The progesterone values were expressed in ng/ml. Study 2 was performed to measure blood prolactin concentration at 17.00–18.00 h on prooestrus and oestrus respectively following an injection of 1 mg bromocriptine at 11.00 h on prooestrus and oestrus respectively. Non-injected females served as controls. The prolactin level was determined using the anti-serum S6 and the reference preparation RP1, according to the double antibody radioimmunoassay procedure proposed by the NIAMDD. Radioiodinated ^{125}I-rat prolactin was prepared by New England Nuclear (37 µCi/µg). The intraassay and interassay variation coefficients were 8 and 11% respectively. All serum samples were assayed in triplicate in the same assay. The blood prolactin concentrations were expressed in ng/ml of the RP 1 preparation.

2-way analysis of variance, with orthogonal comparisons, after logarithmic transformation, was used for the statistical analysis of the data.

Results and discussion. As shown in the figure, blood progesterone concentration on dioestrus 1 at 11.00 h did not differ in the 3 groups of females injected with bromocriptine ($F^2_{25} = 2.97$; NS). Taken as a whole, progesterone values in bromocriptine-injected females did not differ from those observed in non-injected controls ($F^1_{25} = 2.05$; NS). Neither did these progesterone values in bromocriptine-injected females differ from those observed in tartaric-acid injected females ($F^1_{25} = 2.66$; NS) although, unexpectedly, a higher progesterone concentration was noted in tartaric-injected females than in non-injected controls ($F^1_{25} = 9.45$; $p < 0.001$). On dioestrus 1 at 17.00 h the blood progesterone concentrations did not differ in the different groups of animals ($F^4_{25} = 0.55$; NS). The table shows that prolactin values were completely depressed for 6 h following bromocriptine injection on eigher prooestrus or oestrus at 11.00 h.

Our observations clearly show that the surges of prolactin which take place on the afternoon of either prooestrus or oestrus are not needed for the function of the corpus luteum during the oestrus cycle in the rat. Bromocriptine treatment, which suppressed both surges, did not alter progesterone secretion at the time of the highest activity of the corpus luteum. These results are in keeping with those of Acker and Alloiteau[3] who showed in hypophysectomized female rats that prolactin was not necessary for luteal activity. For their part Döhler and Wuttke[4] using mated female rats on prooestrus also reported that the corpus luteum could function on the expected day of dioestrus in the absence of any surge of prolactin.

However the question remains as to whether LH is implicated in the control of the corpus luteum activity during the oestrous cycle in the rat. Unpublished results from our laboratory indicate that bromocriptine did not affect LH release on the afternoon of prooestrus. Therefore one may wonder whether the cyclic corpus luteum can actually develop its activity independently of any pituitary control on the day following prooestrus as suggested by in vivo experiments[3,7,8] or in experiments using granulosa cell tissue cultures[9]. Recently, Gallo[10] reported that LH level was higher on dioestrus 1 than on oestrus and dioestrus 2. Therefore the role eventually played by the tonic secretion of LH in the control of the luteal function in the cyclic female rat should be the subject of new investigation.

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3 G. Acker and J.J. Alloiteau, C. r. Seanc. Soc. Biol. *162*, 29 (1968).

4 K.D. Döhler and W. Wuttke, Endocrinology, *94*, 1595 (1974).

5 Cl. Aron, G. Asch and J. Roos, Int. Rev. Cytol. *20*, 139 (1966).

6 N. Boehm, M. Hassani, B. Kerdelhue and Cl. Aron, Biol. Reprod. *22*, 466 (1980).

7 K. Uchida, M. Kadowaki and T.I. Miyake, Endocr. jap. *16*, 227 (1969).

8 M.S. Smith, M.E. Freeman and J.D. Neill, Endocrinology *96*, 219 (1975).

9 T.M. Crisp, Endocrinology *101*, 1286 (1977).

10 R.V. Gallo, Biol. Reprod. *24*, 771 (1981).

Effect of progesterone administration on the number of delayed implantation blastocysts recovered from ovariectomized mice[1]

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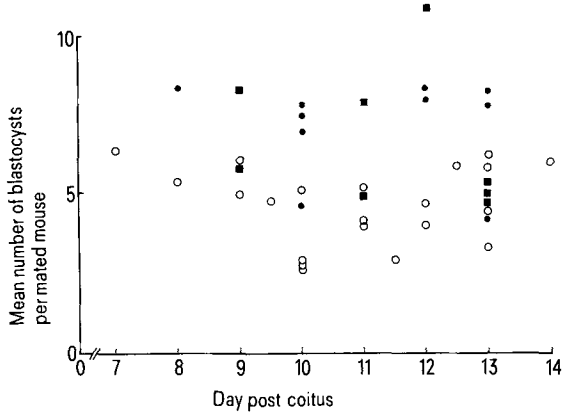
Summary. Experimental delay of implantation was induced by ovariectomizing mice on the 4th day after mating. On the 2 days preceding sacrifice, which was on days 7–14 of pregnancy, 3 groups of mice received a s.c. injection of either progesterone (2.0 mg) in oil, oil, or no injection. Progesterone administration significantly reduced the number of blastocysts recovered after flushing excised uteri with culture medium.

Progesterone treatment of ovariectomized mice appears to metabolically alter the delayed implantation blastocysts they contain. Embryos from steroid-treated mothers accumulate ^{14}C-amino acids more slowly than blastocysts from mice not given progesterone[2]. Administration of progesterone also seems to alter the capacity of delayed implantation blastocysts to convert exogenously supplied glucose into CO_2[3]. Moreover, progesterone treatment appears to increase the viability of delayed implantation blastocysts as measured by their ability to grow into normal fetuses upon transfer to surrogate mothers[4]. Alternatively, progesterone might selectively kill or promote the survival of embryos that are metabolically different from those that survive in the absence of progesterone injection, rather than affecting all embryos in a similar manner[2–4]. In the present study we show that the number of diapausing blastocysts obtained by usual techniques is altered by injecting their mothers with progesterone.

Effect of ovariectomy and progesterone administration on the number of preimplantation blastocysts recovered from pregnant mice

Group of mice	Number of experiments	Total number of female mice		Mean number of blastocysts recovered per mouse per experiment + SE	
Intact	8	92		10.80 ± 0.66	p < 0.01
Ovariectomized (no injection)	11	142		7.26 ± 0.56	n.s.
Ovariectomized (oil injection)	8	103	p < 0.01	6.56 ± 0.66	p < 0.02
Ovariectomized (progesterone injection)	21	372		4.64 ± 0.41	

Materials and methods. Sexually mature ICR Swiss mice (8–13 weeks old) were induced to ovulate and mate by i.p. administration of pregnant mare's serum gonadotropin (5 IU) followed 48 h later by 5 IU human chorionic gonadotropin[5] (Sigma Chemical Co.). Delay of implantation was induced by ovariectomizing mice under pentobarbital anesthesia before noon on day 4 post coitus (day 1 p.c. was the day of copulatory plug detection). 3 groups of ovariectomized mice received either a s.c. injection of 2.0 mg of progesterone dissolved in 0.1 ml of peanut oil, 0.10 ml of peanut oil or no injection on the 2 days preceding sacrifice. All ovariectomized mice were sacrificed on days 7–14 of pregnancy, their uteri excised and then flushed with Dulbecco's modified Eagle medium (GIBCO) as described previously[2,6,7]. The embryos thus obtained were used in other experiments. No special precautions were taken during flushing since our goal was to determine if the number of embryos would be altered with a commonly used protocol[2–4,6–8] for obtaining diapausing blastocysts. Blastocysts from normal pregnancies were obtained at approximately 86 h p.c. In each experiment 4–39 mice were sacrificed at approximately the same time, their uteri excised and placed together in culture medium to await flushing into the same depression of a Maximov slide. Thus, a mean number of embryos per mouse could be calculated in each experiment. The mean number of blastocysts obtained per mouse ± the SE for 8 or more experiments is reported in the table. Analysis of variance coupled with a multiple range test for unequal sample sizes was used to analyze the data statistically[9].



Relationship between the mean number of blastocysts per mated mouse in each experiment and the day post coitus on which ovariectomized mice were sacrificed. Mice were injected with progesterone in oil, ○; oil, ■; or received no injection, ●; on the two days preceding sacrifice.

Results and discussion. The day of pregnancy on which ovariectomized mice were sacrificed did not affect the number of embryos obtained (fig.). However, it has been shown that fewer diapausing blastocysts are obtained when delay of implantation is extended to 20 or 30 days p.c.[4]. Recently, Fisher and Macpherson[10] found that the number of diapausing embryos per mouse decreased dramatically between days 6 and 12 p.c. In the latter study mice had been superovulated and thus contained an average of 29.03 blastocysts per pregnant mouse initially (26.13 embryos per mated mouse) while our mice were merely ovulated (10.80 blastocysts per mated mouse, table). We were, therefore, less likely than Fisher and Macpherson[10] to observe a decrease in the number of embryos per mouse as the length of diapause increased because a) we started with fewer embryos per mouse and b) the number of embryos per mouse seems not to decrease below approximately four even when delay of implantation is extended to 30 days p.c.[4].

Progesterone administration significantly reduced the number of diapausing blastocysts obtained from mice after experimental induction of delay of implantation (table). In a previous study it was reported that progesterone administration did not alter the number of blastocysts recovered[4]. In the later report the number of embryos recovered on day 10 of pregnancy was reduced by approximately 1.7 embryos per mouse following progesterone treatment. However, this was not a statistically significant reduction[4] probably because the SE were larger than in the present study (table). Our SE may be smaller because the total number of mice in each group in the present study (table) was more than 3 times the total number of mice in each group sacrificed on day 10 of pregnancy in the previous study[4]. Progesterone administration causes the uterine lumen to close tightly[11–14]. Thus, some embryos may have been lost because of the greater shearing that could have occurred when embryos were flushed from the uterus of progesterone-treated mice. However, since excised uteri were placed in incubation medium for approximately 10 min before being flushed, the closure of the uterine lumen may have been reduced. It is also possible that progesterone had other direct or indirect effects on delayed implantation embryos in utero somehow making them more difficult to obtain. Blastocysts with an intact zona pellucida would be protected from shearing during flushing and this, as well as hormonal factors, could account for the higher number of blastocysts recovered from mice during normal pregnancies (table). Moreover, anesthesia, surgery and/or trauma to the reproductive tract during ovariectomy may have caused loss of embryos relative to intact control mice (table). A similar reduction in the number of blastocysts after ovariectomy was detected by Fisher and Macpherson[10].

Regardless of the reason(s) for the progesterone-induced decrease in the number of delayed implantation blastocysts recovered, it is now important to determine if progesterone causes a selective loss of blastocysts which are metabolically different from those that survive. If progesterone causes the selective loss of less viable embryos which appear to be more metabolically active, then administration of this hormone may not alter all delayed implantation blastocysts in utero as suggested by previous data[2-4]. It would be advantageous if only those embryos that could develop into normal fetuses implanted in the uterus following delay of implantation. If progesterone treatment causes the selective loss of less viable embryos then this could help insure that energy is invested for the production of more normal fetuses. It is interesting that the proposed loss of less viable embryos is coincident with the progesterone-priming of the uterus required before estrogen can induce nidation of diapausing blastocysts[4]. However, since we can know nothing about embryos that may have been lost because of progesterone treatment, further studies are required to determine if this population of 'lost' embryos is different from the embryos obtained. If they are different, it also remains to be determined whether they would enhance or diminish the differences previously observed[2-4] for embryos obtained from mice which had or had not received progesterone.

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2 D. Dabich and L.J. Van Winkle, Experientia *36*, 253 (1980).
3 H.M. Weitlauf, J. Reprod. Fert. *39*, 213 (1974).
4 H.M. Weitlauf, J. Endocr. *51*, 375 (1971).
5 R.E. Fowler and R.G. Edwards, J. Endocr. *15*, 374 (1957).
6 L.J. Van Winkle, J. exp. Zool. *218*, 239 (1981).
7 R.L. Brinster, Adv. Biosci. *4*, 199 (1970).
8 H.M. Weitlauf, J. exp. Zool. *183*, 303 (1973).
9 C.Y. Kramer, Biometrics *12*, 307 (1956).
10 P.S. Fisher and J.W. Macpherson, J. Reprod. Fert. *64*, 33 (1982).
11 L. Martin, C.A. Finn, and J. Carter, J. Reprod. Fert. *21*, 461 (1970).
12 K. Hedlund and O. Nilson, J. Reprod. Fert. *26*, 267 (1971).
13 D.R.S. Kirby, The Biology of the blastocyst, p.393. Ed. R.J. Blandau. University of Chicago Press, Chicago 1971.
14 M.I. Sherman and L.R. Wudl, in: The cell surface in animal embryogenesis and development. p.81. Eds G. Poste and G.L. Nicolson. Elsevier/North-Holland Biomedical Press, Amsterdam 1976.

What is a lefthander?

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Summary. Attributes of lefthanders and lefthandedness were examined and 3 etiologies of lefthandedness were proposed.

The etiology of handedness has been the subject of scientific and quasi-scientific investigation for at least a century[2], and yet handedness remains one of the few behaviors for which the nature-nurture controversy has not been put to rest. Recent opinions as to its etiologies have included a single gene[3], polygenic inheritance[4], gene-environment interactions[5], and environmental influences[6]. We believe the major obstacle in this investigative area is the assumption that there is an archetypic 'lefthander'.

There are 'righthanders'. There is agreement that between 85 and 90% of adult humans use the right hand for most digital manipulations and for all verbal activity, that between 90 and 95% of humans perform verbal processing in the left cerebral hemisphere, and that muscle control takes place in the hemisphere contralateral to the side being controlled[7,8]. Typical righthanders are examples of efficiency of operation which may be parsimoniously explained: They write with the right hand because they are left hemisphere verbal processors[9] i.e., no interhemispheric transfer required, and they perform non-verbal digital manipulations with the right hand because it receives the most practice in fine motor movements. Human behaviors are not rigidly programmed and therefore require initiation and continuous decision-making processes that would be extremely inefficient under simultaneous bilateral hemisphere processing[10].

Lefthanded individuals do not fit into a single, neat, phenotypic or genotypic classification. They are different from righthanders, but more important, they are different from other lefthanders and should not be lumped into a single category. We realize handedness has been considered a continuum based on the number of tasks performed with each hand, but that assumes a qualitative equality of verbal and nonverbal tasks.

Lefthanders are inferior. It has been known for at least 60 years that lefthandedness is overrepresented in populations of children with 'cognitive deficit'[10-13]. In a longitudinal study of 455 children[11], righthanded children performed significantly better than children at 4 years and 6.5 years in several verbal and performance tests. Similar results were obtained with males[12], mean age 20.3 years, but the righthanded subjects only achieved significantly higher scores than inverted lefthand writers, those who write with the hand curved inward; righthand and noninverted lefthand writers were not noticably different. Lefthanders who are forced to use the right hand for writing may account for at least 50% of the stammerers in our society[9], and lefthanders comprise close to 20% of the total mentally retarded population and 28% of the severely and profoundly mentally retarded population, compared to slightly less than 10% of general populations[13].

Lefthanders are superior. There are few studies of gifted or superior subjects, in part because these individuals rarely congregate in groups. One exception is Mensa, the organization for individuals scoring in the 95th percentile or above on standardized IQ-tests. Hand preference of mem-