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**Effect of Super-Centrifuging on the Fission Rate of Paramecium.**

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McClendon<sup>1</sup> reported that prolonged centrifuging (585 times gravity for 24 and 32 hours) increased the fission rate of paramecium. However, his experiments were extended to so few animals (6 experimental and 6 controls) and his controls divided so slowly (an average of 0.11 per day), and had such a high mortality (only one survived the whole period of the experiment) that some doubt has been cast on the validity of his conclusions.<sup>2</sup>

In the present investigation higher centrifugal forces (21,000 and 32,000 times gravity) were employed but for shorter periods (one to 45 minutes). The apparatus used was the Sharples Super-Centrifuge, hence the treatment is referred to as "super-centrifuging." The form experimented on was *P. multimicronucleata* obtained from Prof. L. L. Woodruff of Yale University. Over a hundred individual lines were followed but only the average division rate of each set of super-centrifuged animals is given in the table. The number of animals in each set varied from 3 to 20. The individual organisms and their controls were maintained in 0.025% beef extract solution according to the method of Woodruff and Baitsell<sup>3</sup>. The duration of the experiments was from one to 39 days.

The results are given in Table I in which are recorded minutes of super-centrifuging, days of survival of the individual lines, average fission rate of each set of super-centrifuged animals and their controls during the first 24 hours after treatment, during the first 5 days, and during the whole period of observation when this extended beyond 5 days. The reason for this division was to ascertain whether the immediate effect of super-centrifuging might be to stimulate division as McClendon found, because the majority of his divisions occurred during the first 5 days after treatment. A further division of the experimental animals into "Normals" and "Abnormals" is made on the basis of absence or presence of visible morphological changes in them following super-centrifuging. Where the same controls were used for more than one set of experimental

<sup>1</sup> McClendon, J. F., *J. Exp. Zool.*, 1909, **6**, 265.

<sup>2</sup> Dobell, C., *J. Gen.*, 1914, **4**, 131.

<sup>3</sup> Woodruff, L. L., and Baitsell, A., *J. Exp. Zool.*, 1911, **11**, 135.

animals (as happened when more than one batch were super-centrifuged on the same day) they are counted only once in the averages. The values for the "Normals" and "Abnormals" are combined and the rates for the 3 periods are averaged.

TABLE I.  
*Fission Rate of Super-centrifuged Animals and Controls.*

Minutes Super-centrif.	Days Survival	First 24 Hours			First 5 Days			Total Period of Observation		
		Norm.	Abnor.	Cont.	Norm.	Abnor.	Cont.	Norm.	Abnor.	Cont.
1	6	1.00	3.00	2.30	1.20	1.40	1.32	1.00	1.20	1.26
2	39	0.70	0.00	1.00	1.00		1.14	1.12		1.28
3	38		0.00	0.00		0.40	1.14		1.16	1.25
5	2	2.60	1.60	1.00						
10	30	3.00	1.00	1.00		1.16	1.34		1.21	1.28
15	26	1.10	1.00	2.00		1.16	1.32		1.11	1.30
20	21	3.00	2.00	1.40		1.24	1.26		1.19	1.42
25	3		0.80	1.00						
30	3		0.00	1.70						
45	6	0.00	1.00	0.60		1.84	1.02		1.79	1.10
Aver.*		1.19	0.72	1.27	0.90	1.03	1.23	1.06	1.14	1.25
Combined av.*		0.95			0.96			1.10		

\* These averages represent 20 experiments of which samples only are given in the table.

From these results it appears that the effect of super-centrifuging is in general to lower slightly the fission rate of paramecium. This is true not only during the entire period of observation (77% of cases) but also during the first 24 hours (65%) and during the first 5 days after treatment (75%). This lowering of the fission rate seems to be due to an internal disorganization of the cell because it happened in both "Normals" and "Abnormals" and persisted in the latter even after all visible structural defects due to the treatment had disappeared. However, this change cannot be regarded as a mutation because the longer the lines persisted after super-centrifuging the nearer the rate approached that of the controls. It may be what Jollos<sup>4</sup> calls an "enduring modification", that is, one which persists for some time but not permanently.

<sup>4</sup> Jollos, V., *Biol. Zentralbl.*, 1913, **33**, 222.