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ergab +F nach den ersten 10 min einen kurzen, ernsten Kampf; das Paar brach, und das ♂ jagte das ♀ ständig umher. Die Paare 6 und 7 hatten seit Wochen friedlich in Isolation gelebt. Situation +F wurde am Nachmittag eingerichtet; am folgenden Morgen waren die ♀♀ tot und hatten schwere Verletzungen an Körper und Flossen, die nur von Bissen der ♂♂ kommen konnten.

Die Voraussetzungen der Beobachtungen von Lorenz an *Geophagus brasiliensis* und anderen paarbildenden Cichliden und der quantitativen Untersuchung Rasas an *Etroplus maculatus* unterschieden sich teilweise von denen im *Tilapia*-Experiment. Beide Autoren beobachteten Tiere ohne Bruterfahrung. Die Fremdfische hinter der Glasscheibe waren Reviernachbarn; den *Tilapia*-Eltern hingegen wurde der Fremde im Revier, sogar im Jungenschwarm, geboten.

Rasas *Etroplus* unterschieden sich von den *Tilapien* nur in der Bruterfahrung, nicht aber in der Dauer der gegenseitigen Bekanntschaft der Partner. Bruterfahrene *Etroplus*-Paare brüten nach Rasa auch in Isolation erfolgreich; unklar ist, ob dafür die längere Bekanntschaft mit dem Partner oder allein die Bruterfahrung verantwortlich ist.

Falls die Arten gleich reagieren, sollten die Ergebnisse von Lorenz und Rasa nur an erstmals verpaarten Tieren ohne Bruterfahrung zu erzielen sein.

b) Bei *Haplochromis burtoni*-♂♂ löst der Anblick eines Gegners oder einer Gegnerattrappe Angriffe aus und hebt zudem die allgemeine Angriffsbereitschaft [5]. Das würde erklären, warum auch im *Tilapia*-Versuch gelegentlich der Partner (als Artgenosse) Bisse auf sich zieht, die zum paarzerstörenden Kampf führen können. Da bei *Etroplus*, *Geophagus* und anderen kaum geschlechtsdimorphen Cichliden der Partner einem Gegner sehr ähnlich sieht, könnten die von ihm gesendeten Feindreize die Angriffsbereitschaft erhöhen, bis sie stärker wird als die durch andere Partnermerkmale kontrollierte Aggressionshemmung.

Diese Interpretation macht die Annahme einer endogenen Staubarkeit der Aggression als Erklärung des Paarbruchs durch Paarisolation überflüssig.

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Precision of Entrained Circadian Activity Rhythms Under Natural Photoperiodic Conditions

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Under natural conditions the light cycle is the prime Zeitgeber entraining the circadian rhythms of most animals. It offers sunrise and sunset as arbitrary phase reference points; onset and end of activity time can be used as reference points for circadian phase. The phase-angle difference [1] is given by the time difference between onset or end of activity and sunrise or sunset. A third point, the midpoint of activity time, can be related to noon or midnight, depending on whether the animal is diurnal or nocturnal [2]. All three phase-angle differences have been shown to vary systematically as a function of time of year [3]; there is also a day-to-day variation, characterizing what may be called the precision of phase control. Several factors may be supposed to influence this precision, e.g. the strength of the synchronizing signals [4] and variations in the sensitivity of the organism to these signals. This would lead us to expect systematic changes in precision with time of year.

At the Ecological Station Messaure in Swedish Lappland (66° 42′ N), we kept three tree shrews (*Tupaia glis*) and four golden hamsters (*Mesocricetus auratus*) for up to 2.5 years in a laboratory room where they were exposed to natural light conditions. The room temperature was kept above 18 °C, buno particular effort was made to insulate the room from ext ternal temperature fluctuations and other disturbances. Food

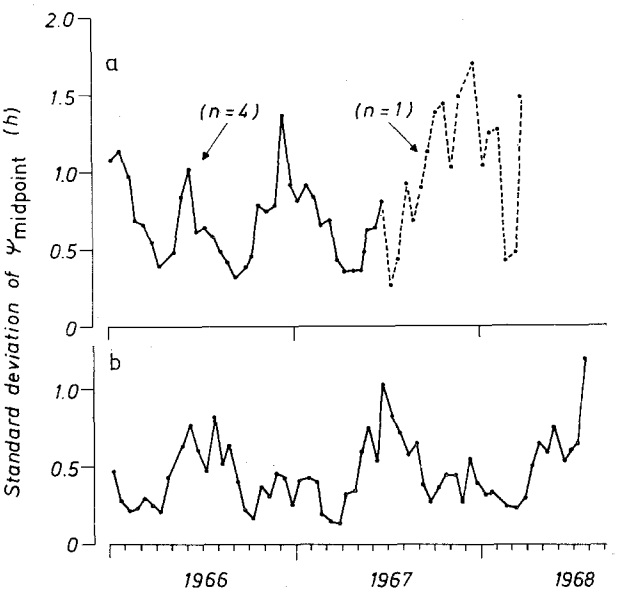

Fig. 1a and b. Standard deviation around the 15-day mean value of phase-angle differences, $\Psi_{midpoint}$, measured between midpoint of activity and a) midnight (*Mesocricetus*) or b) noon (*Tupaia*, $n = 3$), plotted as a function of time of year. Data computed from continuous records of wheel-running activity at 66° 42′ N

and water (ad. lib.) were replenished twice a week. Locomotor activity was recorded by means of running wheels connected to an event recorder. We computed the three phase-angle differences from daily onset and end of activity. As a measure of dispersion (representing the reciprocal value of precision), the standard deviations were calculated around mean values for successive 15-day intervals. Since all three reference points gave essentially the same results, for brevity of discussion only the data relating midpoint of activity to noon (*Tupaia*) or to midnight (*Mesocricetus*) — $\Psi_{midpoint}$ — are considered.

Fig. 1 shows the standard deviation of $\Psi_{midpoint}$ as a function of time of year. The data are averaged over three and four animals, respectively, except for the last part of the hamster record when only one animal was left. Maximum values of standard deviation are found in midsummer for *Tupaia* and in midwinter for *Mesocricetus*; minimum values for both species occur around the equinoxes. There are also minor peaks of standard deviation about six months away from the main maxima. Hence dispersion seems to be smallest (or precision maximal) at a time of the year when day and night are of about equal duration. Similar data available from measurements for the same species at a lower latitude (48° N) and for four other species at both latitudes all display the general pattern shown in Fig. 1, with two peaks of differing magnitude per year. At 48° N, the amplitude of the seasonal variations is considerably smaller than at 66°.

The systematic seasonal variations in precision of entrained rhythms may be attributed to several properties of the entraining Zeitgeber. Two conspicuous seasonal variates of the latter are the light/dark ratio and the duration of twilight. A more detailed analysis of the data, to be published elsewhere, suggests that precision is affected by photoperiod rather than by twilight duration. Three arguments lead us to this conclusion: 1. Standard deviations are significantly different in winter and in summer periods having the same twilight duration (in nocturnal species higher in winter, in diurnal species higher in summer). 2. At two latitudes where there are considerable differences in twilight duration, the values for standard deviation are not quantitatively different around the equinoxes. 3. Minimal dispersion does not coincide exactly with the equinoxes — when twilight is shortest and the light/dark ratio is 12:12 hours — but with a time when duration of activity equals duration of sunlight (in diurnal species) or duration of darkness (in nocturnal species).

This last fact contradicts the otherwise plausible interpretation of our data that strength of Zeitgeber (and hence precision) is greatest when the light/dark ratio is 1:1. The strength of the Zeitgeber certainly depends on the light/dark ratio [5] and it may be expected to influence precision, too.

However, unexplained additional factors must complicate the picture. It is unknown whether the fluctuations in precision have an ecological significance.

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Inhibition by Atebrin (Quinacrine) of Model Protein Synthesis *in vitro*

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Atebrin causes a slight but specific inhibition of protein biosynthesis in *E. coli* in addition to its predominant effect on DNA replication [1]. We report here that Atebrin inhibits the polycondensation of phenylalanine in an *E. coli* ribosome-poly U system.

An inhibition (65 %) of cell-free incorporation of amino acids into chloroplasts by $5 \cdot 10^{-4}$ M Atebrin has been observed [2]. Certain other amino-acridines also inhibit polymerizations of amino acids in cell-free reaction systems [3–5]. Ribosomes from *E. coli* C-2 were prepared and the polymerization of phenylalanine was measured by published methods [6]. The synthesis of ^{14}C-phenylalanyl-tRNA ("charging") was carried out in a similar reaction system from which ribosomes, GTP and poly U were deleted; after 15 min incubation, cold trichloroacetic acid was added to 5 %, the precipitates collected on millipore filters, washed free of non-reacted phenylalanine and counted in a liquid scintillation counter. Poly U-directed ribosomal binding of ^{14}C-phenylalanyl-tRNA was determined by a standard method [7].

Fig. 1a shows the effects of graded concentrations of Atebrin on the three different reaction systems. At $4 \cdot 10^{-4}$ M, the drug inhibited completely the polycondensation of phenylalanine. The inhibition of the condensation reaction is not explained by the marginal action of Atebrin on the poly U-directed ribosomal binding of phenylalanyl-tRNA. Anne K. Krey, in our laboratory, has found no spectroscopic indications that Atebrin interacts with poly U; however, the drug bound to the tRNAs and the ribosomes of *E. coli*. Binding of Atebrin to tRNA evidently was of no consequence to the cell-free reactions which we studied.

Binding of the drug to ribosomes labilizes these particles to heat [5]. We have found, additionally, that increasing concentrations of ribosomes reversed systematically the inhibitory action of $6 \cdot 10^{4}$ M Atebrin (Fig. 1b).

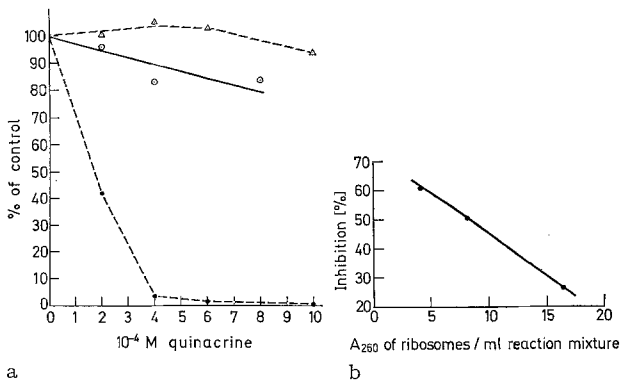

Fig. 1. a) Effects of graded concentrations of quinacrine on polyphenylalanine synthesis (•), "charging" of tRNA with ^{14}C-phenylalanine (○) and on the poly U-directed binding of ^{14}C-phenylalanyl-tRNA to *E. coli* ribosomes (▲). b) Effect of graded concentrations of ribosomes on the inhibition of polyphenylalanine synthesis by $6 \cdot 10^{-4}$ M quinacrine

The most plausible explanation of our results is that the drug interacts with the reactive ribosomal complex and alters its structure in such a manner that its ability to mediate protein synthesis is impaired. While this represents one mode of action of Atebrin, we must emphasize that the principal action of the drug is directed against DNA replication in bacteria [1] and against the same reaction as well as RNA transcription in malaria parasites [8, 9].

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Condensation of Interphase Chromatin in Caffeine-Treated Cells

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Caffeine is known to be a mutagenic substance, hence an interaction with chromatin may be expected. The effect of purines and related substances on living cells was observed in 1952 [1]. Extensive investigations into the behaviour of the nucleolus of cells, treated with some of the mentioned substances [1], revealed beaded filamentous structures, which represent the chromosomal component of the nucleolus [2, 3]. The same effect could be obtained by an increase of temperature [4]. It could be demonstrated that, in cells treated with adenosine, nucleolar chromatin becomes functionally inactive [5].

In vitro studies on the interaction of nucleosides and related compounds with Poly-A and thymus DNA published in 1962 [6] reported a change in the helix-coil transition temperature (ΔT_m). Some of the substances noted in [6] had been found to be active in living cells too [7]. It seemed to be of interest to investigate not only nucleolar structures but also the reaction of the total chromatin in interphase cells.

Living chicken fibroblasts cultivated *in vitro* were treated for 2–2$^1/_2$ h with caffeine at concentrations of 25 and 50 mM and evaluated after Feulgen staining. The stained preparations deviated from the controls (Fig. 1a: interphase nucleus, b: prophase) in having beaded or filamentous structures within the treated nuclei. These filaments and granules are strongly Feulgen-positive and hence represent chromatin (Fig. 1c–f). A comparison between untreated and treated cells reveals different patterns of condensation. The appearance of the condensed chromatin in segments differs from the untreated prophase and can be observed in almost any of the treated interphase cells. It indicates that differential condensation of the interphase chromatin has taken place.

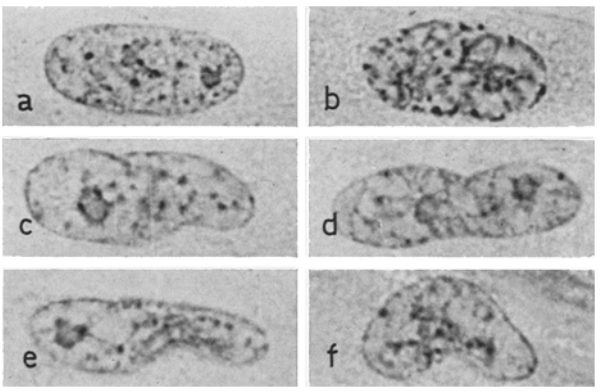

Fig. 1a–f. Chicken fibroblasts, Feulgen staining. a and b: untreated, a interphase, b prophase. c and d: interphases treated with caffeine, 25 mM, 2 h. e and f: interphases treated with caffeine, 50 mM, 2$^1/_2$ h