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Subdivision boundaries are placed differently in polytene chromosome maps of *D. melanogaster.*

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Introduction

The Bridges' drawn maps of the polytene salivary gland chromosomes of *D melanogaster* (C.B. Bridges, 1935, 1938; P.N. Bridges, 1941a,b, 1942; Bridges and Bridges, 1939; reprinted in Lindsley and Zimm, 1992, and in Sorsa, 1988) have served as a universal reference for cytogenetic analysis since they were published. Likewise, the photographic maps of Lefevre (1976) have become a self-evident tool for identification of chromosome arms and regions together with the Bridges' drawings . As Ashburner (1989) notes, "The most useful procedure is to get a rough idea where a breakpoint or *in situ* site is from Lefevre's photomaps and then analyze the region carefully with the appropriate revised map." Yet "The revised maps are neither easy to use nor, in some regions, as accurate as one would wish."

One difficulty in using the revised maps is that several division and subdivision boundaries have been shifted in the process of revision. Boundaries were moved primarily to make use of heavier, darker bands making some regions easier to find and, secondarily, to even up the lengths of divisions and subdivisions as much as possible (Bridges, 1942). The shifts were marked by dashed lines below the map drawings on the maps of the X, 3L and 2L chromosomes. Six or seven boundary shifts were also made in 2R (Bridges and Bridges, 1939) and one or two in 3R (Bridges, 1941a), but these slight changes are not marked on the revised maps of 2R and 3R.

In addition to the above standard maps, there are polytene chromosome maps made later both with light microscopic (LM) and electron microscopic (EM) methods. A prerequisite for the use of the other maps is that they agree, *i.e.*, that the about 600 subdivision boundaries of the maps are placed exactly the same way as in the Bridges´ revised maps. They are not. This was observed when the electron micrograph maps based on thin sections of salivary gland chromosomes, published in 1979-1996, were made (references in Saura, 1986; Sorsa, 1988; Ashburner, 1989; Zhimulev, 1996; Saura *et al.*, 1997).

I have checked the boundary locations in 1) the electron micrograph map from whole mounted salivary gland (SG) chromosomes (Ananiev and Barsky, 1985); 2) the photo-map of the polytene fat body (FB) chromosomes (Richards, 1980); 3) the LM and EM division maps of the salivary gland chromosomes (Sorsa, 1988); 4) the light microscopic photomap (in Heino *et al.*, 1994).

Results and Discussion

Table 1 lists the subdivision boundaries of the above maps which differ from the revised maps of the Bridges'. The table also suggests how the boundaries should be corrected. Some additional notes about shifts, discrepancies and the correspondence of subdivisions (after the changes) are given in the following.

Table 1. Boundary lines of certain maps that are marked differently from the Bridges´ revised maps and my opinion on how they should be changed. Abbreviations: SG = salivary gland chromosome map; FB = fat body chromosome map; EM = electron microscope map; LM = light microscope map; A&B = Ananiev and Barsky,1985; R = Richards,1981; S = Sorsa, 1988; x = difference is evident; ? = uncertain.

Boundary	SG A & B	FB R	SG S	How the boundary should be placed
3D/E	x	-	-	move slightly to the right
11D/E	?	-	-	move slightly to the right
12E/F	-	x	-	move a little to the left
13A/B	x	-	-	move a little to the left
13E/F	-	x	-	move to the right
13F/14A	-	-	x (LM)	move to the right
17A/B	x	-	-	this boundary = 17B/C; add the correct A/B boundary to the left of the old one
17B/C	x	-	-	this boundary = 17C/D
17C/D	x	-	-	this boundary = 17D/E
17D/E	x	-	-	delete
17E/F	?	-	-	should be moved slightly to the right?
18A/B	?	-	-	move slightly to the left?
18B/C	x	-	-	move slightly to the left
18D/E	-	-	x (LM)	delete
18E/F	-	-	x (LM)	this boundary = 18D/E
18F/19A	-	-	x (LM)	this boundary = 18E/F; mark the correct 18F/19A boundary to the right of the old one
22F/23A	x	-	-	this boundary = 23A/B; mark the correct boundary 22F/23A to the left of the old one
23A/B	x	-	-	delete
24C/D	x	-	-	move slightly to the right
26E/F	-	x	-	move to the left?
28B/C	x	-	-	move to the left (28B is a very short subdivision)
28E/F	-	x	-	move to the right
29F/30A	-	?	-	move slightly to the right?
30A/B	x	-	-	move to the left
34F/35A	x	-	-	move just a little to the right
35B/C	-	x	-	delete
35C/D	-	x	-	this boundary = 35B/C
35D/E	-	x	-	this boundary is 35C/D; add the correct 35D/E to the right of the old one
38A/B	x	-	-	move a little to the right
43C/D	-	-	x (LM)	move to the left
43D/E	-	-	x (LM)	move to the left
44B/C	-	x	-	move slightly to the left
44D/E	-	x	-	move to the right
47B/C	?	-	-	
49B/C	x	-	-	move a little to the left
56B/C	-	-	? (LM)	move a little to the right?
56D/E	-	-	? (LM)	move slightly to the left?
57D/E	x	-	-	move a little to the right
63F/64A	x	-	-	move just a little to the right
64B/C	?	x	-	move to the right
64E/F	x	-	-	move slightly to the right
65A/B	x	-	-	move to the right
65F/66A	x	-	x (LM, EM)	move a little to the right
68C/D	-	-	x (LM)	move to the right
70C/D	-	x	-	move to the left
73A/B	?	-	-	move to the right?
75B/C	-	x	-	delete
75D/E	-	x	-	this border = 75B/C; mark the correct 75D/E to the right of the old one
88C/D	x	x	-	move to the left (A&B); move to the right (R)
88D/E	-	x	-	move to the right
89A/B	-	x	-	move to the right
90B/C	-	x	-	move to the right
95A/B	x	-	-	move to the right
95E/F	x	-	-	move to the left
98C/D	x	-	-	this boundary = 98D/E; add correct 98C/D boundary to the left
98D/E	x	-	-	this boundary = 98E/F
98E/F	x	-	-	delete
98F/99A	-	x	x (EM)	move to the left
99C/D	x	-	-	move slightly to the right
101E/F	x	-	-	this boundary is 101F/102A; mark the correct 101E/F to the left of the old one
101F/102A	x	-	-	move to the left
102A/B	x	-	-	delete

The X chromosome. Four subdivision boundaries, 7C/D, 13F/14A, 14A/B, 16A/B, were shifted slightly to the right on the revised map (Bridges, 1938), and subdivisions 20E and 20F (borders 20D/E and 20E/F) were added to the proximal end of the chromosome. The changed borders are, in general, easy to locate. According to Richards (1980), the border 13F/14A in the FB map appears more like the original SG map than the revised version in band intensities. In the SG chromosome maps the borders in divisions 17 and 18 need to be attended to. The region 17A in the map of Ananiev and Barsky (1985) corresponds to 17A and B of Bridges' map, their 17B equals Bridges' 17C, their 17C equals to Bridges' 17D, and their 17D+E equals Bridges' 17E. The boundaries 18D/E, 18E/F, 18F/19A in the LM map (in Sorsa, 1988) should be also changed; these corrections have been made in the LM map of Heino *et al*. (1994).

2L chromosome. The following 12 subdivision boundaries were dashed (and shifted?) in the 1942 map (Bridges, 1942): 27F/28A, 28B/C, 29B/C, 33B/C, 34B/C, 34D/E, 36D/E, 37E/F, 38A/B, 38E/F, 38F/39A, and 39B/C. According to Wright *et al.* (1976) and Ashburner (1978) P.N. Bridges (1942) indicated some boundaries as being altered, when, in fact, they were not (39B/C) and, furthermore, altered some boundaries without so indicating (38C/D, 39D/E). The boundary line 39F/40A should also be dashed (Saura 1986). The list of differently placed boundaries of Saura (1986) included more borders of 2L than is presented here (Table 1). The now omitted boundaries may, after all, be correctly placed. Taken together, 2L is the hardest of the major chromosome arms to analyse.

2R chromosome. Contrary to what Lefevre (1976) states, 6-7 subdivision boundaries were changed in the revised map (Bridges and Bridges, 1939), but these changes are not indicated by dashed boundary lines. According to Saura (1986), the shifts may include at least some of the following: 42A/B, 43C/D, 43D/E, 44D/E, 47E/F, 50C/D, or perhaps 41C/D and 44C/D. The boundaries 43C/D and 43D/E, which are incorrectly placed in the division maps (Sorsa 1988) have been corrected in Heino *et al*. (1994).

3L chromosome. Bridges (1941a) made 18 changes in the revised map: 63B/C, 66A/B, 67A/B, 67C/D, 70D/E, 72B/C, 73A/B, 73B/C, 73E/F, 74C/D, 74E/F, 75A/B, 75C/D, 75D/E, 77B/C, 77E/F, 78F/79A, 79A/B, and added subdivisions 80D, 80E, and 80F. The boundaries included in Table 1 should be moved only slightly to the right or left. According to Richards (1980), the assignment of the 70C and 70D boundaries is made difficult by the deeply staining bands in 70C5-10.

3R chromosome. One or two subdivision changes were made in the revised map of Bridges (1941b) even though Lefevre (1976) stated that no boundaries were changed. The changes are not, however, marked in the map. The shifted boundaries might be (or not) 84E/F, 88A/B or perhaps 100D/E and 100E/F. The boundary 88C/D is marked too far to the right in the map of Ananiev and Barsky (1985) but too far to the left in the map of Richards (1980). In addition, other changes should be done in the maps (Table 1). The changes alter the subdivision names. For example 98C in the map of Ananiev and Barsky (1985) equals 98C+D on Bridges' map, their 98D = 98E and their 98E+F = 98F. The border 98F/99A is marked too far to the right in two maps (Table 1).

Chromosome 4. Subdivision boundaries of 4R are relatively easy to identify (Saura *et al.*, 2002). In the map of Ananiev and Barsky (1985) there are three boundary differences.

Table 1 includes a total of 62 boundary lines of the three chromosome maps, which are probably marked differently from the Bridges' revised maps. The boundaries 64B/C, 65F/66A, 88C/D and 98F/99A were marked incorrectly in a similar fashion in two maps, other borders only in one map.

The revised map of 2R contains the least amount of discrepancies and is thus the easiest chromosome arm to analyse. Among the different maps, the map of Ananiev and Barsky (1985) had most discrepancies, while the LM map of Heino *et al*. (1994; not included in Table 1) is (almost)

correct. Finally it should be noted that the boundary sites which should be corrected in our 1979-1996 electron micrograph maps (references in Saura *et al*., 1997) are not included here.

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