Table 7.2. Kinetic parameters in stratified squamous epithelia

Tissue and reference	Parameter	I_S (%)	I_M (%)	T_C (h)	t_S (h)	t_{G_2} (h)	t_2 (h)	t_M (h)	k_B (cells/1000 cells/h)	T_T (h)	T (h)	I_P (%)
Mouse epidermis												
Sherman *et al.* (1961)	ear	2.8	0.12	583[7]	30[4]	5.9[4]	6.5[4]	1.3[4]	9.3[12]		489[9]	54.5[2]
Blenkinsopp (1968*a*)	ear			532[14]	34[13]							68[3]
	abd.			156	8.4							68[3]
Hegazy and Fowler (1973*a*) (dorsum)				101[4]	11.6[4]		2.0[4]	1.4[4]	6.9[12]			100[5]
				107[5]								100[6]
				96–102[6]								
				110[7]								
Clausen *et al.* (1979) (dorsum)				53.6	8.8	3.2		1.0	4.0		144[8]	
Iversen *et al.* (1968) (dorsum)				84[5]							96[9]	
												58[3]
Hamilton and Potten (1972) (dorsum)				107							187[8]	57[15]
Potten *et al.* (1974) (dorsum)				120[5]	14[5]							90[5]
Cameron (1970)	dorsum										7–14[5] d	
	ear										14–21 d	
	abd.										7–14 d	
	plantar										10 d	
Olsson (1976) (dorsum)				65								
Clausen *et al.* (1981)					8.5		3.2					
					8.9–11	1.2–2.4 (1.7)						
Rat epidermis												
Storey and Leblond (1951) (plantar)									2.2[10]		16.9[8] d	
Bertalanffy *et al.* (1965)	plantar								1.9[10]		24.4[8] d	
	abd.								2.6		15.9 d	
	ear								1.4		29.9 d	
Fukuyama and Epstein (1966)										3 d[1]		
Mouse oesophagus												
Leblond *et al.* (1964)		6.5	0.3	70[14]	7[4]				12[10]		105[10,11]	70[3]
											175[8]	
Blenkinsopp (1968*a*)				58[14]	9.1[13]	2.8						71[3]
Blenkinsopp and Gilbert (1969)				64[14]								
Blenkinsopp (1969)				41[7]	8.5[5]	2.8						
Thrasher (1971)[16]		6.6–12.6			7.6[4]	1[4]	1.6[4]				64–120[11]	
					8.0	1.75	2.0					
Duffill *et al.* (1977)				39[10]	8.2[4]							
Greulich (1964)		3–11										
Rat oesophagus												
Leblond *et al.* (1964)				54.3[14]							81.5[10,11]	58
											131.8[8]	
Mouse squamous forestomach												
Wolfsberg (1964)				30[4]	13.5[4]		2–2.5[4]		3.9[12]		260[11]	11
Frankfurt (1967)				55[4]	7[4]				6.5[12]			100[5]
												57[3]

Tissue and reference	Parameter	I_S (%)	I_M (%)	T_C (h)
Hamster cheek pouch epithelium				
Brown and Oliver (1968)				130±7[6]
				135±17[7]
Brown and Berry (1968)[17]				
Gibbs and Casserrett (1969)				
Izquierdo and Gibbs (1974)				
Oral epithelia				
Blenkinsopp (1968*a*)	Mouse tongue			53[14]
Blenkinsopp and Gilbert (1969)				84[14]
Cameron (1970)	Filiform papilla			
Cameron (1966)				21–35
Potten and Hume (1976)		6.9		
Beagrie (1963)	Mouse gingiva	5.5–7.9		

1. As measured from the basal layer.
2. This is the fraction of the population occupied by the basal layer, and assumes that all basal layer cells are proliferative.
3. This is calculated from the progenitor:non-progenitor cell argument detailed in Chapter 8, section 5.
4. As measured by the FLM method.
5. As measured by the continuous labelling method.

(see chapter 2, section 7), but Brown and Oliver did obtain a value of 135 ± 17 (SEM) hours. The SEM estimates in these measurements were derived from the least squares regression of N_B/N_T (Fig. 6.1, p. 230), and from SD t_S and SD I_S for the two methods used respectively. These values are obviously close, especially when the confidence interval is taken into consideration. In this respect, it is perhaps worth emphasizing that the format of the FLM curve obtained by Hegazy and Fowler (1973*a*) shows such a square wave course that there is likely to be a very tight distribution of cell cycle times for those cells which are contributing to the second peak.

The above mentioned studies are the only ones published where independent corroboration from more than one method has been forthcoming, but there are several other published values for T_C which are worth considering, and these are summarized in Table 7.2. The continuous labelling method has been employed to measure $t_{G_2} + t_M + t_{G_1}$ from the inflexion point on the curve and then adding the duration of t_S, usually found from an FLM analysis. Frankfurt (1967) reported a value of 55 hours for mouse squamous forestomach, while Iversen *et al.* (1968) obtained 84 hours for mouse dorsal epidermis; Blenkinsopp (1968*a*; 1969) calculated values of 41 and 64 hours for mouse oesophagus, and of 84 hours for the mouse ventral tongue, all obtained using the continuous labelling technique. In mouse dorsal epidermis, Potten *et al.* (1974) reported a value of 120 hours,

t_S (h)	t_{G_2} (h)	t_2 (h)	t_M (h)	k_B (cells/1000 cells/h)	T_T (h)	T (h)	I_P (%)
7.6[4]							
8.6±0.8[4]		2.4[4]	0.8–1.2[10]	4.1[10]		113[11]	
				5.1[10]		120[11]	
10[4]		2[4]	53–77 min			72–96[1]	
				0.12		8.4 d	
				0.26		3.8 d	
8[13]							71[3]
						4 d[5]	
7						53	
						65–86	
7					24h–10d	24h–10d	

6. Using the Brown and Oliver method (see Chapter 6, section 2).
7. A stage-duration calculation.
8. Total turnover time (including basal cells).
9. Differentiating layers only.
10. Stathmokinetic method.
11. Basal layer only.
12. From $k_B = I_S/t_S$.
13. From $t_S = I_S/r_S$, assuming $r_S = r_M$.
14. From calculated life of progenitor cell in basal layer.
15. See text (section 7.4).
16. Depending on age.
17. Depending on time of day.

again from the continuous labelling method, while the required t_S value was calculated from the continuous labelling curve. One of the several drawbacks of this method is the difficulty in establishing the point of inflexion (see Chapter 3, section 5), but from the format of the published curves (Fig. 7.4, p. 270) the inflexion point for the germinative cells is usually quite discrete, and consequently no great difficulty is experienced in reading off the value of $t_{G_2} + t_M + t_{G_1}$.

Indirect measurements from a foreshortened FLM curve have also been popular; Sherman *et al.* (1961) did as several authors have done, and calculated cell cycle time values from I_P/k_B, assuming that I_P = 54 per cent (see section 7.4), calculating k_B from I_S/t_S, and assuming a rectangular age distribution, to give a value of 583 hours for the mouse ear. Thrasher (1971), in the mouse oesophagus, obtained values ranging from 64 to 120 hours, depending on the age of the animal; Cameron (1966) reported 21 to 37 hours for the mouse filiform papilla; these values would of course more properly be called *basal layer turnover times* rather than cell cycle times (see Chapter 6, section 3). On the other hand, in the mouse squamous forestomach, Wolfsberg (1964) fared rather better; her curve for cells with >6 grains per nucleus shows a distinct second peak, and indicates a median cell cycle time of about 30 hours.

Some investigators have calculated the cell cycle time from metaphase arrest experiments; Blenkinsopp (1968*a*) used a relationship which in fact reduces to