species can be demonstrated to be present in homogenous preparations of calf thymus transferase, but only the α and β peptides are present (Protzel and F.J.B., unpublished result). All species react with anti-TdT in microdiffusion tests. The immunoprecipitation procedures provide clean resolution of questions about peptide structure.

Our major objective in these experiments was to analyse a system exhibiting nuclear localisation of transferase. Having found a distinctly different form of transferase peptide in 'non-thymic' cells, we suggest that differentiation in the thymus may lead to peptide chain cleavage producing the 'thymic' form of enzyme. Of even greater speculative interest is the possibility that the high MW form, that form present in the nucleus, may be the form exhibiting important biological activity.

F. J. BOLLUM
MCKAY BROWN

Department of Biochemistry,
Uniformed Services University of the Health Sciences,
Bethesda, Maryland 20014

Received 8 November 1978; accepted 12 January 1979.

1. Chang, L. M. S. & Bollum, F. J. *J. biol. Chem.* **246**, 909–916 (1971).
2. Bollum, F. J. *Proc. natn. Acad. Sci. U.S.A.* **72**, 4119–4122 (1975).
3. Gregoire, K. E., Goldschneider, I., Barton, R. W. & Bollum, F. J. *Proc. natn. Acad. Sci. U.S.A.* **74**, 3993–3996 (1977).
4. Bollum, F. J. *Adv. Enzym.* **47**, 347–374 (1978).
5. Huang, C. C., Hou, Y., Woods, L. K., Moore, G. E. & Minowada, J. *J. natn. Cancer Inst.* **53**, 655–660 (1974).
6. Foley, G. E. *et al. Cancer* **18**, 522–529 (1965).
7. Laemmli, U. K. *Nature* **277**, 680–685 (1970).
8. Bonner, W. M. & Laskey, R. A. *Eur. J. Biochem.* **46**, 83–88 (1974).
9. Pazmiño, N. H., McEwan, R. N. & Ihle, J. N. *J. Immun.* **119**, 494–499 (1977).
10. McCaffery, R., Harrison, T. A., Parkman, R. & Baltimore, D. *New Engl. J. Med.* **292**, 775–780 (1975).

Stopped visual motion

WHILE undertaking another experiment, we discovered a surprising and dramatic visual phenomenon. We were observing two gratings of high contrast and different spatial frequency (see Fig. 1 inset) while both gratings were rotating at a rate of 1 revolution per min. Both gratings were easily visible at the viewing distances used. The coarse grating was seen to revolve as expected; however, the fine grating appeared to revolve very slowly. This phenomenon has been shown to over 100 people[1] and all were startled by the observation. The individual reaction was to assert that the two gratings must be rotating at different physical speeds. This disbelief was readily corrected by removing the two gratings from their turntables and replacing each of them in the position of the other. Another entertaining variation of the observation is to observe the fine grating at the distance where it is perceived as a uniform disk; naturally, no movement can be seen at this distance. If one now advances slowly towards the grating it is initially seen as stationary; as one approaches closer it is seen to rotate progressively faster. At a particular distance it seems to rotate faster than the coarse grating. We have quantified these causal observations and show here that the

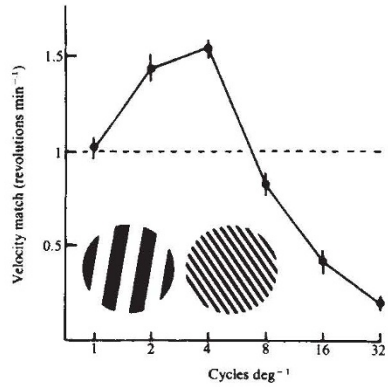

Fig. 1 Velocity match for gratings of different spatial frequencies—the dotted line is the true physical rate of revolution. The vertical bars are ±1 s.e. ($n = 5$). The diameter of the disks was 10 cm.

perception of slow rotation movement is related to the spatial frequency and contrast of the pattern which is rotated.

A 1-cycle deg^{-1} grating was used as reference and it was rotated at 1 revolution per min. A second grating was attached to a variable-speed turntable which could be controlled by the subject. In the first experiment the subject was requested to look fixedly at one or the other turntable alternately. He then adjusted the speed of rotation until the two disks were matched in velocity.

The results are shown in Fig. 1. The horizontal dotted line is the 1 cycle min^{-1} reference velocity. It is clear that as the spatial frequency (fineness of the grating) is increased the apparent velocity rises, reaching a peak at 4 cycles deg^{-1}. Thereafter, the apparent velocity slows down rapidly.

Further quantitative observations established that the following variables affect the phenomenon. If the control grating is centred on the fovea and a grating of identical spatial frequency is viewed in the periphery of the visual field, the peripheral grating is seen to move much more slowly. In this experiment the subject looked with his fovea at a reference grating of 2 cycles deg^{-1} with a velocity of 1 rotation per min. With reference to the foveal standard grating the velocity match of a grating of identical spatial frequency at the following eccentricities were: 5°: 1.4 ± 0.2; 10°: 2.2 ± 0.2; 15°: 3.2 ± 0.2; 20°: 3.7 ± 0.3; 25°: 5.4 ± 0.2.

At very low contrasts (near threshold) the perceived speed of rotation also slows down or stops. However, at medium and high contrast no change in the rate of rotation is found as a function of contrast.

The above observations suggest two separate mechanisms for detecting rotation. In the first, the motion is actually seen; in the second, no motion is seen, but if the subject looks for some time he deduces that rotation must be occurring for he remembers that some time before, the grating was, for example, at 12 o'clock and now it is at 3 o'clock, and so on. When he cannot see the real motion, the observer is left with the strange impression that somehow the continuity of the flow of physiological time is lost.

Neurophysiological studies on single neurones of the visual system are now required to establish whether this singular deception of motion is due to an insensitivity of visual neurones to rotary disks containing high spatial frequencies.

F. W. CAMPBELL

The Physiological Laboratory,
Downing Street,
Cambridge, UK

L. MAFFEI

Laboratorio di Neurofisiologia del CNR,
Via S Zeno 51, 56100 Pisa, Italy

Received 30 November 1978; accepted 17 January 1979.

1. Campbell, F. W. & Maffei, L. *J. Physiol., Lond.* **289** (in the press).

0028–0836/79/0278—0192$01.00