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Sex of Parabiotic Twins of Ambystoma Maculatum (Shaw).*

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Since Burns published his paper on "the sex of parabiotic twins in amphibia,"[1] it has been found difficult to reconcile his statements and his general conclusions with the results of other experimental studies in sex development of vertebrates. He alleged that everyone of 80 pairs of *Ambystoma maculatum* joined in parabiosis at the tailbud stage had developed into unisexual twins, 36 being of the female and 44 of the male sex. The absence of heterosexual combinations was said to suggest that embryonic sex differentiation is a hormone controlled reaction of the "all or none" type. Moreover, the approximate 1 : 1 ratio of male and female pairs was taken as an indication "that there is no prepotency constantly favoring either sex," but that in genetically heterosexual pairs the first differentiating member governs also the development of its mate so as to develop into the identical sex. In contrast to this, Witschi[2] and Witschi and McCurdy[3] found in parabiotic frogs and newts a clear ratio of 1♂♂:2♂♀:1♀♀. In cases of secondarily induced sex reversal the male sex predominated. Later Burns[4] reported new experiments with *Ambystoma tigrinum* that gave results corresponding closely to ours. However, he still upholds the accuracy of his original statements with respect to *Ambystoma maculatum*. Differences of such fundamental character within one genus seemed extraordinary and since they were an obstacle to a rational interpretation of the whole body of experimental data, the authors were moved to repeat Burns' experiment with the same material—*Ambystoma maculatum* (Shaw), *syn. A. punctatum* (L) of New Haven, Connecticut. Though the investigation which was started in the spring of this year is not yet completed, it is already clear at this time that Burns must have misinterpreted his material. Of 41 pairs so far preserved nearly one-half represent heterosexual combinations. The result is 7♂♂:18♂♀:16♀♀.

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[1] Burns, R. K., *J. Exp. Zool.*, 1925, **42**, 31.

[2] Witschi, E., *Biol. Bull.*, 1927, **52**, 137; *J. Exp. Zool.*, 1931, **58**, 113.

[3] Witschi, E., and McCurdy, H. M., PROC. SOC. EXP. BIOL. AND MED., 1929, **26**, 655; Witschi, E., PROC. SOC. EXP. BIOL. AND MED., 1930, **27**, 763.

[4] Burns, R. K., *J. Exp. Zool.*, 1930, **55**, 123; 1931, **60**, 339.

In the heterosexual pairs the following conditions are met with: (1) In 3 cases the female had developed faster than the male twin; consequently typical ovaries (though of slightly subnormal size) are present near the end of the larval period. (2) In several cases (about 6) the ovaries were topographically typical, but the cortex contained a reduced number of germ cells of which few or none had entered the ovocyte stage. (3) In nearly half the cases (8) the ovaries were only small vestiges, sterile, or containing few abnormal germ cells (free-martin effect). (4) Feeble attempts at sex reversal were observed in only 2 of these female gonads. (5) the testes of the male twins are at best slightly smaller. In some cases (about 4), however, they were found considerably smaller than in ♂♂ pairs of corresponding size and age, or in single controls. In this respect *Ambystoma maculatum* resembles more closely the conditions previously reported for frogs (Witschi[2]) than those of the California newt (Witschi and McCurdy[3]). In the latter a more decided reciprocal inhibition of the testicular development has been found. In every case, however, facts are in disagreement with Burns'[4] conclusion that "the male usually dominates because of a differential stimulative effect of the anterior hypophysis accelerating development of the testis"—the latter supposedly being "doubly stimulated" in heterosexual pairs. (6) Male twin mates of females with relatively well developed ovaries in a few cases (4) exhibit hermaphroditic features not observed to this extent in the 7 ♂♂ pairs nor among the single controls (58 males plus 41 females). As in some similar cases of heterosexual pairs of frogs (Witschi[2]), the early developing ovaries obviously have retarded the testicular differentiation of the co-twin, giving its cortex a chance to develop in the female sense. No trace of male-female sex inversion, i. e., no transformation of testicular into ovarial tissues has ever been observed.