DEVELOPMENT OF MOUSE AND RAT ZYGOTES FOLLOWING TRANSFER TO NON-SYNCHRONIZED RAT AND MOUSE OVIDUCTS

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It has repeatedly been observed that transfer of zygotes, two-cell stages or blastocysts to the oviduct of a recently mated mouse leads to implantation and subsequent pregnancy (Bittner & Little, 1937; Tarkowski, 1959; Zeilmaker, 1968).

Studies *in vitro* have shown that the development of the mouse zygote to the blastocyst stage is frequently hampered by a failure to pass the two-cell stage (Whittingham, 1966). For this critical phase in the development, the ampullar region of the mouse oviduct must be present, either *in vivo* (Whittingham, 1968a; Cross & Brinster, 1970) or *in vitro* (Biggers, Gwatkin & Brinster, 1962; Whittingham, 1968b, c).

The question arises whether the critical contribution of the oviduct is dependent on the hormonal conditions prevailing after oestrus, since Whittingham (1968c) demonstrated, in explantation studies with oviducts containing zygotes, that the cycle stage at which the oviducts were explanted influenced egg development.

The present study is concerned with the early development of mouse and rat zygotes after their transfer to the oviducts of prepuberal, cyclic and pregnant mice and prepuberal rats. Mouse zygotes were collected from Swiss mice between 13.00 and 15.00 hours on the day a vaginal plug was found. The oviduct was flushed with modified Krebs-Ringer solution containing pyruvate (Biggers, Whittingham & Donahue, 1967). Rat zygotes (Wistar strain) were obtained in a similar way. Recipients were prepuberal (closed vagina), cyclic (3 to 4 months old), and pregnant (Day 6 or Day 7) (C3Hf × DBAf)_{F1}, C3Hf or Swiss mice, and prepuberal Wistar rats. As there was no difference between the recipient mice, the combined results obtained with these strains are presented. Between 15 and 30 min after collection, the zygotes were transferred to the left oviduct by means of a mouth-blown pipette (Noyes, Doyle, Gates & Bentley, 1961) under Nembutal sedation. The zygotes with adhering granulosa cells were transferred with as little additional fluid as possible. Occasionally, a small air bubble was also blown into the tube; however, no harmful effects were seen. Embryos were recovered 72 or 96 hr after their transfer by flushing the oviduct and uterus.

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In order to ascertain whether mouse and rat morulae which were recovered after 72 hr would develop into blastocysts, a 12- to 24-hr period of incubation in 100- μ l droplets of pyruvate containing medium (Biggers, Whittingham & Donahue, 1967) under paraffin oil (5% CO₂ in air) was instituted, following isolation. The observations on zygote development are presented in Table 1. The results show that synchronization of the oviduct is not a requirement for zygote development and that mouse and rat zygotes can develop in xenogeneic oviducts *in vivo*.

Some of the recovered morulae were transferred to the uterus of pseudo-pregnant hosts. Thirteen out of twenty-four mouse morulae and seven out of eleven rat morulae recovered from the oviducts of prepuberal mice, and seven out of eight mouse morulae obtained from rat oviducts developed into living

Table 1. Development of mouse and rat zygotes following transfer to a non-synchronized mouse or rat oviduct

Donor	No. and status of recipients	No. of zygotes transferred	No. of morulae* recovered/total no. of embryos recovered
Swiss mice	8 prepuberal mice	36	17/24
	3 oestrous mice	22	20/20
	9 metoestrous mice	82	45/54
	5 dioestrous mice	36	11/12
	5 pro-oestrous mice	25	18/18
	3 pregnant mice, Day 6/Day 7	25	18/24†
	6 prepuberal rats	46	17/24
Rats	19 prepuberal mice	127	47/106‡

* Following a 12- to 24-hr period *in vitro*, thirty-four out of thirty-eight mouse morulae and thirteen out of seventeen rat morulae developed into blastocysts.

† Six of these eighteen embryos, recovered after 90 to 96 hr, were found to be in the blastocyst stage.

‡ Ten of these forty-seven embryos, recovered after 90 to 96 hr, were found to be in the blastocyst stage.

young. This indicates that the developmental potential of the eggs is normal. The number of degenerated and lost eggs is not indicated, but empty zonae and degenerated eggs were encountered in all groups. Apart from one morula obtained from the uterus of a recipient mouse, all rat and mouse morulae and blastocysts which developed in the oviduct of the prepuberal mice were recovered from the oviduct. It seems, therefore, that egg development proceeded without normal egg transport.

These observations may be of practical importance when further development of rat and mouse zygotes is required and synchronized recipients are not available. A similar independence from the endocrine status of the host was noticed by Brinster & Thomson TenBroeck (1969) and by Lawson, Adams & Rowson (1972) in a study on the development of mouse eggs (two-cell stage) and sheep eggs (two- to twenty-six-cell stage) in the oviduct of the rabbit.

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