

# CHRONOBIOLOGY & CHRONOMEDICINE

BASIC RESEARCH AND APPLICATIONS

EDITED BY  
G. HILDEBRANDT/R. MOOG/F. RASCHKE



**Verlag Peter Lang**

Frankfurt am Main · Bern · New York · Paris

CIP-Kurztitelaufnahme der Deutschen Bibliothek

**Chronobiology & [and] chronomedicine** : basic re=  
search and applications ; Marburg/Lahn, FRG, 1986 / [Europ.  
Soc. for Chronobiology. Ed. by G. Hildebrandt ...]. - Frankfurt  
am Main ; Bern ; New York ; Paris : Lang, 1987.

(Proceedings of the ... annual meeting of the  
European Society for Chronobiology ; 2)  
ISBN 3-8204-9882-6

NE: Hildebrandt, Gunther [Hrsg.]; European Society  
for Chronobiology: Proceedings of the ...

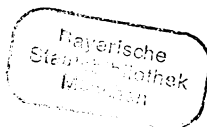
ISBN 3-8204-9882-6

© Verlag Peter Lang GmbH, Frankfurt am Main 1987  
Alle Rechte vorbehalten.

Das Werk einschließlich aller seiner Teile ist urheberrechtlich  
geschützt. Jede Verwertung außerhalb der engen Grenzen des  
Urheberrechtsgesetzes ist ohne Zustimmung des Verlages  
unzulässig und strafbar. Das gilt insbesondere für  
Vervielfältigung, Übersetzungen, Mikroverfilmungen und die  
Einspeicherung und Verarbeitung in elektronischen Systemen.

Druck und Bindung: Weihert-Druck GmbH, Darmstadt

Printed in Germany



## CONTENTS

### I. BASIC AND CELLULAR ASPECTS

Cellular and molecular aspects of circadian rhythms: a review H.-G. SCHWEIGER †	15
Endogenous rhythms in mammalian smooth muscle K. GOLENHOFEN	26
Protein phosphorylation and circadian clock mechanism L. RENSING, D. TECHEL & A. SCHROEDER-LORENZ	39
Desensitization of the <u>Gonyaulax</u> circadian oscillator to 80 S translational inhibition by cold treatment R. HARDELAND, I. RODE, I. THOREY, G. HARNAU & R. SCHACHTLER	49
Chronobiological experiments in <u>Gonyaulax polyedra</u> and <u>Euglena gracilis</u> with heat-stable cytosolic extracts modulating protein synthesis E. QUENTIN, J. WILDE, A.C. SCHILLING & R. HARDELAND	55
Temperature-compensation of ultradian rhythms in Ciliates F. KIPPERT	60
A study of the location of the circadian clock of the insect <u>Hemideina thoracica</u> (Orthoptera: Stenopelmatidae) R.D. LEWIS & B. WADDELL	65
Ultradian rhythms in lower Eukaryotes: timers for cell cycles D. LLOYD & S.W. EDWARDS	69
Channel recordings from cultured arcuate neurons: a preliminar note E. MARANI, M. CORINO, R.v.d. BERG & W.J. RIETVELD	74
Influence of photoperiod on body temperature rhythms in the djungarian hamster T. RUF, S. STEINLECHNER & G. HELDMAIER	79

Long-lived chaotic transients in glycolysis M. MARKUS & B. HESS	85
--	----

## II. DEVELOPMENT AND AGING

The primordial clock of a marine Australian plasmodial rhizopod H. SILYN-ROBERTS, W. ENGELMANN & K. GRELL	90
Effect of photoperiod on developmental rhythms in the Egyptian cotton leafworm ( <u>Spodoptera littoralis</u> ) B. CYMBOROWSKI & G. ZIMOWSKA	94
The effect of melatonin on the development of the medio basal hypothalamic region in the rat W.J. RIETVELD & E. MARANI	100
Effects of age on length and amplitude of freerunning rhythms of sleep-wakefulness in the rat W. WITTING, W.A. van GOOL & M. MIRMIRAN	104
Preliminary data on chronophysiology of motor behaviour in low-risk preterm infants C. FAIENZA, C. CAPONE, L. CARPEGGIANI, M. D'INNOCENZO, M.C. GALGANO & E. SANI	110
Daily distribution of body movements in low-risk preterm infants C. FAIENZA, C. CAPONE & M.C. GALGANO	114

## III. METHOLOGICAL ASPECTS

### a) Problems of Masking

The problem of masking and some ways to deal with it D.S. MINORS & J.M. WATERHOUSE	119
Comparison between different agents of masking R. MOOG, G. HILDEBRANDT & P. ZEZULA	136
Entrainment and masking of circadian rhythms of rabbits by restrictive feeding B. JILGE	140

## b) Data Acquisition and Processing

Temporal patterns of wheel-running behaviour in the scorpion <i>Androctonus australis</i> C. DUBE & G. FLEISSNER	147
Assessment of rest-activity cycle in human subjects by measurements of body motility O. BENOIT, G. MENSEAU, J. LACOMBE & J. FORET	152
Monitoring cyclical variation of heart rate in patients with nocturnal disturbances in respiratory regulation T. PENZEL	155
New statistical methods of quantitative chronobiology E. RESCHENHOFER	160

IV. COORDINATION AND INTERACTIONS

Coordination and synchronization in the cardiovascular- respiratory system F. RASCHKE & G. HILDEBRANDT	164
Interpretation of differences in power spectra of blood pressure, heart rate, and respiration in man N. HONZIKOVÁ, J. PEŇÁZ & B. FIŠER	172
The coordination of heart beat and respiration during ergometric stress in patients with functional cardiovascular diseases M. WECKENMANN, G. ADAM, E. RAUCH & A. SCHULENBERG	177
Heart rate variability at different autonomic states K. ECKOLDT, W. BRAUN & V. LANGE	181
Changed relations between cardiorespiratory parameters and heart rate variability in endurance-trained individuals at rest H.H. ABEL, R. KRAUSE, D. KLÜSSENDORF & H.P. KOEPCHEN	187
The development of heart rate and its variability from birth to puberty in man E. SCHUBERT, C. KRUSCHE & H. SPEDA	193

- Heart rate variation is reduced in patients with long lasting history of diabetes mellitus. On the special influence of the respiratory system 197  
M. BÜHRING, U. JABLONKA, B. RESCHKE, R. SALLER & Ch. ROSAK
- Possible central oscillators synchronizing brain waves and muscle oscillations in man? 202  
M. KEIDEL, W.-D. KEIDEL, W.S. TIRSCH & S.J. PÖPPL
- Etiology and significance of 0.5-2/min rhythm in intercranial pressure without periodic respiration 209  
U. DIRNAGL, K.M. EINHAUPL, G. SCHMIEDER, P. FRANZ, C. GARNER & H.W. PFISTER
- Cognitive time structures and neuronal zeitgebers: models and results of a relationship 214  
R. SINZ

#### V. CHRONOPATHOLOGY, CHRONOPHARMACOLOGY, CHRONOTOXICOLOGY

- Influence of light/dark cycles on the hypertensive (HR) response of tobacco to four bacterial plant pathogens 220  
B.W. KENNEDY
- Azadirachtin induces splitting in cockroach locomotor activity rhythms 222  
S.Z. HAN & W. ENGELMANN
- Effects of  $\text{Li}^+$  and  $\text{Rb}^+$  and of the  $\text{K}^+$ -channel blocker TEA on the circadian locomotor activity in the house fly, Musca domestica 226  
H.P. SCHMID & W. ENGELMANN
- Effect of lithium on circadian activity of acetylcholinesterase (AChE, EC 3.1.1.7) in the reticular formation of the mouse brain stem under LD 12/12 illumination conditions 230  
M.H. LEWANDOWSKI & E. MARDYLA
- Changes in the rat circadian rhythm of food intake after long term application of clorgyline 238  
W.J. RIETVELD, W.T.J.M. HEKKENS & G.A. GROOS
- Circadian activity rhythms in hamsters unaffected by imipramine 243  
J. ASCHOFF

Food selection in chronic methamphetamine treated rats: dependence on circadian phase K. KRÄUCHI, A. WIRZ-JUSTICE & H. FEER	247
The effect of chronic application of methamphetamine in suprachiasmatic nucleus lesioned rats W.J. RIETVELD & A. WIRZ-JUSTICE	252
Circadian-phase dependent effects of beta-receptor blocking drugs on motor activity of rats B. LEMMER & G. NEUMANN	257
Time-dependent absorption of iron after gastrectomy A. MARKIEWICZ, H. BOLDYS & J. KALACIŃSKI	262
Circadian influence on the effects of a single prenatal alcohol injection on the development in mice I. SAUERBIER	265
Circadian variation of the atropine effect on the running performance of mice treated with 1,2,2-trimethylpropylmethyl- phosphonofluoridate (SOMAN) H. ARBOGAST, M. HALLEK, B. ARBOGAST & L. SZINICZ	270

## VI. CLINICAL ASPECTS AND APPLICATIONS

Clinical roots of biological rhythm research (Chronobiology) W. MENZEL	277
Further steps toward a neonatal chronocardiology F. HALBERG, R. HERMIDA, G. CORNELISSEN, C. BINGHAM, F. MARTIN, G. MAINARDI, C. PANERO, P. HURLEY, B. TARQUINI, P. SCARPELLI, R. SCARPELLI, R. LIVI & M. CAGNONI	288
Circadian variations of complaints by patients suffering from angina pectoris, hypertension, and heart failures L. PÖLLMANN, H. LEISING & B.E. STRAUER	293
Changes in circadian pattern of heart rate in patients after acute myocardial infarction C. HECKMANN & M. BUSCH	299
Circa- and ultradian blood pressure variation in a patient with malignant paraganglioma before and after $\alpha$ -blockade M. MIKULECKÝ, L. KUBÁČEK, I. BALAZOVJECH & A. VALACHOVÁ	307

- Investigations of circadian rhythms in patients with Anky- 312  
 losing Spondylitis  
 M. HEROLD & R. GÜNTHER
- Circadian variations of plasmaconcentrations of cortisol 317  
 and ACTH in patients with Rheumatoid Arthritis. -  
 A presentation by cosinor method  
 G. NEECK, K. FEDERLIN, V. GRAEF, D. RUSCH &  
 K.L. SCHMIDT
- Patient-to-patient evaluation of plasma total cortisol 324  
 circadian rhythmicity in CUSHING's syndrome, imitating  
 obesity and controls  
 M. MIKULECKÝ & A. KREZE
- Chronobiometrical study of secretory IgA concentration in 330  
 saliva of healthy human subjects  
 M. MIKULECKÝ, A. SEIDLOVÁ & A. VALACHOVÁ
- Dipeptidyl-peptidase IV: age-dependent freerunning rhythm 335  
 in the serum and asymmetric reaction to stress in the  
 kidney  
 J. SCHUH & D. BALSCHUN
- Diurnal variations of urinary excretion of total glycos- 340  
 aminoglycans, guanosine 3':5' -monophosphate (cGMP) and  
 adenosine 3':5'-monophosphate (cAMP): indications for  
 different circadian rhythms?  
 T.O. KLEINE, B. STEINHÄUSER & U. KROH
- The clinical significance and long-term recording of 346  
 physiological parameters in patients with sleep apnea  
 J.H. PÉTER, Th. PENZEL & P. von WICHERT
- Comparative study of circadian temperature rhythms in 351  
 different regions of the body in female patients with  
 inoperable gynecologic tumors. - Preliminary data  
 W. MARKTL, W. KALLINGER, R. RICHTER, G. ALTH, H. KOREN,  
 W. NESPOR, H. KOLBABEK, M. GRUSKA & N. KLAMMER
- On the influence of meteorological dynamics on the 356  
 circadian rhythm of the collective body temperature  
 H. WAGNER & H. JORDAN
- Comparative chronobiological study on the body tempera- 360  
 ture under light therapy in depressed patients and in  
 healthy controls  
 M. GRUSKA, M. DIETZEL, W. MARKTL, N. KLAMMER &  
 O.M. LESCH



- Changes of mood during sleep deprivation in patients of  
different nosological groups 364  
H.-J. HAUG, E. FÄHNDRICH & R.-D. STIEGLITZ
- Influence of saunahyperthermia in the evening upon  
circadian rhythm of the neurotransmitter substance P 371  
E. CONRADI, R. BRENKE & R. RATHSACK
- Interplanetary magnetic field sector polarity, season  
and emotional surrounding tumor operation: factors in  
the ecology of cancer progression? 375  
H.W. WENDT

## VII. REACTIVE PERIODS

- Reactive periods and spontaneous rhythms 382  
G. HILDEBRANDT
- Periodic course of body temperature and pulse-  
respiration frequency ratio during clinical treatment 387  
K. TRAGESER & M. WECKENMANN
- Circaseptan reactive periodicity during cure treatment 392  
L. PÖLLMANN, G. HILDEBRANDT & M. HELLER
- Circaseptan reactive periodicity of renal functions  
during 4-week balneotherapeutical cure treatment 398  
C. GUTENBRUNNER & H. SCHULTHEIS
- Circadian rhythms and circaseptan periodicity of the  
administration of analgesic drugs after oral surgery 403  
L. PÖLLMANN & G. HILDEBRANDT
- On uni-modal and bi-modal annual rhythms in man 407  
L. KLINKER

## VIII. ELEMENTS OF CHRONOHYGIENE

- Circadian rhythms in performance: neurophysiological  
and behavioural data for morning-type and evening-  
type subjects 413  
G.A.KERKHOF & C.J. VERDUIN

Advance of rising time affects more circadian variables than delay of bedtime J. FORET, O. BENOIT, M. CLODORE, N. TOURON & Y. TOUITOU	423
Experimental sleep-wake reversal in rats: effects on sleep, temperature and feeding parameters M. LANCEL	427
The effects of hypnotics on the day sleeps of shift-workers S. FOLKARD, S. VIDAČEK, L. KALITERNA & B. RADOŠEVIĆ-VIDAČEK	434
Circadian rhythms in blind persons R. MOOG, H. ENDLICH, G. HILDEBRANDT & H. MARTENS	439
Variations of pain threshold and vigilance functions within the menstrual cycle L. PÖLLMANN, G. HILDEBRANDT, S. MEHRHOFF & E. SCHRAGE	442
<b>AUTHOR INDEX</b>	449

**CIRCADIAN VARIATION OF THE ATROPINE EFFECT ON THE RUNNING PERFORMANCE OF MICE TREATED WITH 1,2,2-TRIMETHYLPROPYLMETHYL-PHOSPHONOFUORIDATE (SOMAN)**

H. ARBOGAST, M. HALLEK, B. ARBOGAST & L. SZINICZ

Institut für Pharmakologie und Toxikologie der Akademie des Sanitäts- und Gesundheitswesens der Bundeswehr - BSW, Ingolstädter Landstr. 100, D-8046 Garching-Hochbrück, FRG

INTRODUCTION

The efficacy of atropine as antidote in an organophosphate poisoning has been frequently documented (BERRY et al, 1966; HELM, 1980). This compound has become an indispensable component of the therapy. In contrast, little is known about the influence of atropine on the non-lethal effects of organophosphates.

The setup of this experiment arose out of the observation that the toxic effects of many drugs change with the time of day. This could be demonstrated for a large variety of drugs (REINBERG & HALBERG, 1971) including paraoxon, the active metabolite of parathion, organophosphate and a potent cholinesterase inhibitor (MAYERSBACH, 1974) and soman, a very potent and rapid-acting organophosphate "nerve agent" (ELSMORE, 1981).

In this study, the influence of atropine on the motor performance of mice treated with soman and the circadian variation of this effect were investigated.

METHODS

White male NMRI-mice, weighing between 20 and 25 g with tap water and standard mice chow ad lib (Altromin) were used. The animals were allowed to adapt for 10 days and were then trained for three consecutive days, once daily, for 60 min. A mesh wire drum (20 cm diameter) rotating at 14 rpm was used.

The animals received the compounds to be tested immediately before the running period of 60 min. Before the injection and after the experiment (running period) a modified neurologic behavioral screening program was performed, according to IRWIN (1968). 26 parameters were tested: body position, locomotor activity, exophthalmus, abnormal movements, tremor, convulsions (viewing glass); appearance, piloerection, eye opening, startle reaction (arena); visual placing, grip strength, corneal reflex, pinna response, toe and tail pinch responses, body tone and temperature (steel wire grid); positional struggle, abdominal and extremity tone, salivation, lacrimation, skin colour, diarrhea, respiratory rate, biting provocation (supine position). The differences between the single values before the injection and after the running period were formed

and summarized to five scores: activity, reflexes, muscle tonus, autonomous and abnormal behavior.

After randomization, 7 animals per group received either saline solution s.c. and i.p., or soman (50% LD<sub>50</sub> s.c. and saline i.p., or soman (50% LD<sub>50</sub> s.c. and atropine (10 mg/kg) i.p.

In a blind procedure, this setup was repeated at six different time points along the 24-h scale, with a total of 126 animals.

A detailed description of the method will be published elsewhere (ARBOGAST et al, in preparation).

## STATISTICS

The results were checked for significant differences by oneway and twoway of variance (ANOVA, 1983) and rhythms were quantified by the cosinor method (NELSON et al, 1971; BINGHAM et al, 1982).

## RESULTS

Primarily - independently from daytime - in animals receiving soman alone running performance, as well as the screening scores activity, reflexes, muscle tonus and autonomous behavior were significantly reduced, the abnormal behavior score was increased. Looking at the data in dependence of daytime (Fig. 1), for this group a significant circadian variation could be detected in the activity and abnormal behavior scores.

The animals treated with soman and atropine demonstrated a marked improvement in running performance, activity, reflexes, autonomous and abnormal behavior scores, compared to the animals receiving soman alone. Atropine treatment had no effect on muscle tonus, as expected.

A highly significant circadian variation, however, could be verified in running performance of this group (Fig. 1a), as well as in the screening scores activity and abnormal behavior (see also Table in Fig. 1). The clearly twin peaked data curves indicate the existence of an additional 12-h rhythm, which could be manifested by the cosinor method.

The most striking daytime variation, however, was prominent in the improvement of running performance by atropine therapy (Fig. 2a showing the %al improvement of running performance in the atropine therapy group compared to the respective animals receiving soman alone in dependence of daytime). Here, data vary between -63 and +223%.

If analyzed by the cosinor method (Fig. 2b), these data exhibit a significant circadian rhythm with an acrophase towards the end of the activity period of the mice (seen in circle A). Also, an ultradian 12-h rhythm could be manifested (shown in circle B).

Compared to the saline controls, an acrophase shift in the activity score of the groups receiving soman (with or

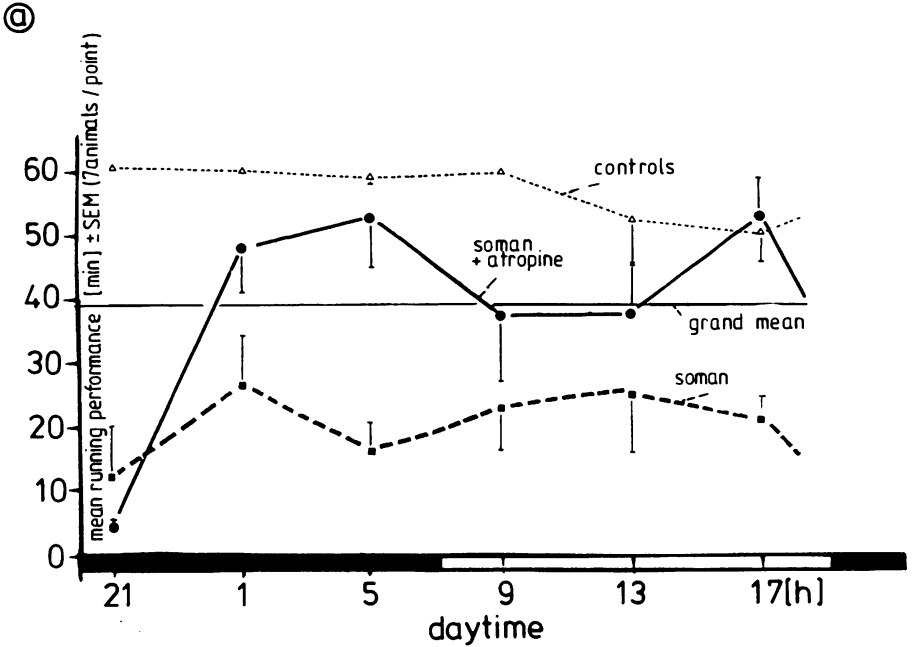
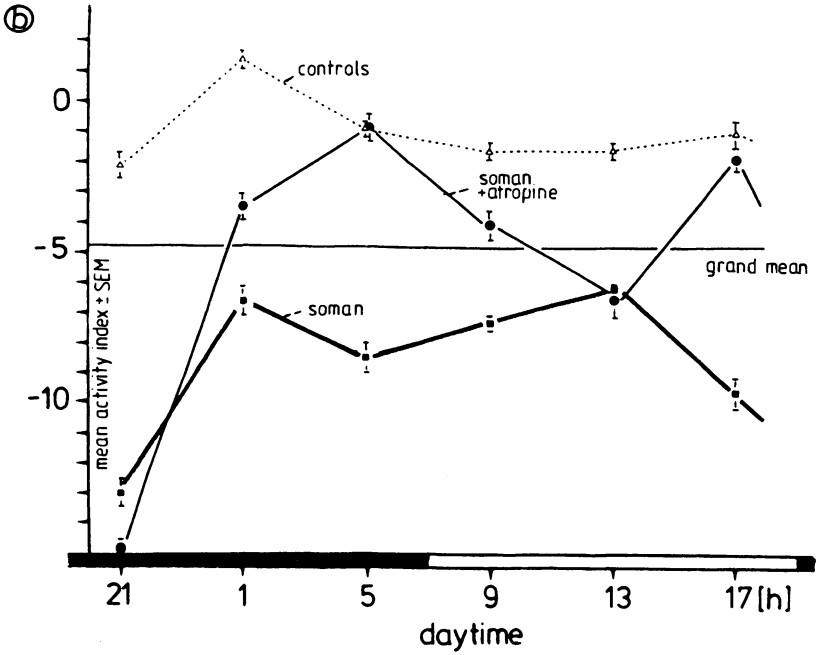
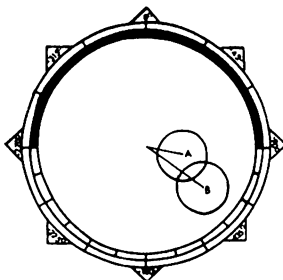
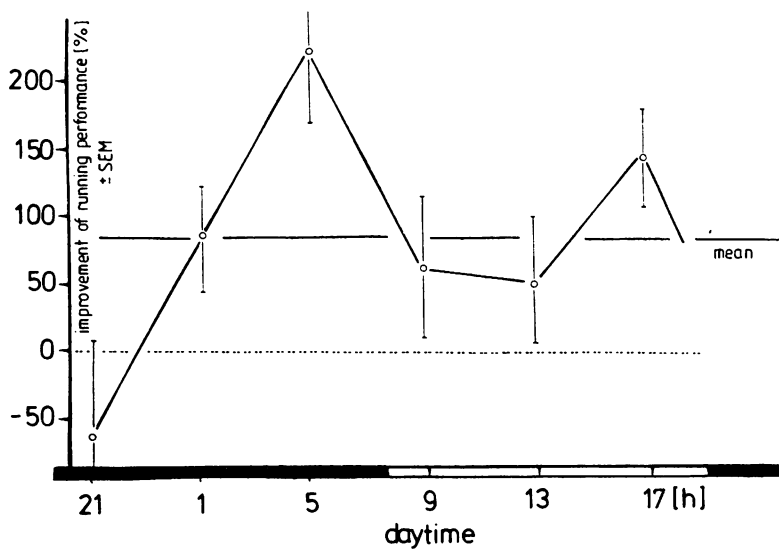


Fig. 1: a) Circadian variation of the mean running time (min.) in mice treated with saline, soman, soman+atropine;  
 b) Circadian variation of the mean activity score (arbitrary units) in mice treated with saline, soman, soman+atropine; each data point represents 7 animals; the inserted table demonstrates all time dependences obtained by ANOVA at different levels of significance.



	running performance	activity	autonomous behavior	abnormal behavior	reflexes	muscle tonus
one-way-analysis						
CONTROLS		+	++	+		
SOMAN		+		++		
SOMAN + ATROPINE	+++	++		++		
two-way-analysis						
THERAPY	+++	+++	+++	+++	+++	+++
TIME	++			+++		

+  $p < 0,05$   
 ++  $p < 0,01$   
 +++  $p < 0,001$



SINGLE COSINOR

p	period (h)	n	mesor	amplitude ± SE	acrophase ± SE (h)
A:	24	42	83.9	58.6 ± 39.8	6.45 ± 2.40
B:	12			108.2 ± 39.8	4.16 ± 0.41

Fig. 2: a) Circadian variation of the atropine effect on the mean running performance improvement (%) in mice treated with soman;  $n = 7$  animals per time point; b) cosinor analysis of mean running performance improvement; the parameters of the 24- and 12-h rhythms are listed below the graph.

without atropine) could be observed. Activity acrophases in the latter groups showed a clear synchronicity with the acrophase of running performance improvement.

## CONCLUSIONS

In conclusion it can be stated that the application of atropine clearly improved the effects caused by soman, except muscle tonus. The effect of atropine on motor behavior as well as on all the neurologic scores showed strong circadian variations, stronger than those in controls and in animals receiving soman alone. Acrophase synchronicity of running performance improvement with the rhythm of the activity score could also be shown. Hence, activity could thus be used as a "marker rhythm".

As one possible interpretation, it might be suggested that the rest-activity cycle of the animals also synchronizes the sensitivity of the organism towards atropine. The 12-h rhythms manifested in our activity data are also confirmed by literature, where 12-h rhythms in activity are commonly described (HALBERG & HALBERG, 1984).

ELSMORE (1981) reported about circadian variations in the toxic (lethal) effects of soman. His finding of a circadian rhythmicity in the susceptibility to "nerve agent" poisoning could be confirmed by our data for the non-lethal effects. In addition, the detection of a circadian dependence of the therapeutic atropine effect very well coincides with ELSMORE's findings demonstrating a significantly higher LD<sub>50</sub> and a significantly lower body weight loss during the dark period. His cholinesterase measurements in three brain regions (brainstem, hypothalamus and midbrain) all exhibited peak concentrations during the dark span, when soman was least toxic.

We also found atropine efficacy highest during the dark period. So it might be suggested that as one of the possible mechanisms the circadian rhythmicity of brain acetylcholinesterase may cause the circadian dependence of the therapeutic atropine effect.

As a final remark, the data presented here show the necessity of considering the time of day when performing organophosphate toxicity experiments.

## REFERENCES

1. ARBOGAST, H., HALLEK, M. & SZINICZ, L. (1987): Assessment of the motor performance and the neurologic state of the mouse: An alternative to LD experiments. In preparation.
2. BERRY, W.K., DAVIES, D.R. & RUTLAND, J.P. (1966): Problems in the treatment with oximes and atropine of rats poisoned by organophosphates. *Biochem. Pharmacol.* 15, 1529
3. BINGHAM, C., ARBOGAST, B., CORNELISSEN, G. & HALBERG, F.



- (1982): Inferential statistical methods for estimating and comparing cosinor parameters. *Chronobiologia* 9, 397-412
4. ELSMORE, T. (1981): Circadian susceptibility to soman poisoning. *Fundam. Appl. Toxicol.* 1, 238-241
  5. GROFF, W.A., KAMINSKIS, A. & ELLIN, R.I. (1976): Interconversion of cholinesterase activity units by the manual delta pH method and a recommended automated method. *Clin. Toxicol.* 9, 353-358
  6. HALBERG, F. & HALBERG, E. (1984): Chronopharmacology and further steps toward chronotherapy. *Pharmacokinetic Basis for Drug Treatment*, pp. 221-248
  7. HELM, U. (1980): Nervenkrampfstoffvergiftung (Alkylphosphatvergiftung). In: *Wehrmedizin, E. Rebentisch* (ed.). Urban & Schwarzenberg, München, pp. 247-260
  8. IRWIN, S. (1968): Comprehensive observational assessment: Ia. A systematic, quantitative procedure for assessing the behavioral and physiologic state of the mouse. *Psychopharmacol.* (Berlin) 13, 222-257
  9. MAYERSBACH, H. von (1974): Circadian liver detoxication and acetylcholinesterase rhythmicity: two limiting factors in circadian E600 toxicity. In: L.E. Scheving, F. Halberg & J.E. Pauly (eds.). *Chronobiology*, Igaku Shoin Ltd., Tokyo, pp. 191-196
  10. NELSON, W., TONG, Y.L., LEE, J.-K. & HALBERG, F. (1979): Methods for cosinor rhythmometry. *Chronobiologia* 6, 305
  11. REINBERG, A. & HALBERG, F. (1971): Circadian chronopharmacology. *Annu. Rev. Pharmacol.* 11, 455-492
  12. Die Statistikprozeduren (1983). In: *SPSS 9 - Statistik-Programm-System für die Sozialwissenschaften*, 4. Aufl., Fischer-Verlag, Stuttgart-New York, pp. 105-266

## A U T H O R I N D E X

ABEL, H.H.	187
ADAM, G.	177
ALTH, G.	351
ARBOGAST, B.	270
ARBOGAST, H.	270
ASCHOFF, J.	243
BALAŽOVJECH, I.	307
BALSCHUN, D.	335
BENOIT, O.	152,423
BERG, R.v.d.	74
BINGHAM, C.	288
BOLDYS, H.	262
BRAUN, W.	181
BRENKE, R.	371
BÜHRING, M.	197
BUSCH, M.	299
CAGNONI, M.	288
CAPONE, C.	110,114
CARPEGGIANI, L.	110
CLODORE, M.	423
CONRADI, E.	371
CORINO, M.	74
CORNELISSEN, G.	288
CYMBOROWSKI, B.	94
DIETZEL, M.	360
DIRNAGL, U.	209
D'INNOCENZO, M.	110
DUBE, C.	147
ECKOLDT, K.	181
EDWARDS, S.W.	69
EINHÄUPL, K.M.	209
ENDLICH, H.	439
ENGELMANN, W.	90,222,226
FAIENZA, C.	110,114
FÄHNDRICH, E.	364
FEDERLIN, K.	317
FEËR, H.	247
FISER, B.	172

FLEISSNER, G.	147
FOLKARD, S.	434
FORET, J.	152,423
FRANZ, P.	209
GALGANO, M.C.	110,114
GARNER, C.	209
GOLENHOFEN, K.	26
GOOL, W.A. van	104
GRAEF, V.	317
GRELL, K.	90
GROOS, G.A.	238
GRUSKA, M.	351,360
GÜNTHER, R.	312
GUTENBRUNNER, C.	398
HALBERG, F.	288
HALLEK, M.	270
HAN, S.Z.	222
HARDELAND, R.	49,55
HARNAU, G.	49
HAUG, H.-J.	364
HECKMANN, C.	299
HEKKENS, W.T.J.M.	238
HELDMAIER, G.	79
HELLER, M.	392
HERMIDA, R.	288
HEROLD, M.	312
HESS, B.	85
HILDEBRANDT, G.	136,164,382,392,403,439,442
HONZIKOVÁ, N.	172
HURLEY, P.	288
JABLONKA, U.	197
JILGE, B.	140
JORDAN, H.	356
KALACIŃSKI, J.	262
KALITERNA, L.	434
KALLINGER, W.	351
KEIDEL, M.	202
KEIDEL, W.-D.	202
KENNEDY, B.W.	220
KERKHOF, G.A.	413
KIPPERT, F.	60
KLAMMER, N.	351,360
KLEINE, T.O.	340
KLINKER, L.	407
KLÜSSENDORF, D.	187
KOEPCHEN, H.P.	187
KOLBABEK, H.	351

KOREN, H.	351
KRÄUCHI, K.	247
KRAUSE, R.	187
KREZE, A.	324
KROH, U.	340
KRUSCHE, C.	193
KUBÁČEK, L.	307
LACOMBE, J.	152
LANCEL, M.	427
LANGE, V.	181
LEISING, H.	293
LEMMER, B.	257
LESCH, O.M.	360
LEWANDOWSKI, M.H.	230
LEWIS, R.D.	65
LIVI, R.	288
LLOYD, D.	69
MAINARDI, G.	288
MARANI, E.	74,100
MARDYLA, E.	230
MARKIEWICZ, A.	262
MARKTL, W.	351,360
MARKUS, M.	85
MARTENS, H.	439
MARTIN, F.	288
MEHRHOFF, S.	442
MENSEAU, G.	152
MENZEL, W.	277
MIKULECKÝ, M.	307,324,330
MINORS, D.S.	119
MIRMIRAN, M.	104
MOOG, R.	136,439
NEECK, G.	317
NESPOR, W.	351
NEUMANN, G.	257
PANERO, C.	288
PEŇÁZ, J.	172
PENZEL, T.	155,346
PETER, J.H.	346
PFISTER, H.W.	209
PÖLLMANN, L.	293,392,403,442
PÖPPL, S.J.	202
QUENTIN, E.	55

RADOŠEVIĆ-VIDAČEK, B.	434
RASCHKE, F.	164
RATHSACK, R.	371
RAUCH, E.	177
RENSING, L.	39
RESCHENHOFER, E.	160
RESCHKE, B.	197
RICHTER, R.	351
RIETVELD, W.J.	74,100,238,252
RODE, I.	49
ROSAK, Ch.	197
RUF, T.	79
RUSCH, D.	317

SALLER, R.	197
SANI, E.	110
SAUERBIER, I.	265
SCARPELLI, L.	288
SCARPELLI, P.	288
SCHACHTLER, R.	49
SCHILLING, A.C.	55
SCHMID, H.P.	226
SCHMIDT, K.L.	317
SCHMIEDER, G.	209
SCHRAGE, E.	442
SCHROEDER-LORENZ, A.	39
SCHUBERT, E.	193
SCHUH, J.	335
SCHULENBERG, A.	177
SCHULTHEIS, H.	398
SCHWEIGER, H.-G.	15
SEIDLOVÁ, A.	330
SEMLER, H.	187
SILYN-ROBERTS, H.	90
SINZ, R.	214
SPEDA, R.	193
STEINHÄUSER, B.	340
STEINLECHNER, S.	79
STIEGLITZ, R.-D.	364
STRAUER, B.E.	293
SZINICZ, L.	270

TARQUINI, B.	288
TECHEL, D.	39
THOREY, I.	49
TIRSCH, W.S.	202
TOUITOU, Y.	423
TOURON, N.	423
TRAGESER, K.	387

VALACHOVÁ, A.	307,330
VERDUIN, C.J.	413
VIDAČEK, S.	434
WADDELL, B.	65
WAGNER, H.	356
WATERHOUSE, J.M.	119
WECKENMANN, M.	177,387
WENDT, H.W.	375
WICHERT, P.von	346
WILDE, J.	55
WITTING, W.	104
WIRZ-JUSTICE, A.	247,252
ZIMOWSKA, G.	94
ZEZULA, P.	136