Tabelle 2. Mittlerer DDE- und HCB-Gehalt in allen untersuchten Eiern (ppm Trockengewicht)

	DDE	HCB
Wanderfalke	74,2	26,0
Sperber	65,0	13,0
Habicht	13,0	49,9
Rotmilan	8,7	7,5
Turmfalke	7,5	3,6
Schleiereule	3,0	2,6

breites Nahrungsspektrum (Rotmilan) günstiger als ein enges (Sperber, Wanderfalke, Habicht), wenn nicht Kleinsäuger den Großteil des täglichen Bedarfs ausmachen (Turmfalke, Schleiereule). So sind Arten, die sich hauptsächlich von Mäusen ernähren, wesentlich geringer mit Bioziden belastet. Unterschiede im Grad der Kontamination bestehen weder innerhalb eines Geleges noch zwischen Erst- und Nachgelege.

Nach den Ergebnissen der Studie scheinen zumindest 6 Vogelarten (Seeadler, Sperber, Wanderfalke, Rohrweihe, Uhu, Zwergseeschwalbe) äußerst empfindlich auf die Umweltverschmutzung zu reagieren. Es kommt bei ihnen häufig zu erheblichen Fertilitätsstörungen. Hierin dürfte ein Grund für die z.T. besorgniserregenden Bestandsrückgänge zu suchen sein [2].

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Photoperiodic Synchronization of Circannual Rhythms in the European Starling (*Sturnus vulgaris*)

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It has been demonstrated in a few bird species that the annual cycles of various physiologic and behavioral functions are controlled by an endogenous circannual rhythmicity [1, 2]. Under seasonally constant environmental conditions these rhythms persist for several cycles with a period that is usually slightly different from 12 months. This observation on the one hand demonstrates the true endogenous nature of these rhythms; on the other hand it raises the question of the Zeitgebers which, under natural conditions, synchronize (entrain) circannual rhythms with the natural year. Since it is known from many bird species that photoperiod (the light fraction of the 24-h day) may exert drastic effects on seasonal phenomena [3], it appears likely that the annual cycle of photoperiod is the dominating Zeitgeber of circannual rhythms in birds. Even though this hypothesis is indirectly supported by a variety of results [4], the behavior of avian circannual rhythms has not yet been rigorously explored in experiments classically carried out to investigate the effectiveness of an environmental cycle as a Zeitgeber [5].

The results summarized in Figure 1 demonstrate that the environmental rhythm of photoperiod is a Zeitgeber of circannual rhythms in the European starling: the rhythms of gonadal size and molt, functions known to be controlled by an endogenous rhythmicity [4, 6], can be synchronized by photoperiodic cycles with periods drastically shorter than 1 year. Even a cycle with a period of only 2.4 months (5 cycles per year) is capable of synchronizing both the testicular and

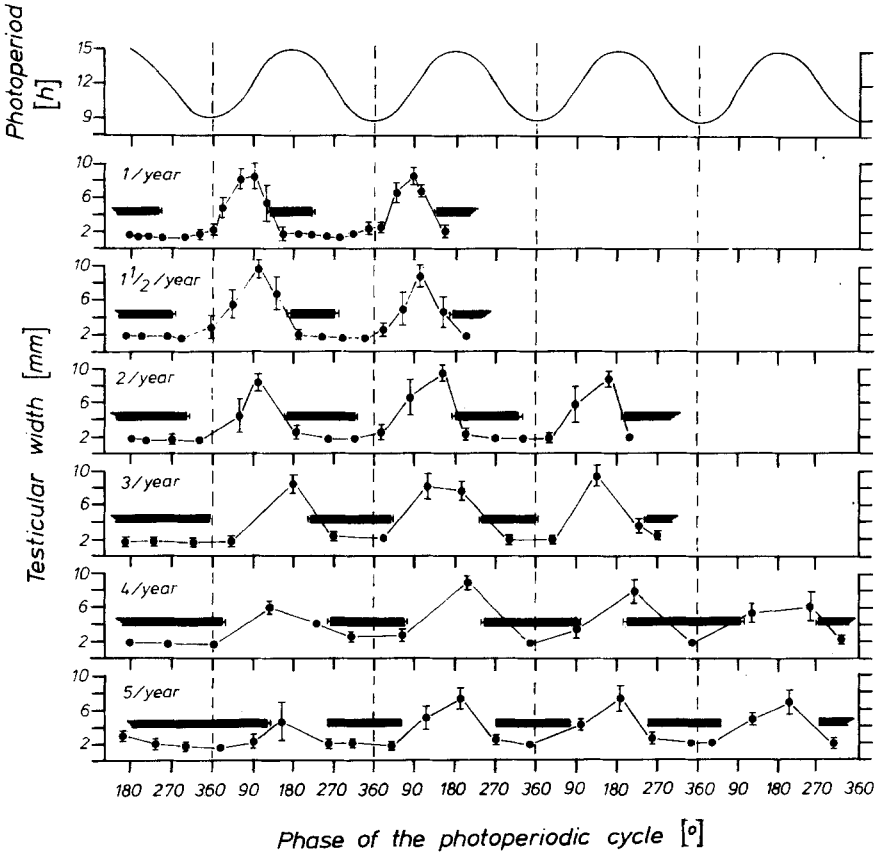

Fig. 1. Rhythms of testicular width (*points*) and molt (*bars*) in six groups of European starlings exposed to sinusoidal changes of photoperiod as shown in *upper panel*. Amplitude and general shape of these photoperiodic cycles were the same in all groups but their duration varied from 1 cycle per year (cycle duration 365 days; *second panel*) to 5 cycles per year (cycle duration 73 days; *lowest panel*). Each group consisted of 8 to 12 birds. Testicular width was established in all individual birds at 2- to 4-week intervals by laparotomy, and onset and end of molt were determined by regular inspections of the birds. In this figure, duration of photoperiodic cycles is normalized to 360° and data are plotted relative to the phase of photoperiodic cycles (0°=phase of shortest photoperiod; 180°=phase of longest photoperiod). Vertical lines at curve points and horizontal lines at bars: SD.

the molt rhythms, indicating a wide range of entrainment of these biological periodicities. Within the range of entrainment the phase relationship between the rhythms of photoperiod and those of testis size and molt changes systematically as a function of the period of the former: as the period of the photoperiodic cycle decreases, the phase of the testicular rhythm (e.g., testicular maximum) and that of the molt rhythm (e.g., onset of molt) become progressively delayed. This behavior is in agreement with predictions derived from general oscillator therory [7] and suggests that circannual rhythms—like circadian rhythms—may be described as oscillators in the technical sense.

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A Modulator of Some Noradrenergic Processes*

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The number of specific receptors appear to be insufficient to account for catecholaminergic functions of various intracerebral structures [1]. Since norepinephrine-hypersensitivity of immature hypothalamic dendrites concurs with high concentrations [2] of a glycopeptide with high specific binding for norepinephrine (a substance isolated by Lee [3] from mouse brain), the effects of this substance on noradrenergic systems has been studied. The results suggest that this substance fulfills the minimum necessary requirements of a "modulator" of noradrenergic processes (criteria established by Bloom et al. [4], Florey [5], Zetler [6]) and may serve as one of the possible postsynaptic substrates for circulating hormone effects.

The glycoprotein fraction was isolated from rat brain following the method of Lee [3]. Brain homogenates were extracted and precipitated with ammonium sulfate (30–50%), dialyzed, chromatographed on DEAE cellulose, eluted with a sodium chloride-based gradient system into 10 fractions. Protein contents [7] and binding activity for labeled norepinephrine (by equilibrium dialysis) were ascertained. Norepinephrine binding increased with purification [brain homogenates (4,100 mg protein) specific binding activity averaged 182 counts/min/ng; Fraction 8 (highest activity, 78 mg protein) 1388 counts/min/ng, respectively].

Data analysis by Scatchard's [8] equation revealed at least two binding sites (dissociation constant $2.05\times 10^{-8}\,M$ and $4.20\times 10^{-7}M$). Polyacrylamide gel electrophoresis led to two fractions: "A" with the higher, and "B" with the lower binding affinity. Incubation with inhibitor substances affected ligand binding of A and B in a different manner suggesting that Part A of Fraction 8 (not of Part B) depends on a glycoprotein fraction containing sialic acid, not on nucleic acid or lipid [3, 9].

The effects of Part A of Fraction 8 on in vivo noradrenergic processes has been ascertained following a sensitive and quantitative biological test [10]: the degree of inhibition of spontaneous activity of rat Purkinje cells. Single-unit bioelectric activities of Purkinje cells were extracellularly recorded through implanted platinum microelectrodes (tip diameter 1 μm) on an oscilloscope (Tektronix 561, 3A3) by integrating the gated pulses over 1-sec intervals.

Exogenous norepinephrine, and/or Fraction A were injected by a Hamilton syringe through an implanted chemitrode near the tip of the recording electrodes. Release of endogenous norepinephrine was attempted by stimulation of noradrenergic inhibitory neurons [rectangular pulses (0.2 ms wavelength, 40 cycles/s frequency, 10–100 nA intensities, sets of 1-s pulses alternated with 10-s test periods)]. Electrode- and chemitrode-tip positions were posthumously ascertained.

Table 1. Effects of Fraction A on spontaneous Purkinje cell activities

No. of exp.	Fract. A	Added interventions		Spontaneous Purkinje cell activity	
		Procedure	Amount [μg]	Frequency decrease [%]	Length of frequency decrease (recovery) [s]
25	no	NE	0.01	39 ± 0.21 [a]	19 ± 0.22 (fast)
25	yes	NE	0.01	55 ± 0.28	43 ± 0.32 (slow)
40	no	NE	0.1	100 ± 0	47 ± 0.38 (fast)
43	yes	NE	0.1	100 ± 0	96 ± 0.99 (slow)
40	yes	0	0	10–20 [b]	15 ± 0.35 (slow)
20	yes (heat denatur.)	0	0	0	0
15		6-OH-DA	100–200	0	0
15		α-m-p-t [c]	10–50	0	0
30		elect. st.		20 ± 1.3	(stim. 10 s) 14 ± 0.54 (fast)
30		elect. st.		33 ± 2.9	(stim. 10 s) 22 ± 0.86 (slow)
30		elect. st.		80 ± 4.6	(stim. 15 s) 20 ± 1.3 (fast)
30		elect. st.		100 ± 5.8	(stim. 15 s) 43 ± 3.9 (slow)

[a] Mean ± S.E.M. Differences between Fraction A injected and not injected rats were statistically significant (Student t-test, $P<0.001$)

[b] Fraction A was used up to 30 times physiological concentrations. Within these limits it did not cause 100% inhibition of the spontaneous activity

[c] α-methyl-p-tyrosine

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