Naturally Occurring Primate Hybrid

Abstract. *Two members of a troop of wild* Macaca irus *in Malaysia have been tentatively identified as hybrids of* M. irus *and* M. nemestrina. *Mechanisms prohibiting such hybridization in the natural habitat may have broken down under heavy predation pressure which finally resulted in the local extermination of* M. nemestrina.

Two monkeys in a troop of *Macaca irus* in Kuala Lumpur, Malaysia, have been tentatively identified as hybrids of *M. irus* and *M. nemestrina.* Identification was made after several months of observation of the wild monkeys; they were then compared with two hybrids produced from the same species in the laboratory. The two wild specimens are members of a troop of 18 monkeys. One is an adult female, while the other is a nearly adult male who is the control male of the troop. All other males in the troop are less than 4 years old. A second troop of *M. irus* live in the same isolated forest but the two troops remain distinct. No other monkeys live in this forest. The youngest animal in the troop containing the hybrids was about 6 months old when the hybrids were discovered, and no further births occurred in the 4 months during which the troop was observed.

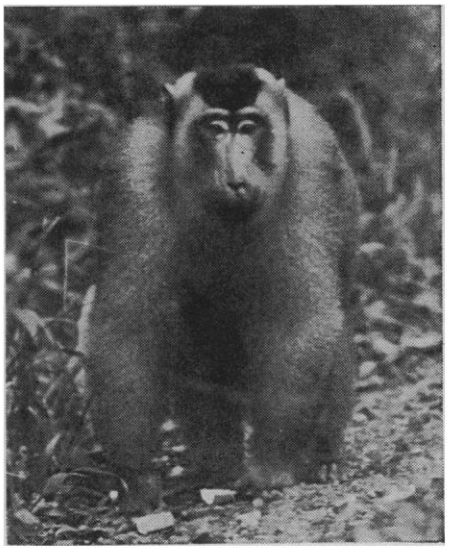
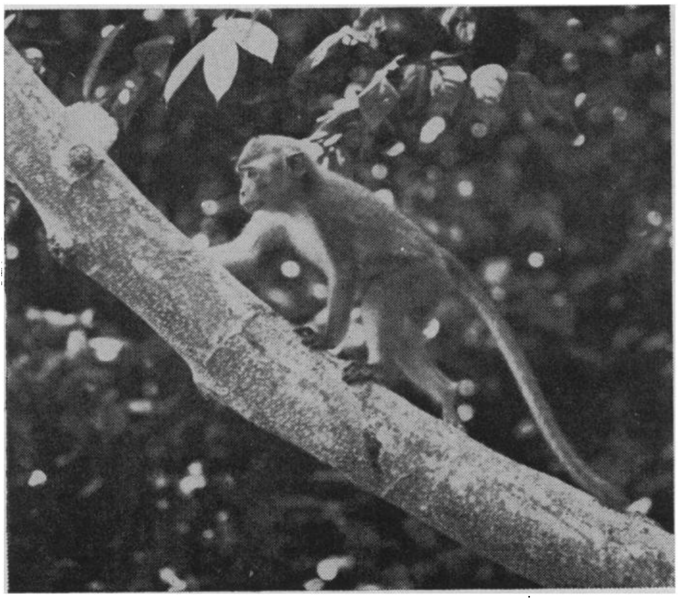


Fig. 1 (left). Adult male pigtail monkey (*Macaca nemestrina*) in a wild population 120 km from area where hybrids were discovered. The distinctive "pigtail," about 10 to 15 cm long, can just be seen over the animal's head. Estimated weight of this animal is 11 kg, which is about average.

Macaca nemestrina had formerly inhabited this forest but had been exterminated by local hunters and trappers. The two macaques are often found in the same forest but no hybrids are normally found; therefore hybridizing probably occurred only under the unusual conditions produced when the pigtail troop was being exterminated. Since male pigtails are usually killed off quickly by hunters, it is possible that at some point only one or two females of the pigtail troop survived and that these joined one of the two resident *M. irus* troops.

The discovery of these naturally occurring hybrids, who are between what appear to be two distinct species, is important for several reasons. First, the hybrids produced in captivity and never seen in the wild may indeed be produced in the wild if the habitat is sufficiently disturbed. Considering the degree to which natural habitats are indeed being disturbed, it should not be surprising that at times the habitat is disturbed in such a way as to produce a set of conditions, such as may be produced in the laboratory, under which hybridizing will occur. Second, it is necessary to be extra cautious in evaluating evidence of intergradation (*1*) in view of the fact that specimens may indeed be hybrids occurring under special disturbed conditions without regard to geographic boundaries. The variety of primate taxa which will hybridize in the laboratory (*2*) suggests that the genetic separation of many closely related taxa sharing the same geographic habitat depends on factors inherent in the natural habitat and that these factors may be disturbed in some cases, thus permitting hybridization.



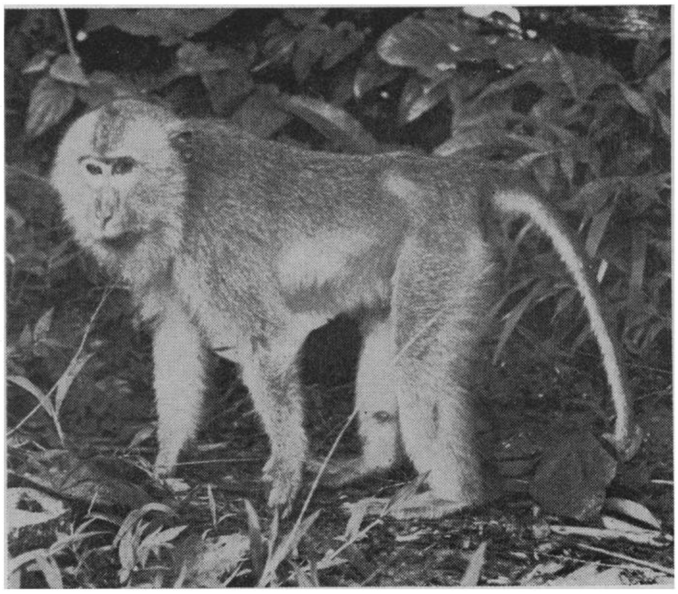


Fig. 2 (left). Adolescent male kra monkey (*Macaca irus*) in the same troop as the hybrids. Estimated weight of this animal is about 3.6 kg. Adult males usually weigh about 5.4 to 6.8 kg. Fig. 3 (right). Male identified as possible hybrid of *Macaca nemestrina* and *M. irus.* Note intermediate characteristics: size, tail length and carriage, shoulder hair, and facial ruff, and markings on crown.

The discovery of natural hybrids should be of great interest also inasmuch as it is a hybrid male which is now the sole adult male in the troop and which has been the sole potential breeding male for some time. The female hybrid, although fully adult, appeared to have had no offspring thus far, as judged from the condition of her nipples.

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References and Notes

1. J. Fooden, *Science* **143**, 3604 (1964).
2. S. Zuckerman, *Functional Affinities of Man, Monkeys and Apes* (Kegan Paul, Trench, Trubner, London, 1933).
3. Research supported by NSF grant G-3008 and NIH grant FR-00165.

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Solution Photochemistry of Thymine and Uracil

Abstract. *With dienes as specific triplet quenchers, it has been shown that the photodimerization of thymine in acetonitrile proceeds entirely through the triplet state and the photodimerization of uracil in acetonitrile or in water proceeds in part through the triplet state. The photohydration of uracil probably does not involve the triplet state. Efficiencies of intersystem crossing of thymine and uracil in acetonitrile were determined.*

We report here some observations concerning the mechanisms of the photochemistry of thymine and uracil in water (*1, 2*) and in acetonitrile. Photoreactions of both thymine and uracil were observed in degassed acetonitrile solutions at room temperature as judged by the disappearance of the characteristic ultraviolet absorption of the bases. The products in each case were dimers, as judged by infrared spectra (*3*), chromatographic properties (*3, 4*) and photoreversibility (*5*). The disappearance of substrate with irradiation time was examined for both thymine and uracil with and without added isoprene (*6, 7*).

The vertical triplet excitation energy for isoprene is 60 kcal/mole (*8*). The triplet energies of both thymine and uracil are greater than 70 kcal/mole (*9*). Thus isoprene should quench the triplet states of uracil and thymine at the diffusion-controlled rate. The bimolecular diffusion-controlled rate constant in acetonitrile near room temperature is about 10^{10} liter mole^{-1} sec^{-1}. Thus, at the lowest concentration of isoprene used ($0.7 \times 10^{-3}M$), virtually complete quenching of substrate triplets is expected if the triplets have lifetimes greater than about 10^{-5} second. Isoprene absorbs to the blue of uracil and thymine and thus is not expected to be an efficient quencher of their singlet states by an energy-transfer mechanism. Furthermore, even if there were singlet quenching processes which occur at the diffusion-controlled rate, the short lifetimes ($< 10^{-9}$ second) of the singlets (*10*) should preclude significant quenching by the isoprene at the concentrations used.

Typical results are shown in Figs. 1 and 2 which are graphs of first-order kinetics. Clearly, the photodimerizations of uracil and thymine in acetonitrile are quenched by small amounts of isoprene. With regard to thymine there is, for all intents and purposes, complete quenching. Therefore, we conclude that photodimerization of thymine in acetonitrile proceeds entirely by way of the triplet state. In the case of uracil there is a discontinuity. The reaction is incompletely quenched and furthermore a fourfold increase in isoprene concentration leads to the same amount of quenching. In addition, aeration gave the same results. Thus, we conclude that photodimerization of uracil proceeds by two mechanisms, and the path that is efficiently blocked by the isoprene involves the triplet state. It is not possible to decide at this time whether the unquenched uracil dimerization involves free uracil singlets.

Table 1. Triplet yields in acetonitrile, relative to that for triphenylene taken as 0.95 (*11*). Data obtained in degassed acetonitrile solution at room temperature; 2537-A excitation; *cis*-piperylene concentration 0.01 to 0.05*M*.

Compound	Conc. ($10^{-3}M$)	Φ_{isc}
Thymine	2	0.18
Thymidine	2	.12
1,3-Dimethylthymine	2	.02
Uracil	1.3	.40
Uridine	1.8	.30
1,3-Dimethyluracil	4.0	.08

Initial quantum yields for the disappearance of substrate were measured as 0.05 for $0.7 \times 10^{-3}M$ uracil in degassed acetonitrile, and as 0.005 with isoprene present; about 0.005 for $0.7 \times 10^{-3}M$ thymine in acetonitrile; about 0.00 with isoprene present; about 0.01 for $10^{-3}M$ uracil in degassed water; about 0.000 for $10^{-3}M$ thymine in degassed water.

The quantum yields of thymine

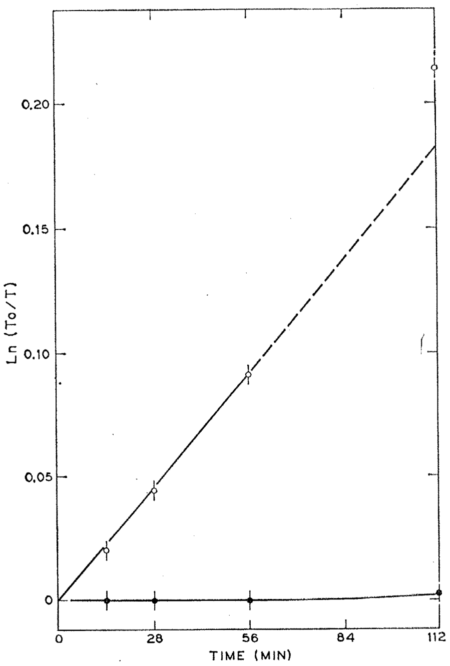

Fig. 1 (left). Photolysis of thymine ($0.7 \times 10^{-3}M$) in acetonitrile; ○, no isoprene; ● $0.7 \times 10^{-3}M$ isoprene.

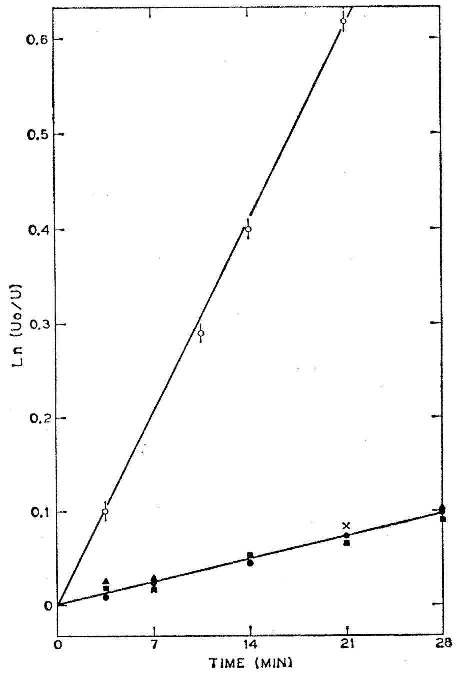

Fig. 2 (right). Photolysis of uracil ($0.7 \times 10^{-3}M$) in acetonitrile; ○ no isoprene; ▲ $0.7 \times 10^{-3}M$ isoprene; ● $1.5 \times 10^{-3}M$ isoprene; ■ $3.0 \times 10^{-3}M$ isoprene; X, air present.