The suspension of inorganic phosphates was filtered through a Millipore filter. The solid was washed with 10 ml of distilled water, then with 10 ml of 95 percent ethanol, and then with 100 ml of absolute ethanol. The solid was finally dried in a vacuum over silica gel for several hours. The dried mixture of phosphates was then analyzed for ammonia by a micro-Kjeldahl method (*9*). Finally, x-ray powder photographs of the solids were taken and compared with those of struvite, hydroxylapatite, and the amorphous phosphate that is precipitated when sodium phosphate is added to seawater. The results of the precipitation experiments are shown in Table 1.

According to Bada and Miller, the concentration of NH_4^+ in the primitive oceans when life began is likely to have been in the range from 10^{-3} to $10^{-2}M$ (*10*). Other authors have questioned whether so much ammonia could have been present (*11*). If the interpretation of Bada and Miller is correct, the concentration of NH_4^+ in evaporating tide pools may have been $10^{-2}M$ or even higher. We have shown here that under those circumstances struvite would have precipitated rather than hydroxylapatite or the more soluble amorphous calcium phosphate. We emphasize that the precipitation of struvite does not represent an equilibrium process; hydroxylapatite is much less soluble than struvite but cannot form in the presence of Mg^{2+}.

If ammonia was abundant on the primitive earth, the evaporation of prebiotic lakes or tide pools could have led to the formation of solid films containing struvite, urea, and other organic compounds including, perhaps, nucleosides and nucleotides (*5*). Then phosphorylation would certainly have occurred at the temperatures reached by dark-colored rock surfaces in strong sunlight. [Temperatures up to 90°C have been recorded in deserts (*12*). We do not have corresponding values for tropical shorelines, but we think it likely that the temperature exceeds 65°C in many places.] We believe that this interpretation provides an attractive mechanism for the prebiotic synthesis of nucleotides such as uridine 5′-phosphate and, particularly, of nucleoside diphosphates such as uridine 5′-diphosphate on the primitive earth.

These considerations lead to one further speculation. All living cells are rich in K^+ and poor in Na^+, although Na^+ is much more abundant than K^+ in the inorganic environment. We would like to suggest the possibility that the K^+ in contemporary organisms replaces NH_4^+ that was present in the Precambrian organisms. The isomorphism of many NH_4^+ and K^+ salts is well recognized, and it is a striking fact that NH_4^+ can replace K^+ in protein synthesis, although NH_4^+ is toxic to most contemporary cells. If this hypothesis is correct, then the possibility that struvite was important for the origins of life becomes particularly attractive. Struvite would have provided the major intracellular inorganic ions, other than chloride, for primitive cells. The fact that substantial amounts of K^+ can replace NH_4^+ isomorphously in struvite (*13*) allows us to understand how a continuous transition from a biological system rich in NH_4^+ to one containing K^+ could have taken place when the atmosphere became oxidizing and ammonia began to disappear from the surface of the earth. Nowadays struvite occurs only in association with organic matter, for example, in bat caves and canned fish (*14*).

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Sexual Differentiation of Pituitary Function: Apparent Difference between Primates and Rodents

Abstract. *Surges in luteinizing hormone secretion resembling those which occur spontaneously during the menstrual cycle were induced by acute elevations in circulating estrogen concentrations in both male and female rhesus monkeys gonadectomized in adulthood. These experiments demonstrate that in primates, in contrast to rodents, exposure of the hypothalamohypophyseal unit to androgens throughout fetal and postnatal development does not prevent the differentiation of the control system that governs cyclic gonadotropin secretion.*

The control of gonadal function in all mammals is mediated by the secretion of follicle-stimulating hormone (FSH) and luteinizing hormone (LH) by the anterior lobe of the pituitary gland. In a number of species, including man, the secretion of these hormones in males is relatively constant (tonic), whereas secretion of these gonadotropins in females is cyclic, characterized by periodic discharges (surges) that eventuate in ovulation (*1*).

In the rat, gonadotropin secretion by the pituitary is governed by two hypothalamic control systems, one regulating tonic secretion, the other governing cyclic release of the preovulatory gonadotropin surge (*2, 3*). Both systems are normally operative in the female, but the cyclic system appears to be nonfunctional in the male (*1, 2*). This sexual difference in the rat is attributable to an irreversible organizing action of testicular androgens during a critical period of neural differentiation (*1, 2*).

In the adult female rat, a daily signal, coupled to the diurnal light-dark cycle, is transmitted to the control system for cyclic gonadotropin secretion but is relayed only when concentrations of circulating estrogens are elevated (*3, 4*). Thus, estrogen administration to ovariectomized rats will result in LH surges at the appropriate time of day (*5, 6*). This response to estrogen cannot be elicited in male rats castrated in adulthood or in females exposed to androgen during the neonatal period, but can be evoked in male rats cas-

trated at birth (*6*). Therefore, exposure of the undifferentiated rat hypothalamus to androgen abolishes the capacity of the cyclic system to respond to the stimulatory action of estrogen, although the neural pathways for the transmission of the signal generated by the cyclic system are demonstrable by electrochemical stimulation (*7*).

A determinant role of early androgen exposure in programming the sexual differentiation of the central nervous system has also been established in the mouse (*8*), the hamster (*9*), and the guinea pig (*10*); and it has been tempting to extrapolate this phenomenon to the higher primates. Attempts to demonstrate such an organizing influence of androgen in primates have been uniformly unsuccessful. The administration of large doses of testosterone to female monkeys on the day of birth failed to modify normal ovarian cyclicity after puberty (*11*), but it may be argued that the androgen-sensitive period in the monkey, like that in the guinea pig (*10*), occurs before birth, and that the treatment impinged on an already differentiated hypothalamus. However, repeated administration of testosterone beginning as early as day 24 of pregnancy (average gestation is 168 days) was equally ineffective in this regard despite pronounced morphologic and behavioral masculinization (*12*). Similarly, pregnancies have been reported in human pseudohermaphrodites virilized by endogenous or exogenous androgens (*13*); however, even in these experiments of nature, the possibility remains that the hormonal environment of the normally developing male fetus was not faithfully replicated.

We examined the role of androgens in the sexual differentiation of the primate gonadotropin control systems by using an alternative approach. In the primate menstrual cycle, the preovulatory LH discharge is initiated by the antecedent rise in ovarian estrogen secretion (*14*); as in adult female rats, the administration of estrogen to women (*15*) or adult female rhesus monkeys (*16*) elicits an LH surge. If the hypothalamus of primates is subject to the same organizing influence of androgens as is that of the rat, this action of estrogen should be undemonstrable in the male rhesus monkey. In fact, intact adult male rhesus monkeys failed to respond to a regimen of estrogen administration which regularly evoked LH surges in adult females (*16*). In males castrated in adulthood, however, the injection of estrogen induced an initial reduction in the elevated plasma LH concentration, followed by a rebound to control concentration and a subsequent decline. This secondary rise in circulating LH resembled the LH surges induced in similarly treated ovariectomized females but was of smaller magnitude (*16*). These provocative results prompted us to perform the following study.

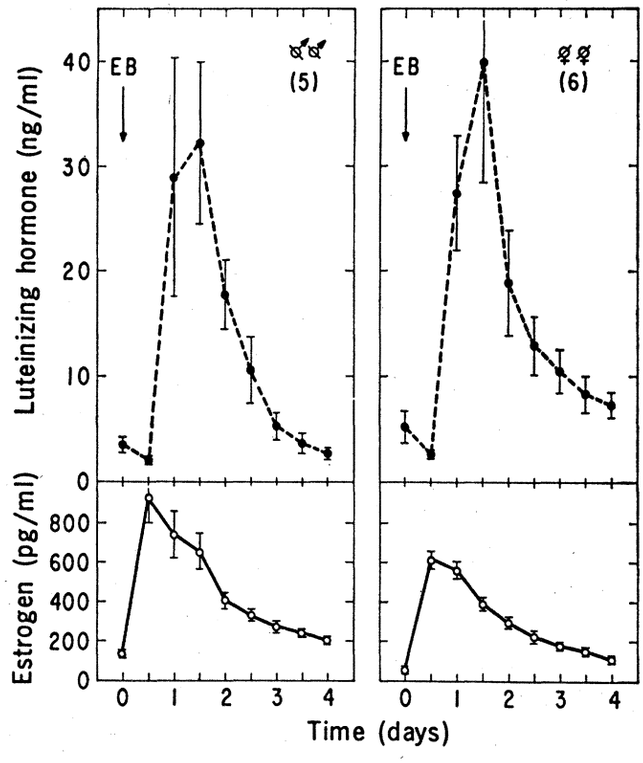

Fig. 1. Induction of surges of luteinizing hormone (LH) in gonadectomized male (left) and female (right) rhesus monkeys by the administration of estradiol benzoate (*EB*, arrow). Before estradiol benzoate was injected, plasma LH concentrations were suppressed by the subcutaneous implantation of Silastic capsules containing crystalline 17β-estradiol. Plasma concentrations of estrogen effected by these treatments are shown in the lower panels. The mean $\pm$ standard error is shown; the number of observations is in parentheses.

Silastic capsules containing crystalline 17β-estradiol were implanted subcutaneously into five male (average weight, 9.9 kg) and six female (5.3 kg) rhesus monkeys that had been gonadectomized when sexually mature; surgery preceded the experiment by 7 to 17 months. The preparation, method of insertion, and dynamics of estradiol release from these capsules are described elsewhere (*17*), as are the radioimmunoassays employed for the measurement of LH (*18*) and estrogens (*19*) in peripheral plasma. By varying the number of capsules implanted, the circulating concentrations of estrogen (60 to 150 pg/ml) were rigorously titrated to effect a chronic reduction of plasma LH concentrations from the elevated values characteristic of gonadectomized animals (*20*) to the low values normally observed in intact monkeys (*20, 21*). A single subcutaneous injection of estradiol benzoate in oil (42 μg per kilogram of body weight) was given 30 to 60 days after the initial estradiol implants were inserted. The resultant time courses in plasma LH and estrogen concentrations in the gonadectomized male and female monkeys are illustrated in Fig. 1. Within 24 hours after the increment in circulating estrogen imposed by the injection of estradiol benzoate, both groups responded by unambiguous discharges of LH. These responses were indistinguishable from one another and closely resembled, in both duration and magnitude, the spontaneous preovulatory LH surge observed during the normal menstrual cycle of female rhesus monkeys (*19, 21*).

The previously reported ineffectiveness of this dose of estradiol benzoate in inducing LH surges in intact males (*16*) could be explained by the presence of testosterone, which has been shown to block LH release in response to estrogen stimulation in the female rat (*22*), much as progesterone does in the female monkey (*14*). The difference between the responses of unsuppressed gonadectomized male and female monkeys to the stimulatory action of estrogen (*16*) appears to be a quantitative rather than a qualitative one, since the administration of larger doses of estradiol benzoate to castrated males does elicit LH surges completely com-

parable to those observed in ovariectomized females (*23*). In the present study, this quantitative difference appears to have been abolished by prolonged exposure to low estrogen concentrations.

Our observations lead to the conclusion that in the rhesus monkey, in striking contrast to the rat, the control system which initiates the secretion of the LH surge is equally competent in both sexes. Since the males studied were exposed to the normal circulating patterns of androgens from the time of conception to adulthood, the foregoing findings and considerations suggest that the schema for the sexual differentiation of the central nervous system of rodents, as it relates to the control of gonadotropin secretion, may not be applicable to primates, including man.

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Plant Taxonomy: Ultraviolet Patterns of Flowers Visible as Fluorescent Patterns in Pressed Herbarium Specimens

Abstract. *Pressed flowers, in herbarium specimens, show visible fluorescent patterns matching the invisible ultraviolet patterns that the flowers show in life. The technique is taxonomically applicable since it makes an important but usually neglected floral character readily demonstrable.*

We recently described a simple technique, ultraviolet video-viewing (*1*), whereby the ultraviolet patterns of flowers, ordinarily visible to insects only, can be observed by man. In essence, the technique consists of illuminating flowers with an ultraviolet light (300 to 400 nm), and viewing them with a television camera equipped with an appropriate ultraviolet-transmitting lens and filter. The ultraviolet pattern on the petals shows up in sharp black-and-white contrast on the video monitor.

While video-viewing herbarium specimens, in order to check on the persistence of ultraviolet patterns after death and desiccation, we noted that the patterns are indeed often preserved in pressed flowers, albeit with some attenuation, but, more interestingly, we found that in such flowers the patterns

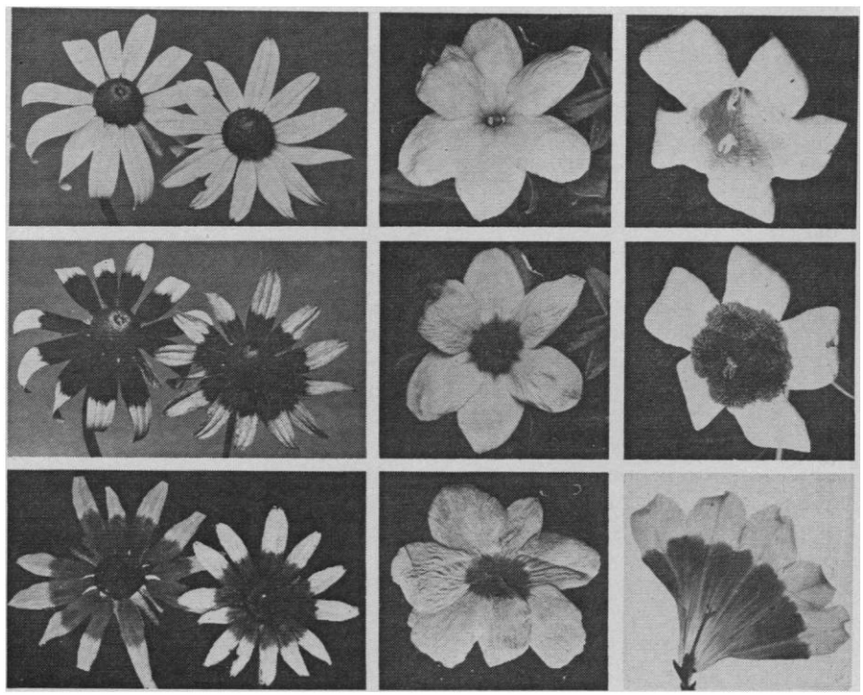

Fig. 1. Visible and ultraviolet patterns of fresh flowers, contrasted with the fluorescent patterns demonstrable after pressing. Horizontal rows: (top) visible patterns of fresh flowers, photographed on conventional film; (middle) invisible ultraviolet patterns of fresh flowers, photographed on ultraviolet-sensitive film; (bottom) visible fluorescent patterns of pressed flowers, induced by ultraviolet illumination, photographed on conventional film. Vertical rows: (left) *Rudbeckia hirta*; (center) *Jasminium mesnyi*; (right) *Gelsenium sempervirens* (corolla spread open in pressed specimen).