Psychology

Widening vistas for eye movement research

from Peter Coles

UNTIL recently the study of human eye movements was strictly for the psychology laboratory; recording required the fitting of uncomfortable contact lenses or the use of head restraints, machines were unreliable, and analysis had to be carried out by an exceedingly tedious manual procedure. Now, unobtrusive computerized machines are becoming available and are opening up eye movement research to workers from a whole new range of disciplines. Some of the new developments — in areas as diverse as neurophysiology and quality control on the production line — were reported at a recent European conference.*

The new machines make it possible to study eye movements in children, and even infants, and provide vital new information for the study of both normal and abnormal visual development. Of particular interest is the possibility that abnormal oculomotor behaviour may either reflect, or be a contributing factor, in reading disorders. One study suggested that children often show inaccurate convergence of the two eyes so that the two foveas are not aimed precisely at the same target (J.F. Stein and S. Fowler, University of Oxford). The authors developed the hypothesis of a 'leading eye' which acts to suppress the conflicting image of the other eye and enables more reliable associations between ocular motor and retinal signals to improve the accuracy of binocular eye movements, in much the same way as Walls suggested in his theory of ocular dominance in 1950. A binocular test showed that by age five years, over 50 per cent of children sampled had developed a stable 'leading eye', whilst the figure was over 90 per cent by age eleven years. It was found that those children who had not developed a stable leading eye had reading ages as much as eight months behind those who had developed a stable leading eye. These results were put to use by investigating effects on poor readers' performance of wearing spectacles which occluded vision from one eye, thus simulating the function of a 'leading eye'. Children with visual dyslexia (and an unstable leading eye) were divided into two groups, one wearing the occluding spectacles for all close work, the other not. After six months, the dyslexic sample who had worn an occluding lens had improved their average reading age by twelve months, whilst the control sample had improved their average reading age by six months. About 50 per cent of the experimental group had also developed a stable leading eye.

Knowledge about the sequence and localization of ocular fixations as opposed to the movements themselves, can help understand, and perhaps improve, efficiency of routine, but critical visual inspection tasks, such as scanning chest X-ray images for tumours or signs of disease. Up to 30 per cent of small tumours recorded on chest images are not reported, even by trained radiologists. Performance cannot be improved simply by presenting sections of the image serially, possibly because this prevents the comparison of potential lesions or 'nodules' with areas judged to be healthy, as occurs in free viewing (D.P. Carmody, St. Peter's College, Jersey City). The efficiency with which radiological examinations are carried out varies considerably during the day. Ocular fixations are of significantly longer duration in morning sessions than after lunch or at the end of the working day (A. Gale, Queen's Medical Centre, Nottingham).

Recent developments in the study of eye movements themselves were mostly concerned with the rapid 'voluntary' saccadic eye movements. The saccadic system is traditionally characterized as being 'ballistic' in so far as the movement is preprogrammed and cannot be altered in mid-flight. This preprogramming is generally thought to occur in the necessary inter-saccadic intervals which seem to be characterized by a minimum refractory period before another saccade can be initiated, with vision being 'suppressed' during the saccade itself. Modern recording techniques make it possible to change the stimulus display as a function of ongoing eye movement and research using these 'contingent' paradigms has led to modifications of most of the 'traditional' characterizations of saccades.

It has emerged that saccade peak velocities are not simply determined by target eccentricity, as had been assumed, but may be slowed in mid-flight (T.J. Crawford, University of Durham). Further evidence was offered for the idea of a speed/accuracy trade-off in the saccadic system, with the implication that accurate saccades may involve a different mode of use of sensorimotor pathways (Z. Kapoula, University of Paris). A very useful contribution was made to our understanding of changes in oculomotor functioning in early infancy, a subject-group which has proved particularly elusive as long as recording devices required attachments to the eye or orbital areas. Whilst infants under five-months of age showed saccades having velocity parameters similar to adults, a subset of infants also showed 'back-to-back' saccades with negligible inter-saccadic intervals, probably never occurring in normal adults (L. Hainline, J. Turkel & I.A. Abramov, Brooklyn College of

*Second European Conference on Eye Movements, Queen's Medical Centre, Nottingham, 19–23 September 1983. Organized by the Biological Engineering Society in association with the Applied Vision Association.

Astronomy

1983 TB and the Geminids

from David W. Hughes

A fast-moving Apollo-type asteroid, 1983 TB, has recently been discovered with the infrared astronomy satellite IRAS. The asteroid was then tracked by observers at the Palomar and Lowell observatories and the orbit calculated by C.M. Bardwell at the Center for Astrophysics, Cambridge, Massachusetts (see IAU circular no.3879). Two surprises were in store. 1983 TB has the smallest perihelion distance of any known asteroid and, even more exciting, the orbit is nearly coincident with that of the Gemini meteor stream. The parameters are given below.

A recent paper on the orbital evolution of the Geminids investigated the possibility that an unknown minor planet could have been influencing the stream (*Mon. Not. R. Astr. Soc.* **199**, 313; 1982). The only asteroid that was known to come anywhere near was 132 Aethra and it was estimated that this only had a minimal effect. Now the new observations show there is a minor planet actually in amongst the meteoroids.

Others have often speculated that comets decay to produce both a stream of meteoroid dust particles and a dead cometary nucleus — this being indistinguishable from an asteroid. One problem was that most known asteroids are considerably larger than cometary nuclei. But still the orbits of Encke's comet, the daytime Taurid meteor stream and asteroid Hephaistos were reasonably similar. Those of the Geminids and 1983 TB are much much closer. □

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	Ω (Deg)	ω (Deg)	I (Deg)	e	q (AU)	a (AU)	P (Years)
Geminids	260.3	324.8	23.6	0.896	0.140	1.35	1.57
1983 TB	261.83	324.59	22.77	0.8944	0.1376	1.3027	1.49

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