Unusual venous plan in frigatebird kidneys.—The efferent venous network in an avian kidney typically consists of branches coalescing to form the renal vein, which leaves the organ anteriorly. The two renal veins, one from each kidney, unite to form the posterior vena cava. Such a system is highly symmetrical in that each renal vein branches independently without extensions crossing from one kidney to the other. This inherent symmetry has been well-documented through the diagrams of Spanner (1925, Morphol. Jahrb. 54: 560), Sperber (1949, Zool. Bidrag Fran Uppsala 27: 429), and Akester (1967, J. Anat. 101: 569), and is shown partially in Figure 1.

While conducting injection studies of renal microstructure (Johnson et al. 1972, J. Morphol. 136: 181), an unusual venous arrangement was found upon post-mortem examination of kidneys in Great Frigatebirds (*Fregata minor*). The efferent vessels were asymmetrical with the posterior vena cava displaced to the right. Drainage of the left kidney was through two large venous channels extending laterally to join the circulatory pathway on the right side (Figure 1). Presumably, the anteriormost of these lateral vessels (a in Figure 1) represents a modified left renal vein. The posterior element (b in Figure 1) cannot be homologized with a known circulatory pathway in other avian species and appears to be unique. In one of two specimens injected, an anastomosis (c in Figure 1) was present between the vessels draining the left kidney. To supplement the fresh material from *F. minor*, preserved specimens of *F. magnificens* and *F. ariel* were examined later. Both species exhibited the same vascular pattern described above. In a series of diagrams representing kidneys from various species, Kuroda (1963, Misc. Repts. Yamashina

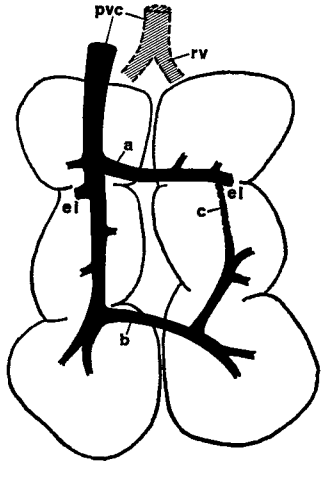

Figure 1. Outline drawing (ventral aspect) of the kidneys and associated efferent blood vessels from a Great Frigatebird. The crosshatched area represents the symmetrical vascular pattern typical of other birds. In the latter, a prominent renal vein (rv) from each kidney joins a medially situated posterior vena cava (pvc). By comparison, frigatebirds display an asymmetrical vascular plan. The external iliac veins (ei) enter the pattern as shown. Other details relating to the diagram are explained in the text.

Inst. Ornithol. 3: 280) showed asymmetrical blood vessels in *F. magnificens* but did not comment about them.

Other representative pelecaniforms obtained as fresh and/or preserved specimens showed this unusual circulatory arrangement to have no ordinal significance. In all of the following species, the efferent venous pattern was symmetrical: *Phaethon aethereus, P. lepturus, P. rubricauda, Pelecanus erythrorhynchos, P. occidentalis, Sula dactylatra, S. leucogaster, S. sula, Morus bassanus, Phalacrocorax auritus, P. olivaceus, P. magellanicus,* and *Anhinga anhinga.* Hence the efferent venous plan of frigatebird kidneys appears to be curiously atypical. Although possibly lacking functional significance in the adult kidney, the arrangement implies a distinctive pattern of morphogenesis.

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Habituation of aggressive responses to avian predators by terns.[1]—Recently, Rydén (1970) examined the antipredator behavior seven or eight pairs of Common Terns (*Sterna hirundo*) directed towards a pair of Herring Gulls (*Larus argentatus*) at a breeding colony in northeast Sweden to determine whether the waning of predator-response observed under experimental situations in some bird species (see Rydén 1970 for references) also occurs in natural situations. Although he found no decrease in attack intensity by the terns, he suggested that habituation may have occurred, but was masked by other factors. While studying Arctic Terns (*S. paradisaea*) at Churchill, Manitoba in 1967 (Evans and McNicholl 1972) and Forster's Terns (*S. forsteri*) at Delta, Manitoba in 1968 and 1969 (McNicholl 1971), I had an opportunity to watch similar antipredator behavior in terns. These observations, combined with those in the literature, suggest that the location at which the predator breeds in relation to the breeding colony may affect the terns' defensive responses.

In 10 Arctic Tern colonies of 141 nests studied at Churchill, avian predators nested out of sight of the colony, except at colony D on whose periphery two pairs of Herring Gulls nested. In all colonies except D, Arctic Terns attacked Herring Gulls and Parasitic Jaegers (*Stercorarius parasiticus*) whenever they started to cross the pond or land encompassing the colonies. At colony D Herring Gulls were not molested as they approached their nests. At Delta most potential avian predators of the Forster's Terns, including Herring and Ring-billed Gulls (*L. delawarensis*) and raptors nested far from the colony, but two pairs of Black-crowned Night Herons (*Nycticorax nycticorax*) nested within the boundaries of the colony in 1968. Forster's Terns attacked all Herring and Ring-billed Gulls, all raptors, and all other herons as soon as they approached the colony, but did not attack Black-crowned Night Herons until they began the descent for a landing, at which the terns attacked vigorously until the herons landed.

Similarly Kruuk (1964: 13–18) found that Black-headed Gulls (*L. ridibundus*)

[1] Publication No. 19 of the University of Manitoba Field Station, Delta, Manitoba.