AN ANNUAL RHYTHM IN THE SEXUAL ACTIVITY OF THE MALE RHESUS MONKEY, *MACACA MULATTA*, IN THE LABORATORY

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(Received 13th July 1970)

Many mammalian species breed seasonally and alterations in the physical environment provide the necessary stimulation. Zuckerman (1932) stated the case for the existence of an uninterrupted sexual life in monkeys and apes, but evidence has since accumulated that establishes breeding with annual rhythmicity in several primate species (Lancaster & Lee, 1965). In the rhesus monkey, a peak of births has been reported between March and May both in North India (Southwick, Beg & Siddiqi, 1961; Prakash, 1962; Lindburg, 1967) and also in the islands near Puerto Rico (Altmann, 1962; Koford, 1965). A survey of the breeding activity of rhesus monkeys in the laboratory shows different findings in different colonies (Ponce de Lugo, 1964), but there is considerable agreement that a similar birth peak occurs in captivity between March and April (Hartman, 1931; Rowell, 1963; Wisconsin data, 1966, quoted by Eckstein & Kelly, 1966). The existence of an annual (here we avoid the term 'seasonal') rhythm in sexual performance and motivation has been difficult to establish with certainty because of the annual disturbance caused by pregnancy and by the birth of young: since pregnancy decreases receptivity (Michael & Zumpe, 1970), this periodically restricts the availability of receptive female partners. We report here on annual changes in the ejaculatory performance of male rhesus monkeys when paired with intact females whose Fallopian tubes had been ligated to prevent pregnancy.

Thirty adult rhesus monkeys obtained from Northern India were studied, fifteen males and fifteen females, and each of the males was tested with up to three female partners making twenty-eight paired combinations. Animals were housed together in the same cage room in individual cages (except when being tested) and fed the same diet throughout (Michael & Saayman, 1967). Temperature was maintained between 65 and 75° F by air-conditioning: the temperature was recorded continuously by a thermograph and remained within these limits for 92% of the year. The mean of the midday and midnight temperatures for January was $67.2 \pm 0.4^\circ$ F and that for August was $67.3 \pm 0.8^\circ$ F. Lighting was controlled by a time-clock which switched on at 06.15 and off at 20.15 hours giving a 14-hr day: this was supplemented by natural daylight in midsummer which gradually extended the daylength by up to 2 hr between mid-June and

mid-July. Thus, although exteroceptive factors were not rigorously controlled, the seasonal changes in temperature and illumination were quite small. Behaviour testing and scoring methods have been described elsewhere (Michael & Saayman, 1967): tests were of 1-hr duration, during which a male and female were paired together and observed from behind one-way vision mirrors. Males were not tested with females more than once daily. Data were obtained from 1156 tests conducted during a 5-year period from January 1965 to December 1969. While observations were made on many behavioural parameters we report here only the changes in the ejaculatory performance of males during different months of the year.

TEXT-FIG. 1. A well marked maximum in the number of ejaculations per test occurred in December. Low levels between February and May coincide with the natural birth season in North India (hatched columns: Southwick *et al.*, 1961). Births cannot account for the decline in the activity of males in the laboratory colony as the Fallopian tubes of females were ligated to prevent pregnancy. (Gestation = $5\frac{1}{2}$ months.) N = number of tests (1156); n = number of pairs. Vertical bars give S.E. of means.

Text-figure 1 shows the changes in the mean numbers of ejaculations per test by fifteen males in a total of twenty-eight paired combinations during different months of the year. There was a well-marked maximum in ejaculatory activity during December which contrasted with low levels in the period, February to May. The mean for November to January, the peak mating period in India, was significantly greater than that for March to May, the peak birth period in the wild (*t* test, $P < 0.001$): there were no significant differences between February, March, April and May (analysis of variance, $F = 2.25$; d.f. 3, 511; $P > 0.1$). These laboratory findings agree quite closely with those from field studies that describe a peak in mating activity in North India during November to January (Southwick, Beg & Siddiqi, 1965; Lindburg, 1967), in Cayo

Santiago during September to November (Conaway & Koford, 1964; Kaufmann, 1965), and in La Parguera during November to December (Vandenberg & Vessey, 1968). It is, perhaps, noteworthy that the peak in the ejaculatory activity of males in our laboratory colony in London coincides with those reported in geographically widely separated free-ranging groups. The decline in male sexual activity in the period February to May (Text-fig. 1) occurred although reproductively active females with regular menstrual cycles (Keverne & Michael, 1970) were available as partners and this period coincides with, but clearly cannot be due to, the birth season and period of gestation in feral rhesus monkeys (Southwick *et al.*, 1961). It is also improbable that the sexual rhythmicity of males described here was determined primarily by ecological factors such as seasonal changes in rainfall and vegetation. Testicular regression in rhesus monkeys, however, has been reported to be maximal between February and May, an increase in tubular diameter and testicular size occurring between September and December (Conaway & Sade, 1965); and it is quite possible that such gonadal changes could account for these annual fluctuations in male behavioural activity. The problem is being further studied by measuring annual changes in the levels of plasma androgens and by pairing males with ovariectomized females maintained on constant oestrogen treatment throughout the year.

This work was supported by grants from the Medical Research Council and the Population Council which are gratefully acknowledged.

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