Karl Hecht, Berlin

Chronopsychophysiology – functional cyclicity - health

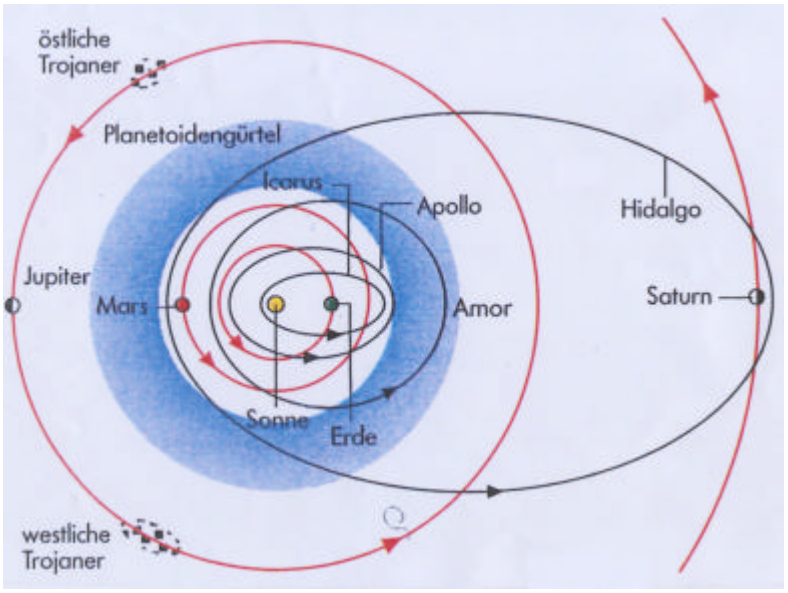
The universe and the world do subsist from closed control loops.

In the past the German astronomer Johannes Kepler stated in „ Mysterium Cosmographicum“ (1596), *“God has written bodies into the circles and the circles into the bodies as long as there didn’t exist any body anymore, which wasn’t equipped internally or external with flexible circles”*. This perception by Kepler which means, more than 400 years ago, that all Nature consists of control- or regulation circuits, is at the same time genius, close to reality and more actual then ever before.

Today we can state as substantiate, that whatever existing system in our nature, distinguish themselves by a relatively stabile and solid network of control circuits with certain mechanism of feedback, information and energy, which will guaranty self regulation in the system itself.

A few samples shall prove the character of control circuits.

As first demonstration for macroscopic control circuits we show here the scheme of the belt of planetoids between Mars and Jupiter.

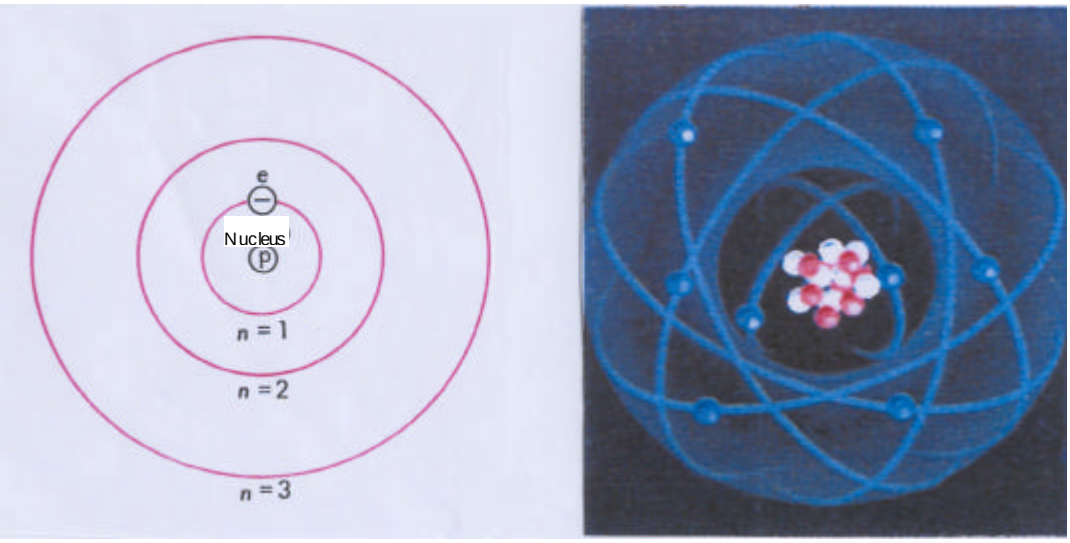


Picture 1: Belt of planetoids between Mars and Jupiter

As examples for microcosmic control circuits first we demonstrate Bohrs' atom model of hydrogen, which you see in the picture on left hand side

p = proton e = electron
n1 = course of quantum in cardinal characteristic
n2, n3 = course of quantum characteristic when stimulated

and second, the simplified shell model of oxygen.



Picture 2: H: atom of hydrogen O atom of oxygen

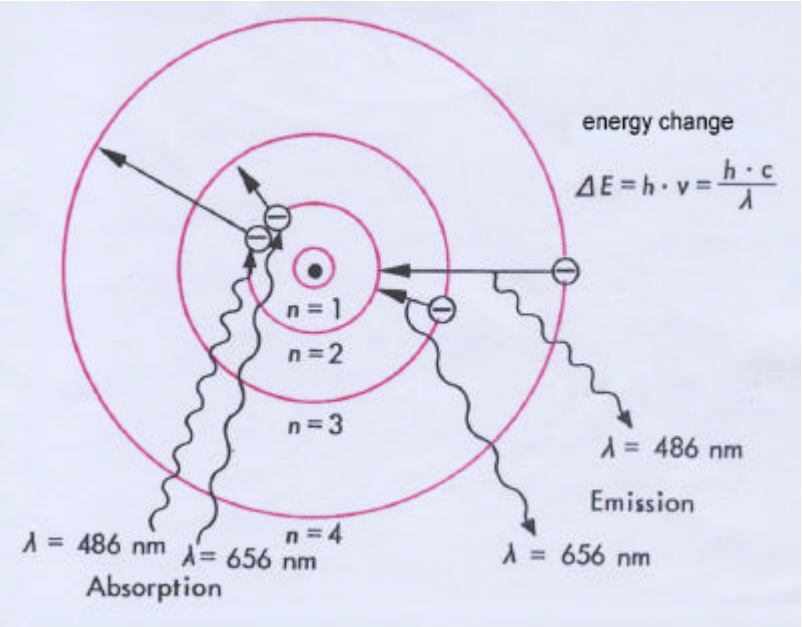
As we do know, the molecule of water does consist of one atom of oxygen and two of hydrogen

Are you able to imagine the netted control circuits of the oceans on our planet, basing on the tetra hydrol structure of hydrogen molecule. Or the human body, 60-75% consisting of water? The science about water, based on functional and structural oscillation, today comes into a revolutionary era on this fact [Kröplin 2004].

This picture shows the H-atom-model with the transition paths of electrons (quantum) when energy is applied or energy output in the example of absorption or emission of light in defined wavelength.

n1 = course distance of quantum in cardinal characteristic

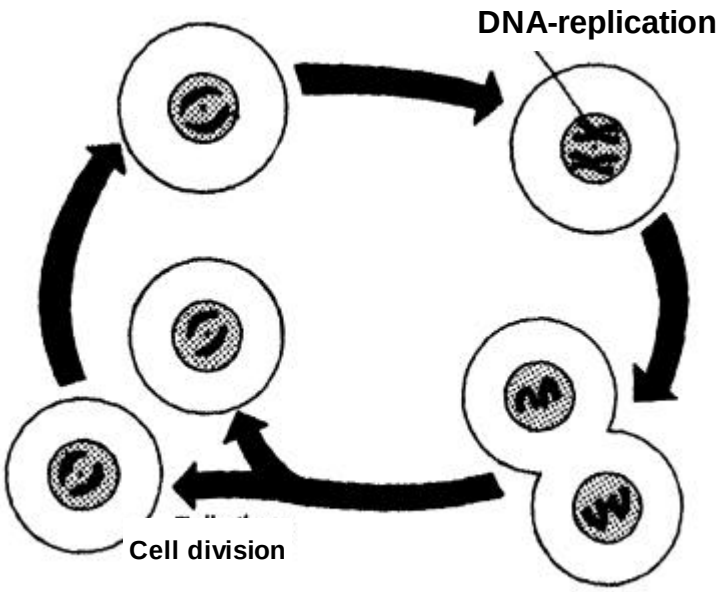
2,3,4 = course distance of quantum when stimulated



Picture 3: atom of hydrogen; process of change in energy

The example demonstrates how energy exchange of the systems is done by control circuits and oscillation, same in biologic systems.

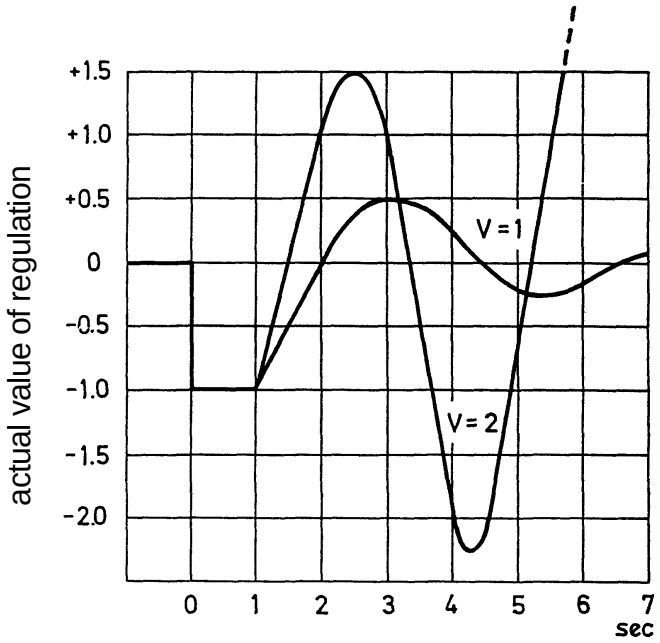
As another example for biologic control circuits we present the cycle of cell division.



Picture 4: cell division

Control circuits are oscillating

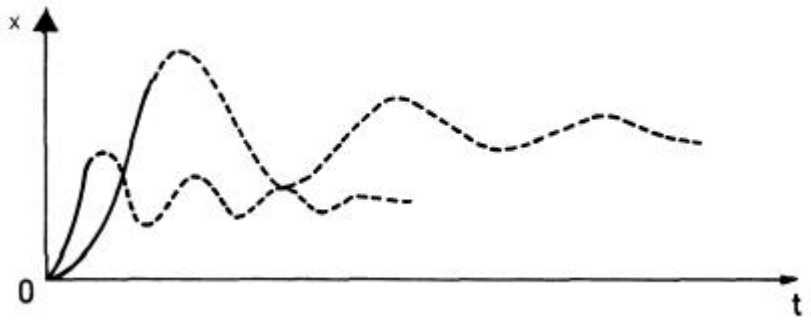
One of the main attributes of a control circuit is the behaviour in time, that is expressed as the oscillation, i.e. periodic, and thus will be measurable.
The attributes of control circuit oscillation enable a conclusion on stability and / or instability.



Picture 5a: oscillation of control circuits

In the top picture you see the model of the interaction of two control circuits with different amplification after disarranging, what had caused a deviation in control at time zero.

Picture below demonstrates entrance oscillation, the typical control circuit attribute.

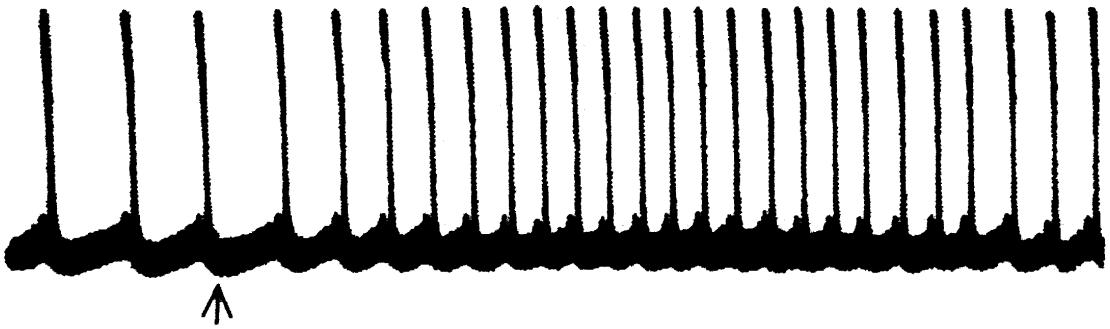


Pictures 5b : control circuit oscillation

In a living process the course / run down of oscillation will have approx. this way on rhythmic activity in cell culture of neuron-heart-muscle-cell, as we will demonstrate. Stimulating the cholinergic neuron will cause /produce that acethylcholine will be released, triggering a short blockade of the periodic heart muscle activity. Stimulation of the adrenergic neuron will set free neuroadrenalin. Due to that, the activity of the heart muscle (myocardium) will be increased, i.e. this will lead to an increase of the frequency. As the periodic variability of the whole human body in total, also in each

single cell, does run coordinated when stimulation comes from both, outside or internal, one can get an imagination on the flexibility of this regulation mechanism in each individuum during the process of adoption.

Stimulation of the cholinergic neuron



stimulation adrenergic neuronum

Picture 6: Stimulation of the cholinergic and of the adrenergic neuron

The relatively stable structure and form of he human body is uphold by innumerable independently renewing, linked control circuits. The plastic form of the human body is composed in time and function interaction of numerous complex dynamic and flexible control circuits. As e.g. the circulation in the body and coronary, neuro-network of the brain, hormonal and propagation system, motion of the body and metabolism. All functional processes of the human body are run oscillating, consequently periodical.

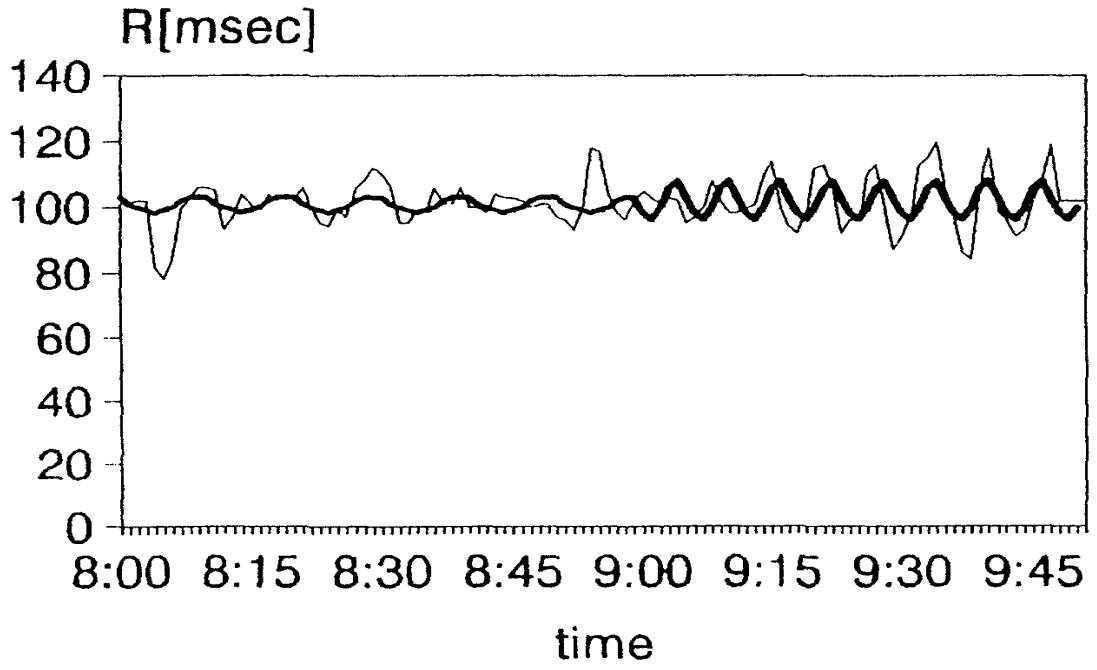
In human bodies we do find a range of frequency from 10^{-6} to 10^{-8} seconds of this various oscillating processes. These can be proven in every level of regulation, e.g. ional, molecular, mega molecular, colloidal, sub cellular as well as organic, complete and social control levels.

A partial breakdown of one of the oscillating control circuits in the human network will cause a loss of energy, information, health and life expectation which can be verified. A total loss of oscillation, e.g. EEG waves, will be the criteria for death. The definition of clinical death is determined by loss or no (flat) EEG-signal wave.

The human body consists of many psychophysiological cycles

When registering and verifying the periodical functions of the body, one has to follow two basic procedures:

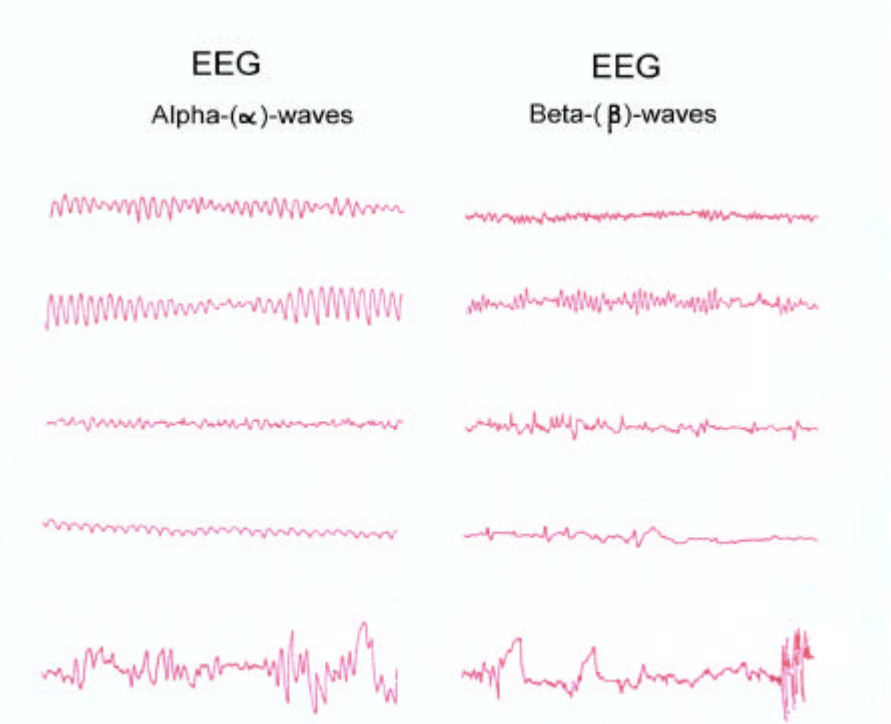
1. Research on time line data (consecutive data) with adequate methods. Mostly we use electrophysiological, non-invasive methods to capture data in time lines, which are the most suitable ones. In some electrophysiological methods one can read the periods of time-line data oscillation with the eyes without amplification etc. like in ECG and EEG. In other parameters this is not always possible. Therefore we need:
2. The biorhythmometrical analysis of time-line data. As there are different methods. E.g. the Cosinor- and CHAT-method by Halberg et al. [Halberg et al. 1998, 1996; Halberg 1962, 1960], the auto correlation- and crossover correlation function or the Fourier analysis. Here we have to take care that within the measured time-line data there is both, one part of stochastic (chaotic) and one of periodic (deterministic) data. The picture shows with the thinner line the stochastic (chaotic) and with the thick line the periodic (deterministic) part within the time-row [Hecht 2001].



Picture 7: skin resistance rhythm analysis

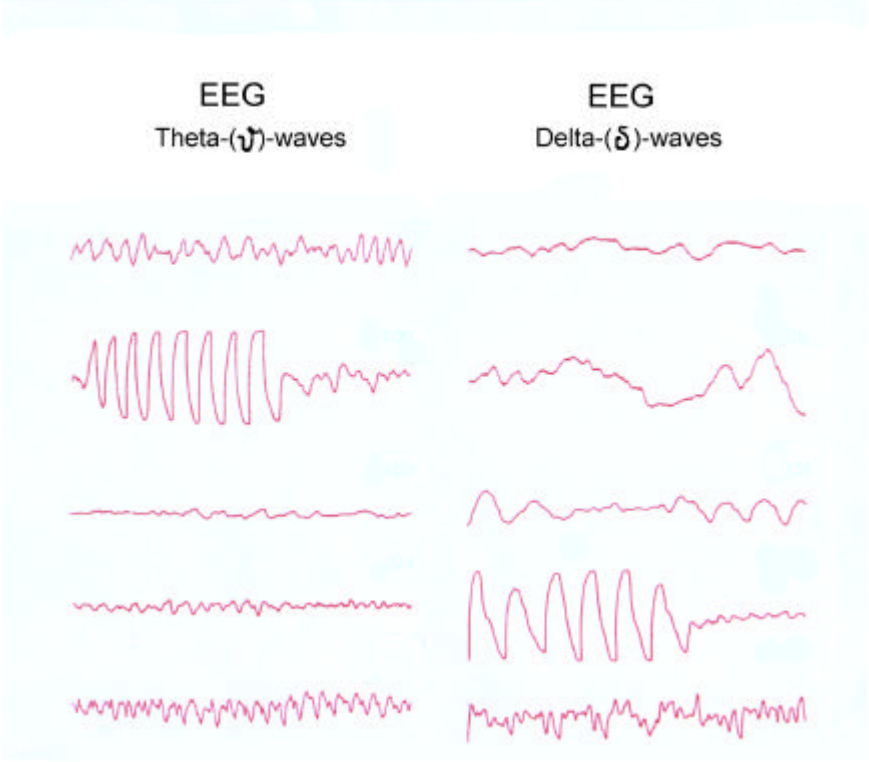
Model --- analyzed rhythm

The form variety of periodic function in frequency and amplitude shall be demonstrated with the alpha and beta waves of EEG. The sequences of 3,3 seconds from an EEG registration of five different, healthy probands (from top down) evidently prove. Alpha waves do have a frequency between 8-13 Hz, beta waves higher than 13 Hz.



Picture 8: EEG: Alpha- and beta waves

We do demonstrate EEG-Theta waves with a range between 4-8 Hz and Delta waves (below 4 Hz) from even the same proband in different configuration.

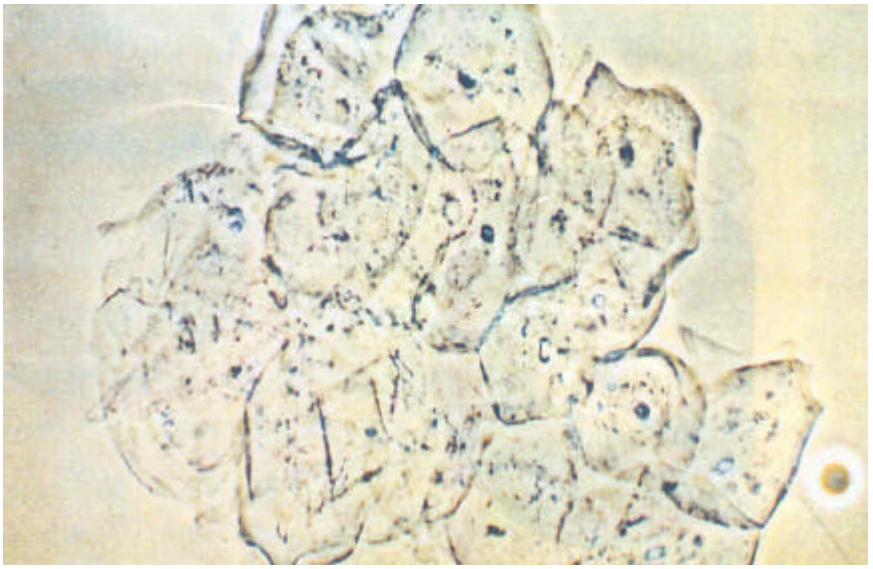


Picture 9: EEG: Theta- and delta waves

Cells and cell formations, metabolism, function of the brain etc. do have their own frequency and are able to oscillate at the same time in most different frequencies. The character of such a frequency can show a rhythm of oscillation in a range of seconds, minutes, hours, days, weeks or months. The single cell can show at the

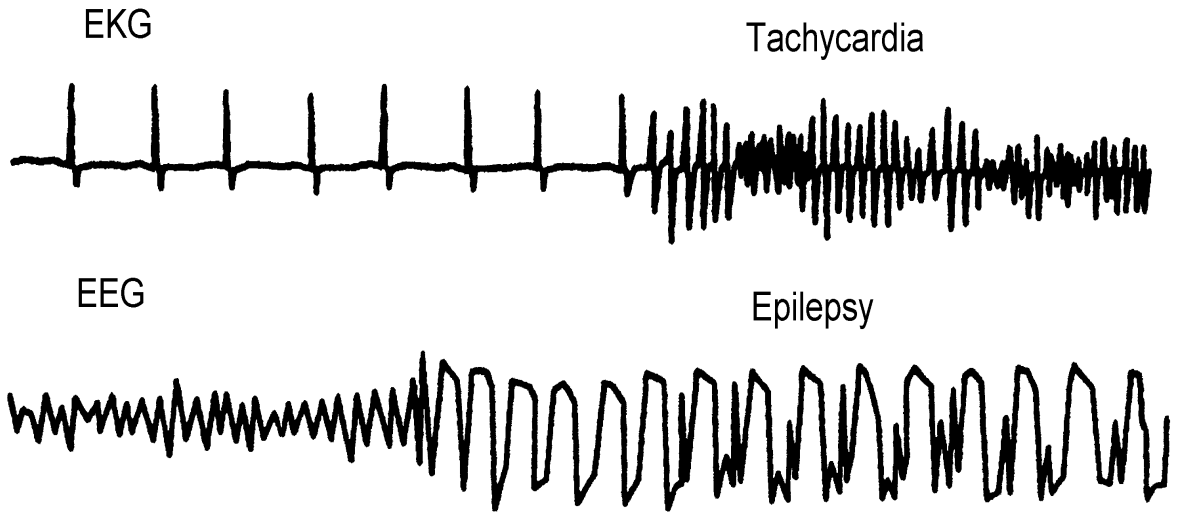
same time an individual rhythm between 8-12 Hz following an ultradiane, circadian and circaseptan rhythm [Schweiger 1987; Hildebrandt 1962].

The individual rhythm of cell formations between 8-12 Hz has been proven by Randoll et al. [1992] by video microscopic methods. Within the cellular matrix cells organize cell colonies and network themselves with “communication channels”. Via these channels the rhythm of one cell formation is synchronized.



Picture 10: Synchronisation of cell rhythm in cellular communication

Pathologic processes always show disordered rhythm or changes in wave structure. This led to establish the definition of dysrhythmia. Simple examples of dysrhythmia will be shown here in this picture by the example of a tachycardic heart attack in the ECG and second in epileptic attack in the EEG. The definition of dyscyclicity or dys-rhythmia would much better describe and characterize those “pathopysiological” processes than the word disease.



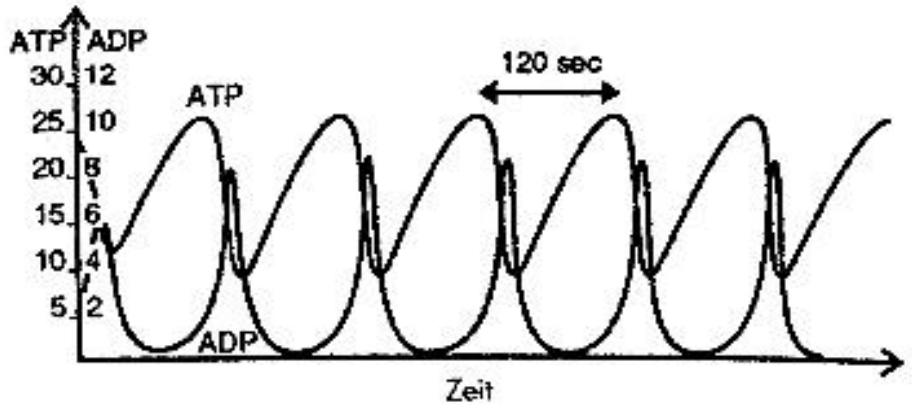
Picture 11: Tachycardia and Epilepsy

Rhythm of minutes - Minute-rhythm

Based on actual findings we can say that there is a minute rhythm regulating a running the metabolic and epigenetic process, including the protein synthesis [Rensing 1973, Sinz and Isenberg 1972]. The periodicity in the range of minutes is controlled by the central nervous system. We do characterize minute rhythms, which show a length of the periods from 0,5 up to 60 minutes, in general we see only 0,5 to 30 minutes. The basic rhythm of these function is approx. 2 minutes [Hecht 2001; Coveney and Highfield 1999; Balzer and Hecht 1989; Hecht et al. 1976; Golenhofen 1962]. These functional systems are able to develop working rhythms in parallel showing a periodical length with the proportion of absolute numbers correlating to the basic rhythm of two-minutes. We call the minute rhythms short ultradiane rhythms.

The extraordinary variability of frequencies, particularly the erratic or gliding transition towards multiplicative resp. demultiplicative wave length, based on absolute numbers correlation of this biorhythmic aspect evidently roused the attention of investigators [Sinz et al. 1975, Hecht et al. 1972, Hecht, Peschel 1965, 1964]. This enables at the same time the determination of individual conditions of the different functions in analogy to the EEG [Hecht 2001].

The correlations of two different principals of function in minute rhythm, phase contrary and phase equal, are an important attribute of the autonomic self-regulation. The economy of energy in our organism is based on this principle, using ATP as an important factor. The oscillation of the ATP correlates with the existing level of glucose and ADP within the mitochondria. When there is only a few ATP, glucose will start interacting and producing the needed ATP, whereas on the other side, when we have plenty of ATP, glycolysis is stopped [Babloyantz 1986].



Picture 12: two minutes rhythm

The picture 12 shows the two-minutes-rhythm of changes in concentration in ATP and ADP [after Coveney and Highfield 1999]. Hecht et al. [1972; Hecht 1984] describe the phase balance of the minute rhythms in central nervous systems and their significance in adoption process. The perfusion and supply with blood in skin and muscles also oscillates phase contrary in two-minute sequences, i.e. the more intensive perfusion of the system on one side changes with a two-minutes rhythm to the increased perfusion of the system on the other side [Golenhofen 1962].

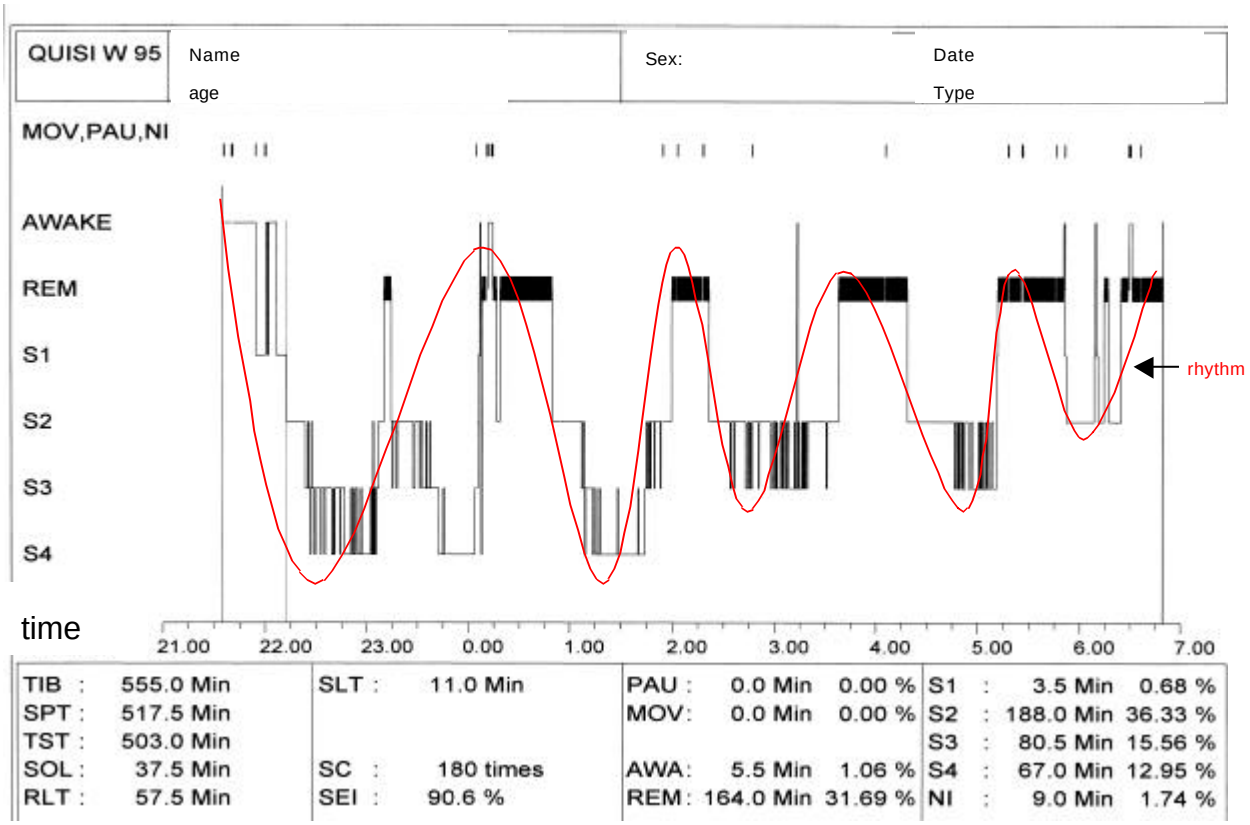
Sleep

Physiological seen sleep is a function consisting from a hierarchy of cycles with a different periodic length [Hecht 1993]. REM-sleep-cycles form the basic rhythm. There were counted to the order of ultradiane rhythms. 1953 Aserinski and Kleitman discovered in sleep polygraphic trials, that there are phases of rapid eye movements [Aserinski and Kleitman 1953]. They called those rhythms REM-phases (Rapid Eye Movement). Today we name this phase of sleep REM-sleep phase, which can be seen with a cyclic between 4 - 6 times during one sleep night. The time between the beginning of one REM-sleep phase and the begin of the next one, is named REM - cycle. The REM-cycles with their relative regularity stand for a certain level of sleep quality, and when they are reduced or disturbed this will be characterized as sleep disorders.

The second partition of sleep is called NON-REM-sleep (NREM) and based on EEG-, EMG- and other parameters divided into 4 NREM-phases:

- I Transition stadium (Awake-sleep)
- II Superficial sleep (doze)
- III Median sleep
- IV Deep sleep (Delta sleep)

The sleep in total is embedded in the rhythm of the day.



Picture 13: normal sleep polygram (hypnogram) showing rhythm

Sleep diagnosis

- REM-cycles are the physiological ground structure of sleep
- Sleep is a separate function of the organism, organized in cycles embedded in the rhythm of the day.
- Sleep profile cycle is the main criteria for quality and recuperation in sleep.
- Sleep is the stepchild in medicine. There is no diagnosis of sleep according to diagnostic or scientific demands.
- With the automated sleep stage classification device the physician will get a new instrument for objective judging of the sleep in his hands.

Why is it so important that sleep diagnosis has to be done objective?

Sleep disorders cause illness and disease

Non restorative sleep is an important risk factor for chronic diseases.

WHO-housing and health-Survey (First results, meeting 20.-22.10.2003 at Bonn): Surveys in European Capitals e.g. Bonn, Budapest, Bucharest, Geneva, and Vilnius. Result: Chronically sleep disorders have been found and proven (statistical assured) to be the main cause for the following diseases:

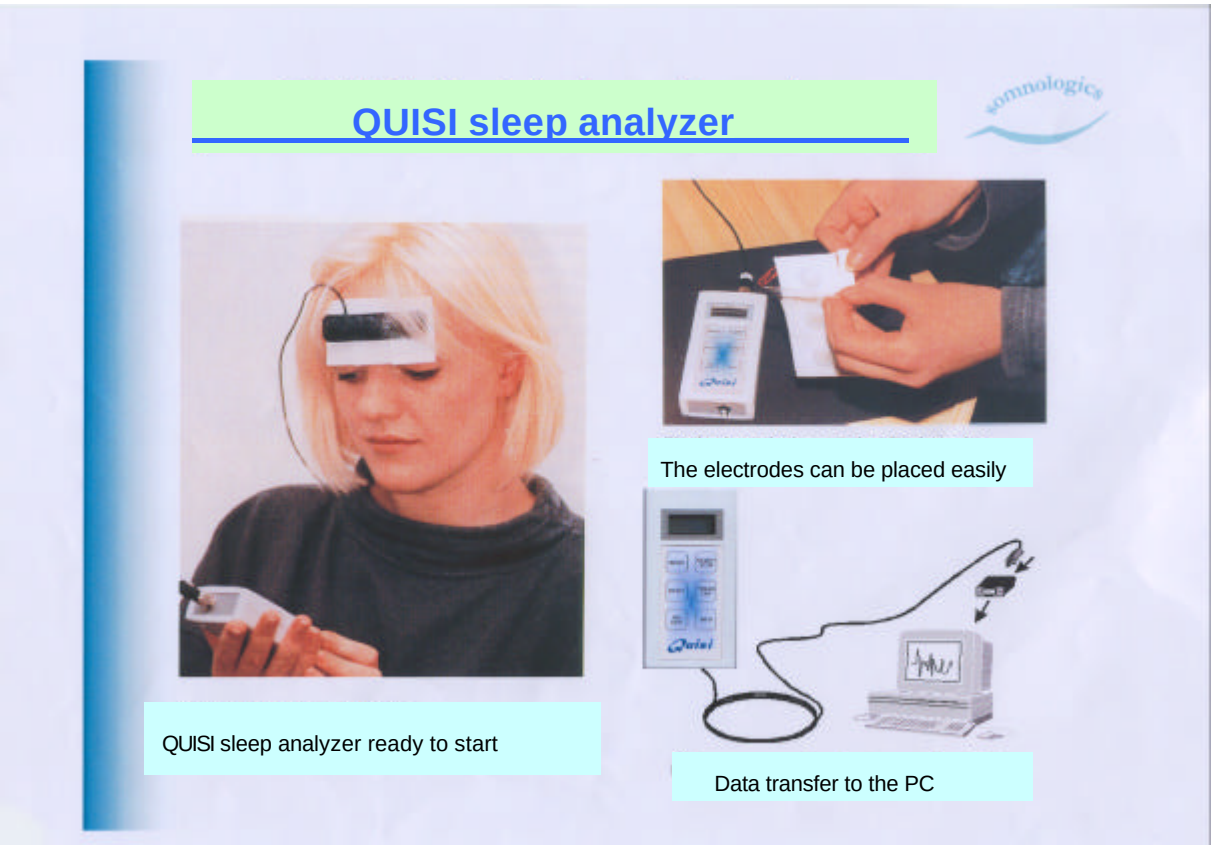
- Diabetes mellitus
- Arterial Hypertonia
- Heart attack
- Stroke
- Maligned tumors
- Asthma
- Bronchitis
- Depression
- Migraine
- Skin diseases
- Allergies
- Gastric ulcers

The prevalence of chronically sleep disorders in Europe:

approx. 12-20% of the total population [Billard 1993]. Only a little part out of them is treated with appropriate therapy. And drugs and sleeping pills should be used in therapy only as an exception and doe not stand as remedy of the first choice.

The ambulatory, automated sleep analyzer QUISI.

What is this device able to do?

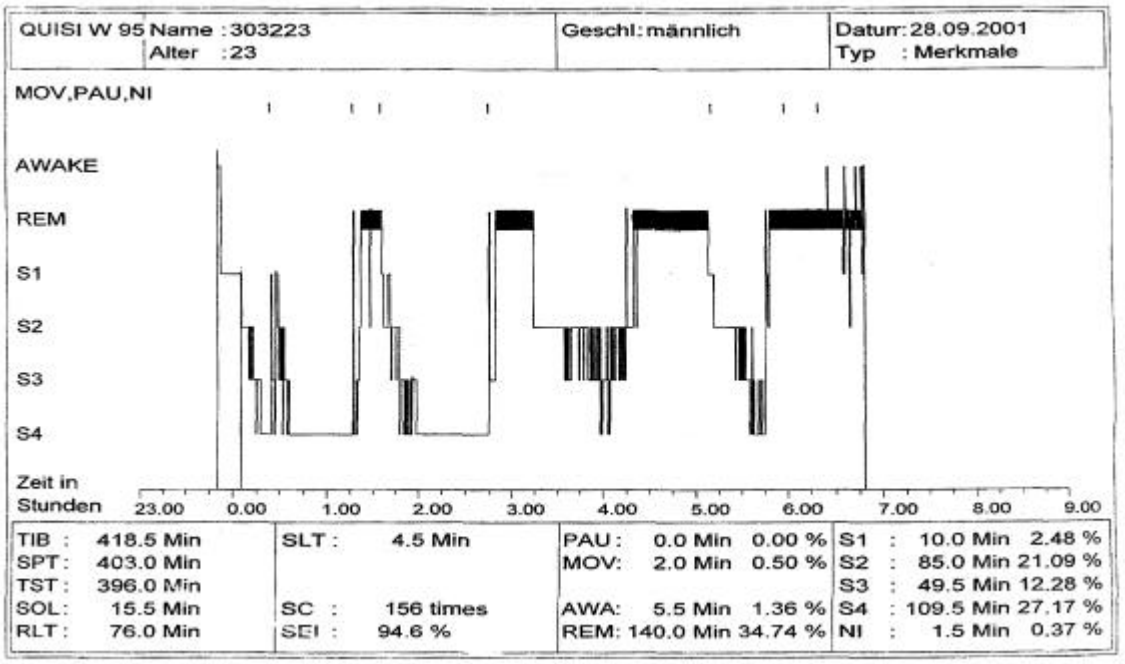


Picture 14: QUISI ambulant, automated sleep analyzer

The QUISI sleep analyzer is steered by micro controllers. Neuronal network controls and classifies the sleep stages. The detection and registration of the EEG is taken by only one tripod frontal electrode which can be easily placed by the patient himself just before going to bed. The device has only to be switched on, when in bed, and switched off, when leaving the bed. Via PC the data will be taken and the classification of sleep stages is done with a specialized software program.

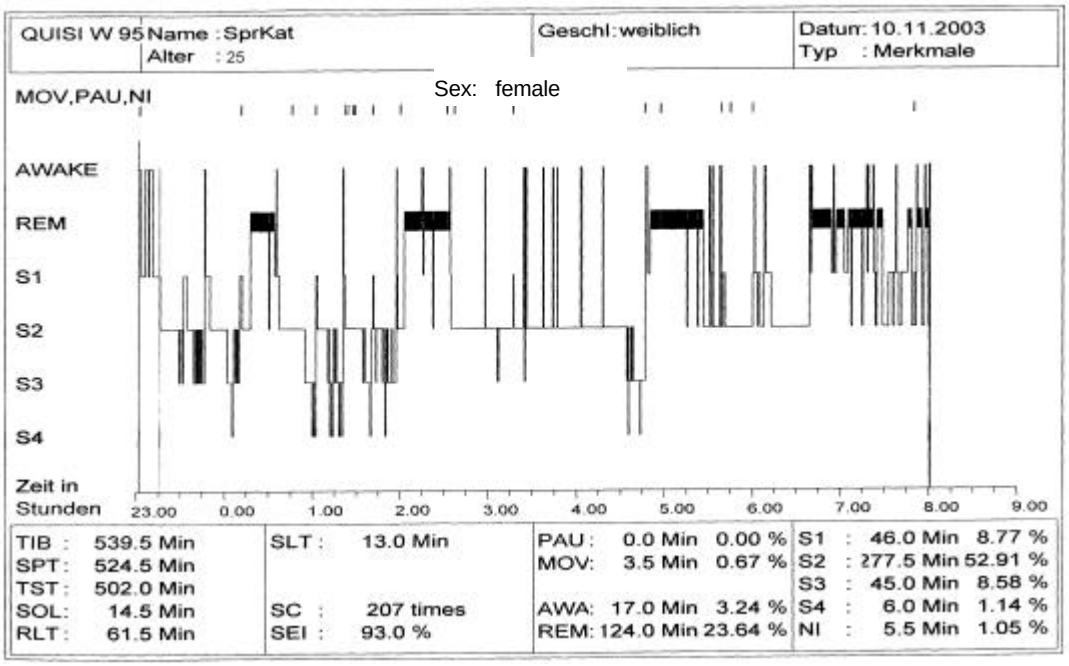
The whole procedure from connecting the device with the PC, transfer and classification will take you approx. 3 minutes. And, most important, the device can be used at home in the bedroom or in clinical patients room.

The print out of the analysis will show the sleep profile and data of the most important parameters, as time in bed (TIB), total sleep time (TST), sleep time (SPT), sleep-onset latency (SOL), REM-latency (RLT), sleep latency (SLT), wake up during the night (AWA) together with the REM-phase all four different sleep stages in percentage and total minutes



Picture 15: standard, healthy and rhythmic sleep profile

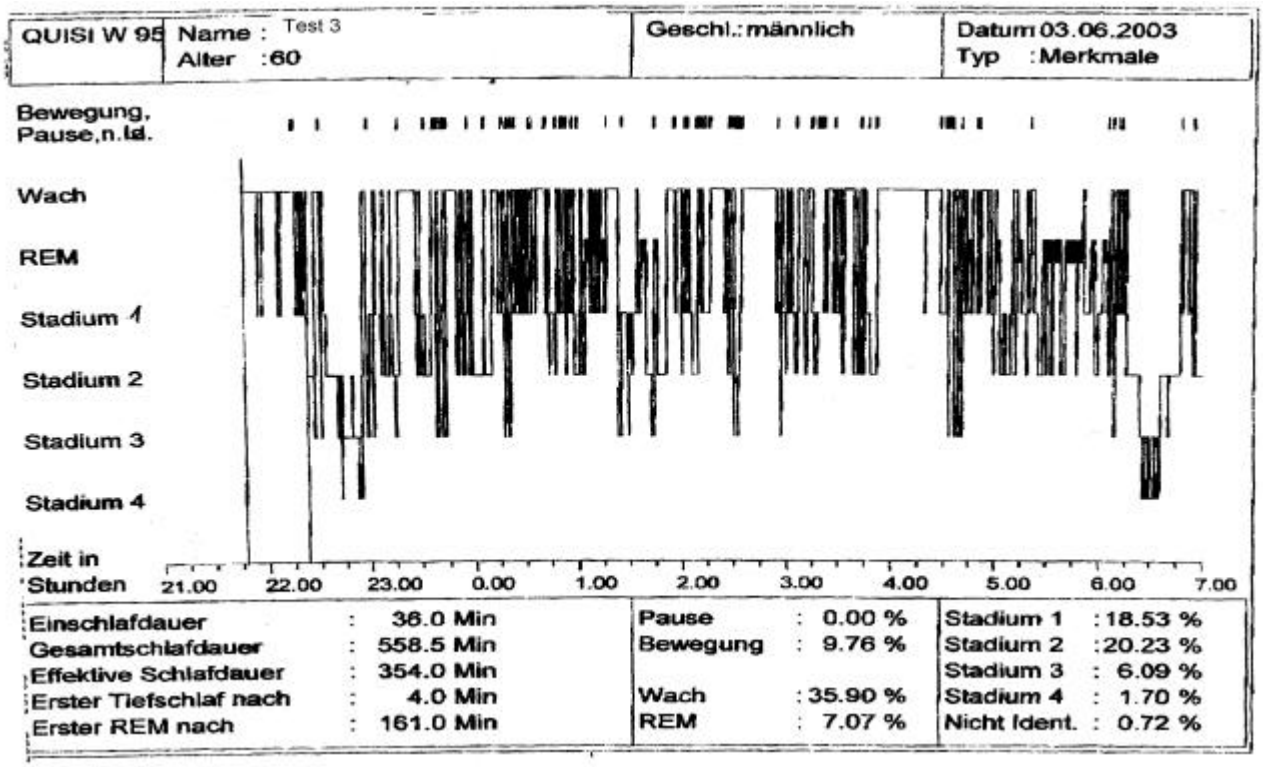
We have already done more than 1.000 sleep-night registrations with the ambulant, automated sleep analyzer. And we will demonstrate here with the following pictures, first normal, functional sleep profiles of healthy probands and later some as examples for different sleep disorders.

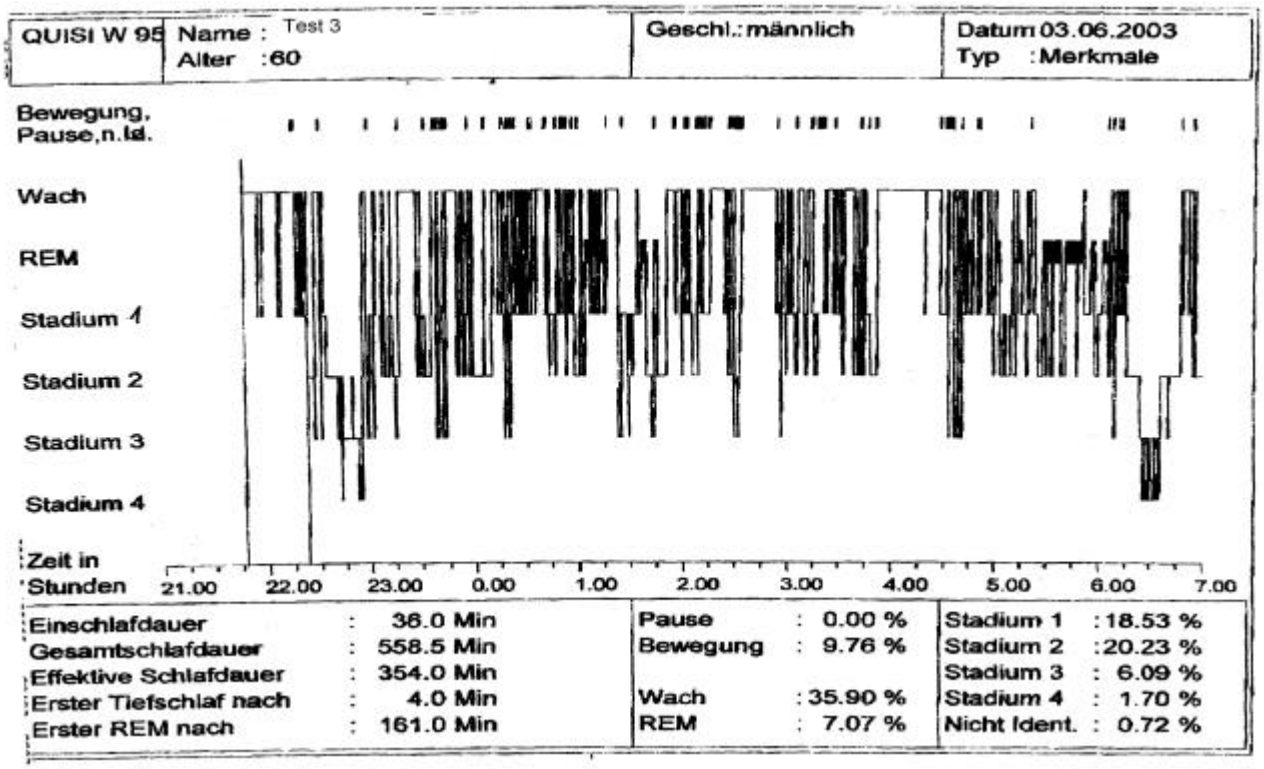


Picture 16: sleep disturbed by noise

There was a truck disturbing the sleep of the lady. Each time a big truck passed her house, caused a short, mostly not conscious noticed, wake up of 1-2 minutes. She has gone through 34 of these short time wake-up episodes in this recorded night. The rhythm of the sleep is disturbed, DELTA-sleep (deep sleep) is much reduced. Diagnosis: Non restorative sleep.

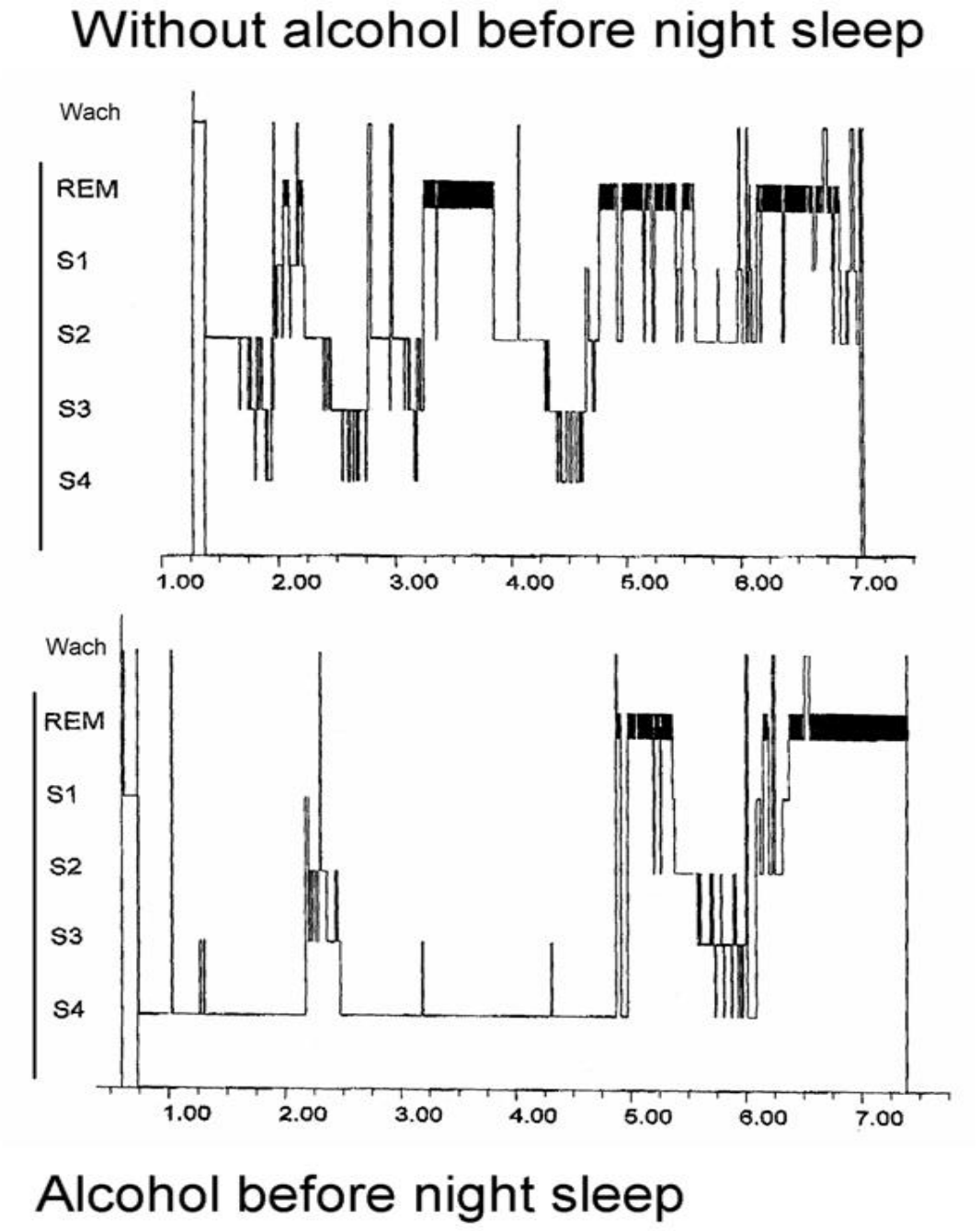
This patient had a multitrauma and due to pain and muscle tension his sleep was very much disturbed. The percentage of awake out of total was 36%. He woke up very frequent. The sleeping drug Loretam, a Benzodiazepine, intensified his sleep disorders. Diagnosis: Non-restorative sleep. The sleep rhythm is disturbed.





Picture 17 : fractionated sleep profile from multitrauma patient with pain

Alcohol shall be a goodnight sleep drink. This is a big error. Alcohol is a big cheater. Top you see a sleep profile with no alcohol before going to bed. Below you see a sleep profile when consuming 3 glasses of champagne and 2 cognacs. The patient immediately fell into a state like coma. Four hours later the rhythm of sleep profile came slightly back. Diagnosis: Non-restorative sleep. Rhythm of sleep is disturbed. The part of physiological sleep is too short. Due to that there is a head-egg in the morning.

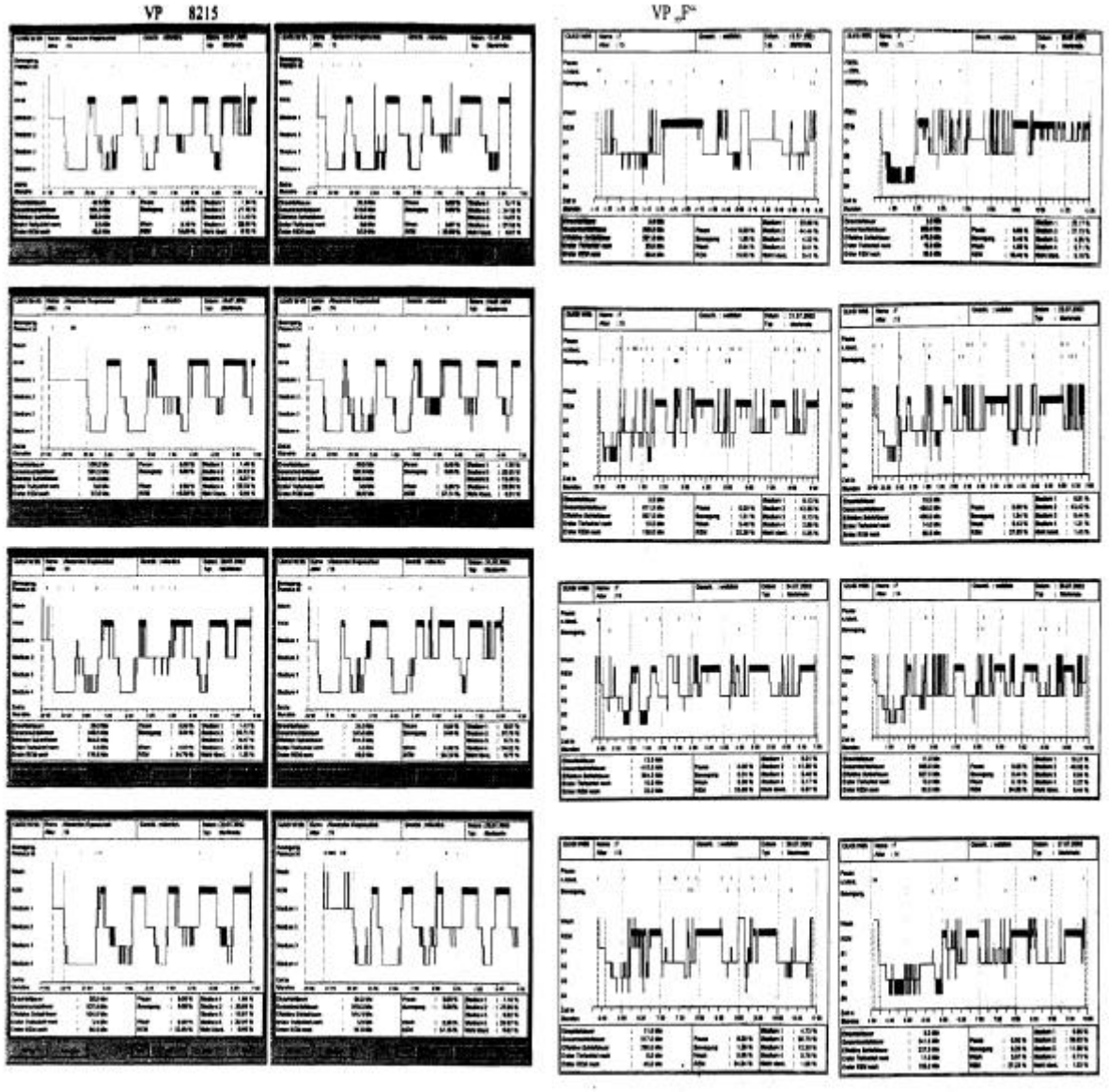


Picture 18: Alcohol disturbing the sleep - showing the influence of alcohol on sleep rhythm, profile and REM

Sleep profiles compared:

This left hand side picture shows 8 consecutively registered sleep profiles of a young man, going to bed and getting up regularly every day. His sleep profiles demonstrate a very good cyclic structure.

Diagnosis: restorative sleep.



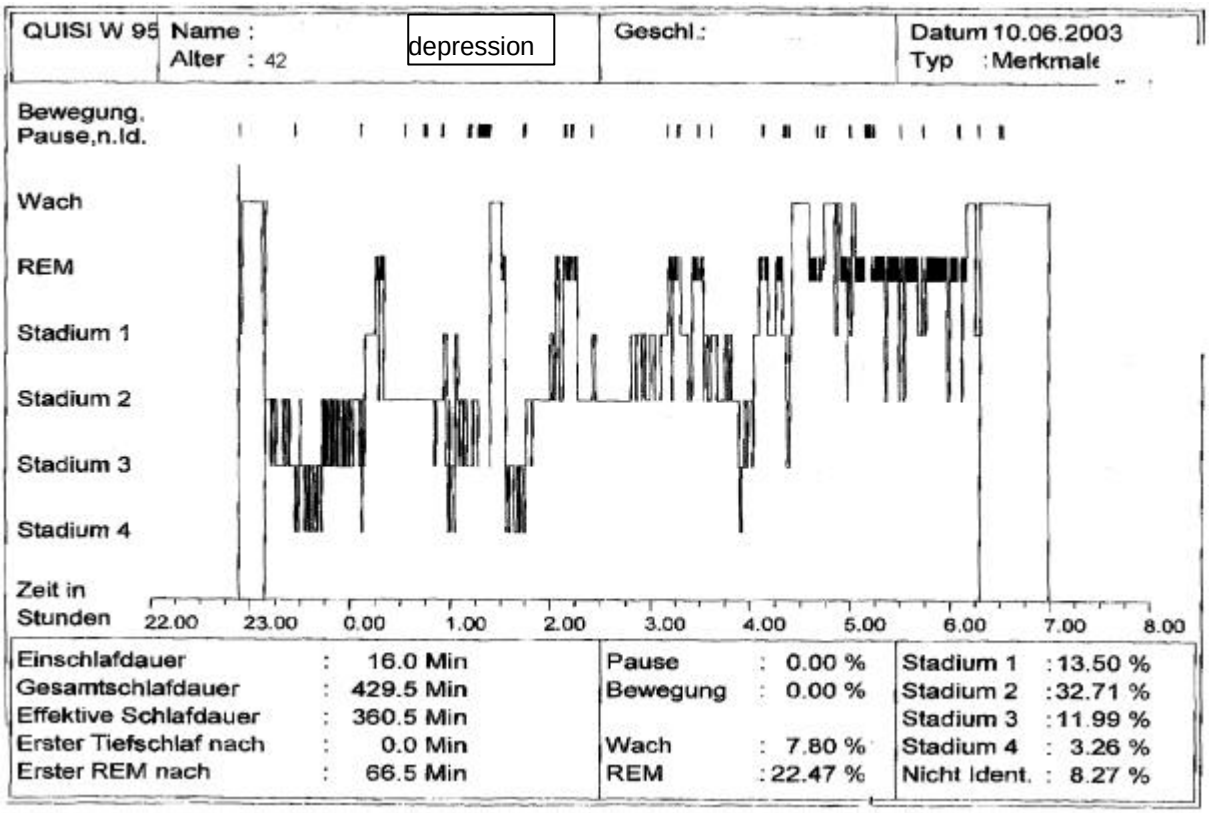
Picture 19. two sleep profiles in comparison, regular daily bedtime, and irregular bed time.

Picture on right hand shows the opposite side of sleep behavior. The proband went to bed very irregular. Time when she went to bed was between 02:00, 04:15, 23:00, 21:00, 00:15, 00:00. 05:30 and 04:30. You will evidently see, that the sleep profiles do show reasonable irregularity and disorders.

Diagnosis: No restorative sleep.

Profile of depression:

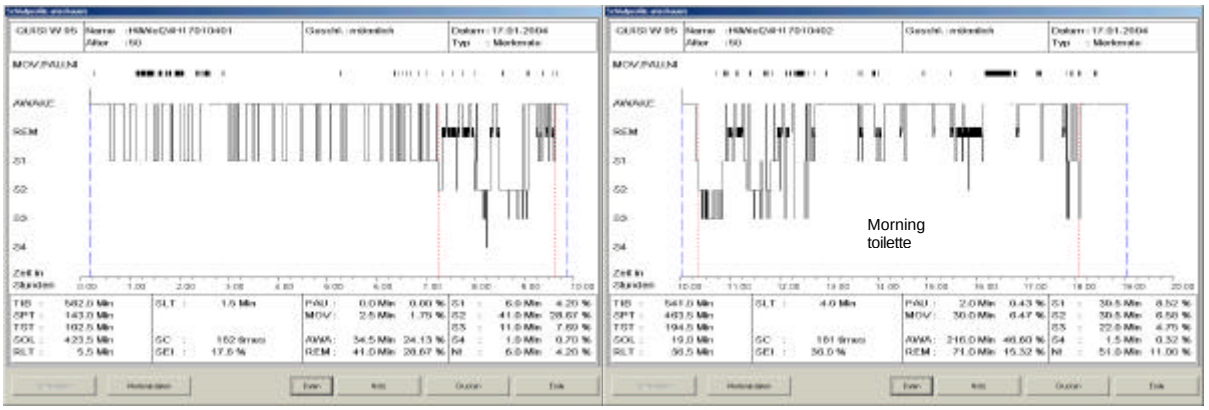
sleep profile of depressive patient, 42 years old, male. This sleep profile shows evidently the characteristics of a depressive patient: disordered sleep rhythm, increased REM-sleep density (especially in the morning), frequent interruption of sleep with short time awakeness, early wake up and reduced Delta-sleep (NON-REM-stage 3 and 4).



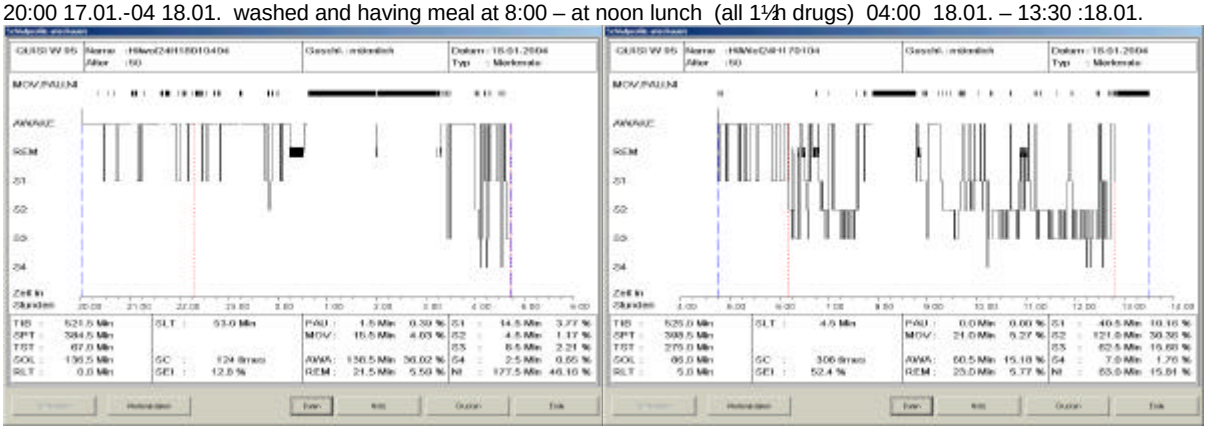
Picture 20: sleep profile showing depression

Stroke: sleep profile of stroke: sleep profile of a patient, male, 50 years old, stat of condition after stroke (apoplectic stroke) followed by dominating symptoms as, somnolence, speech disorder up to loss. muscular spasm, nutrition via sound. As the registration from the nights before showed only a little part and symptoms of sleep, there was taken a continuous recording of day-and night profile in the next two days.

Stroke patient 24 h profile 16./ 17. 01.04 begin 00.00 to 17.01.04 10:00 10:00 17.01. - 18:00 17.01.04



20:00 17.01.-04 18.01. washed and having meal at 8:00 – at noon lunch (all 1½h drugs) 04:00 18.01. – 13:30 :18.01.

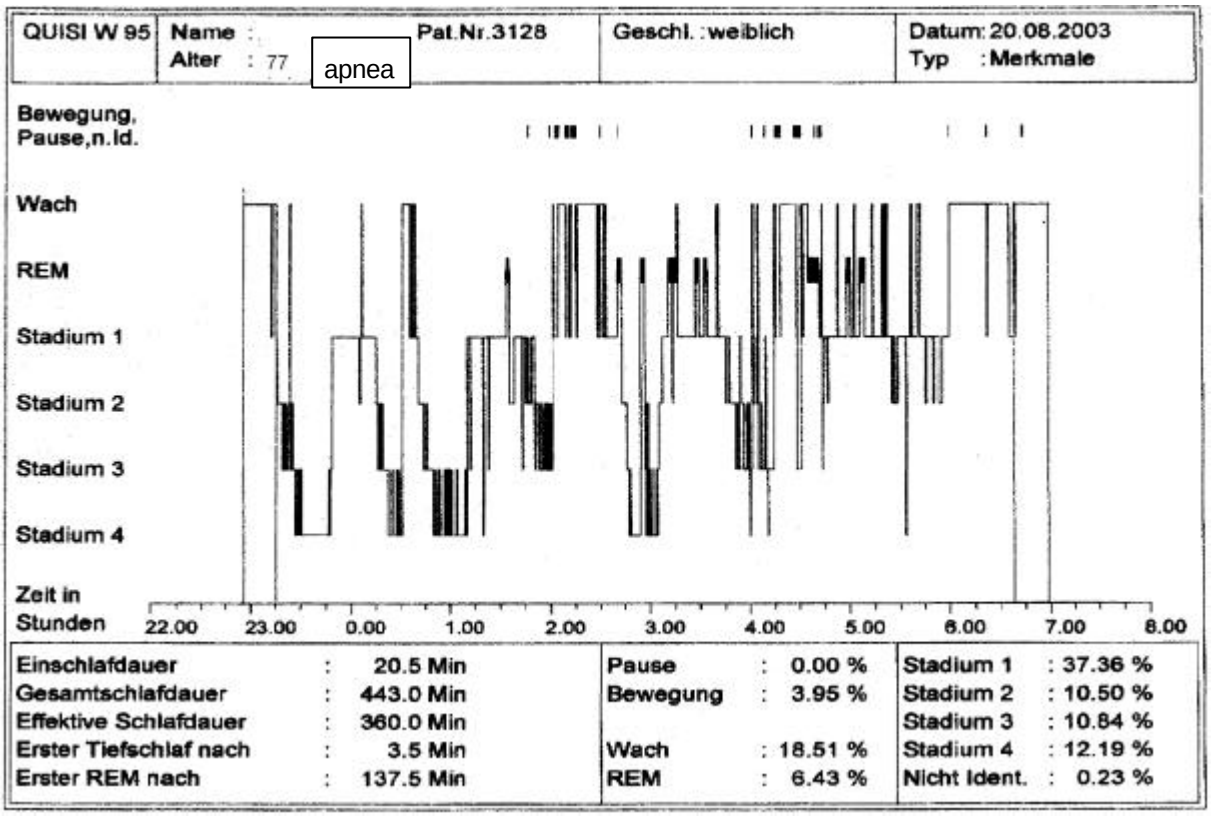


Picture 21: stroke patient 24h sleep profiles

These four sleep profiles demonstrate the following characteristic:
Night from 16th/17th of Jan 04 there was reached a total sleep time of 102 minutes with arrhythmic sleep profile of the night, and 194 minutes during the day. This shift of sleep into daytime is much more evidently seen in the night of 17/18th Jan 04. During the night there is a total sleep time of 67 minutes, but during the day 275 minutes. All four demonstrated sleep profiles are missing the rhythm of sleep. They have to be judged to be pathologic. But this finding shows that it is absolute necessary to include the restoration of the rhythm according to night and day synchronization of sleep-awake rhythm in the scheme and program of therapy.

Sleep apnea syndrome:

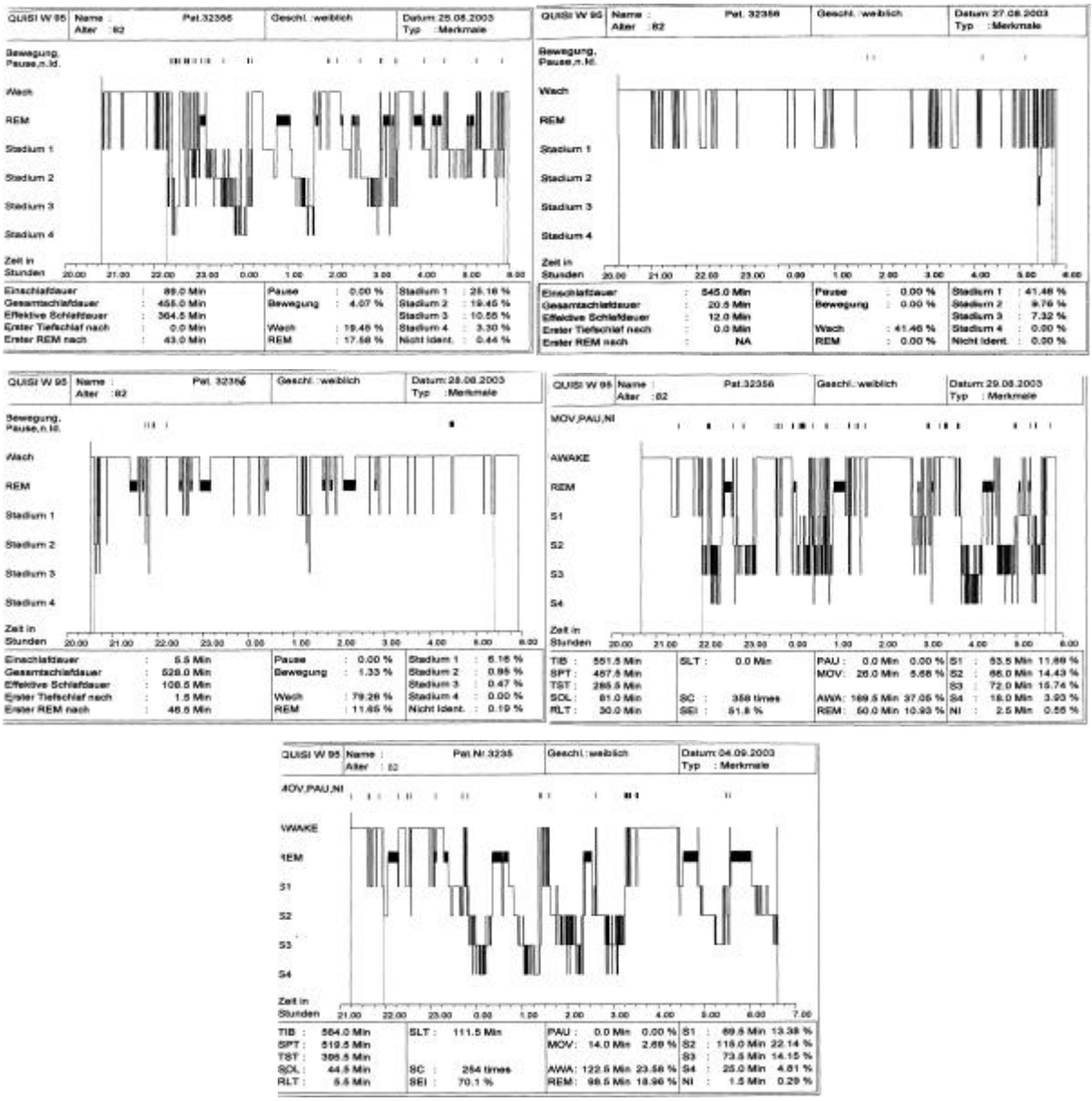
patient female, 77 years, is showing a sleep profile with the characteristic symptoms of sleep apnea: frequent wake-up during the night (38 times) representing a percentage of 19% on total time in bed, frequent change of sleep stages (260x= 43 times per hour). The is a surplus by 10 in NON-REM stage 1 and reduced stage 1 (doze) and Delta- and REM-sleep in addition.



Picture 22: sleep profile showing sleep apnea syndrome

Sleep disorders caused by the effect of analgetic drugs (transdermal adhesive with opiotics): the automated sleep stage classification device is also able to be used in tests of pharmaceutical drugs in home environment. This enables also the validation of non sleep specific drugs on their impact to the sleep. This shall be demonstrated in the next example (this was not a singular one!)

Patient, age of 82 years, claimed still having pain and not able to sleep even taking common analgetic drugs. This state is demonstrated in the sleep profile from 25th August 03 (I) with very long duration of sleep onset latency (time until falling asleep), and frequent wake-up (41 times) together with reduced deep sleep.



Picture 23: Sleep disorders caused by the effect of analgetic drugs

The sleep profile was taken on August 27th 03 (II) 24 hours after application of the transdermal adhesive. There, in fact, no sleep can be seen (only doze = NON-REM stage 1), though the pain was nearly taken as the patient stated. Then the adhesive was removed. The sleep profile recorded on Aug. 28th 03 (III) showing total sleep time of 108 minutes at a total time in bed of 528 minutes, together with a share of awake at 79%, REM- and deep-sleep are reduced.

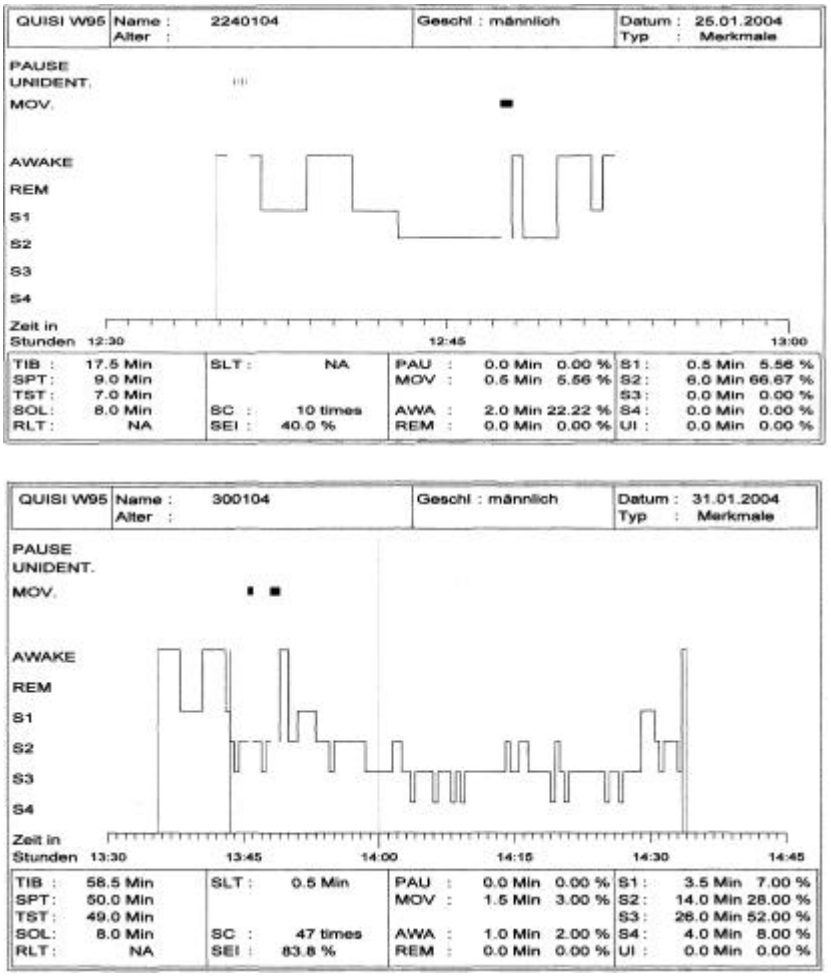
The sleep profile from 29th of Aug. 03 does show an amelioration this way, as at total time in bed of 551 minutes there is a total sleep time increase to 285 minutes combined with sleep onset latency at 81 minutes. The share of awake is still high at 37%. REM-sleep still reduced, but deep sleep is coming back.

Finally on 04th of Sept. 03 (V) the sleep profile does have a similar characteristic as it had before the application of the transdermal adhesive. Consequently is proven, that the singular application of this very strong pain-drug has disturbed the sleep over one week.

Such an absolute objective control of the run of therapy is totally new, and can only be realized with the automated sleep stage classification device.

After dinner nap sleep profiles:

It is also possible to judge objectively the after-dinner nap with the automated sleep stage classification device QUISI®. Here in picture 24 you see an example for a short after-dinner nap, lasting 17 minutes, dominated by surface sleep (NON-REM-stage 2) together with a long lasting after-dinner nap (58 minutes) with a big share of NON-REM-stage 3 and 4. As one felt recovery and fitness after the “mini-sleep”, the pro-band had problems to get activated after the long after-dinner nap.



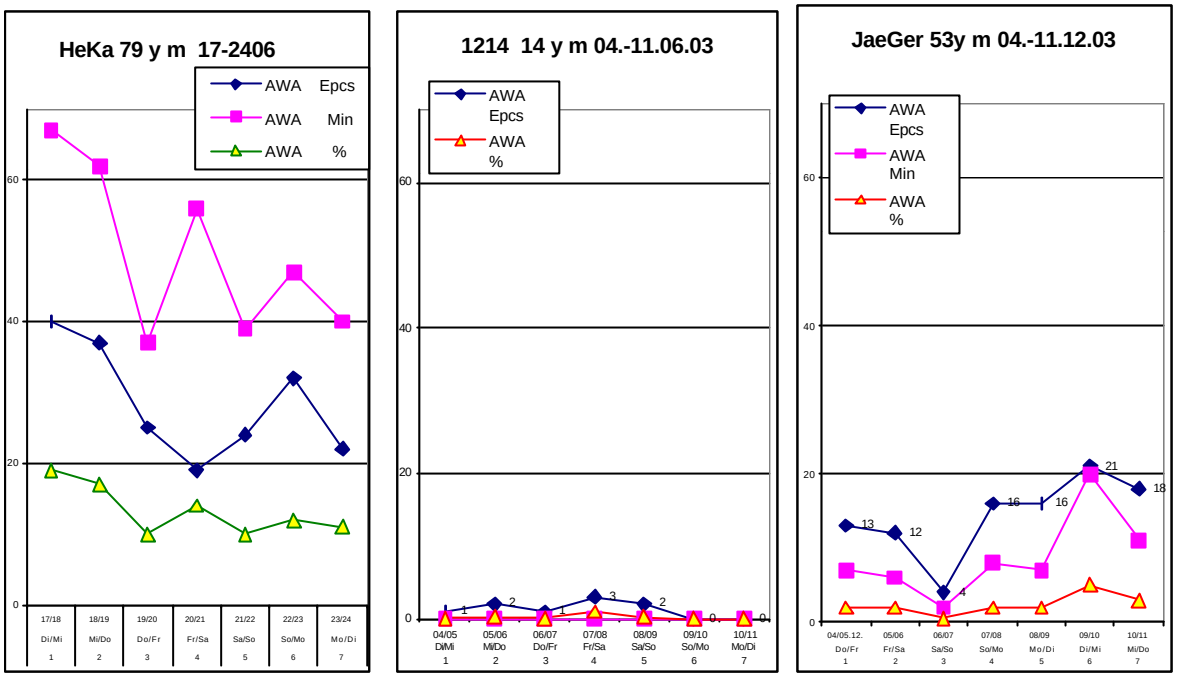
Picture 24 a and b : short and long after dinner nap sleep profiles

The weekly-rhythm of sleep

Duration and quality of sleep are not a constant factor. When we tried to get repro-ductable day-to-day sleep profiles, we discovered a weekly rhythm.

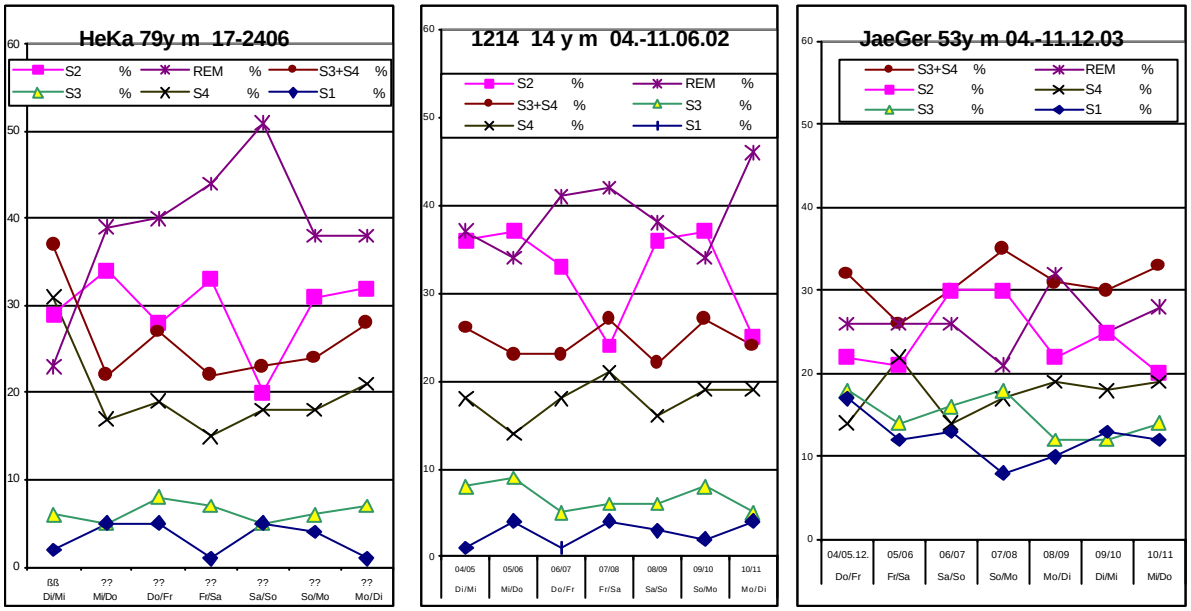
Based on this, we state, that there is at last a registration of 7 nights needed to make real diagnosis. Examinations of only 2 nights, as in sleep laboratory with the unac-customed conditions for the patient will not be sufficient to enable diagnostic of sleep or even sleep disorders.

In this picture we demonstrate the correlation of time factors, starting with total time in bed, total sleep time and sleep time of three patients. The waving from one day to the next is evidently.



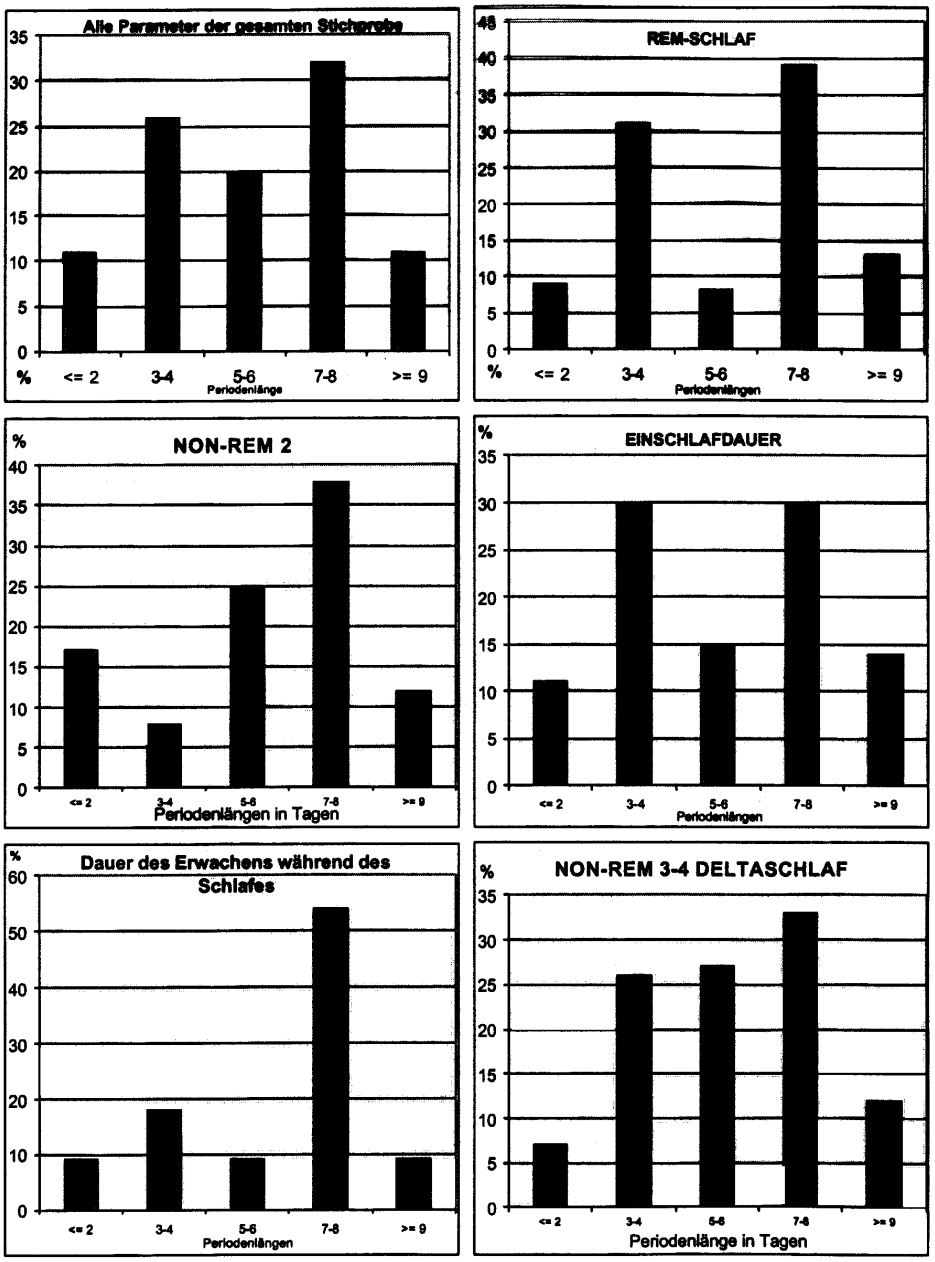
Picture25 : Parameter of wake up during night in weekly rhythm

Picture 25 shows sleep profile parameters of wake up during night from 3 probands, one out of them was having healthy sleep, the other two suffered from sleep disorders, duration of being awake in minutes frequency (n) and percentage of total sleep over all recorded electrophysiological sleep profile.



Picture 26: percentage of sleep stages REM, S1, S2, S3, S4

Picture 26 shows the shares of REM-sleep, an 4 NON-REM-sleep stages in percentage by the same principle in electrophysiological sleep profile from the same probands, one healthy two suffering. These two diagrams demonstrate evidently that there can be enormous waving sleep over the whole week.

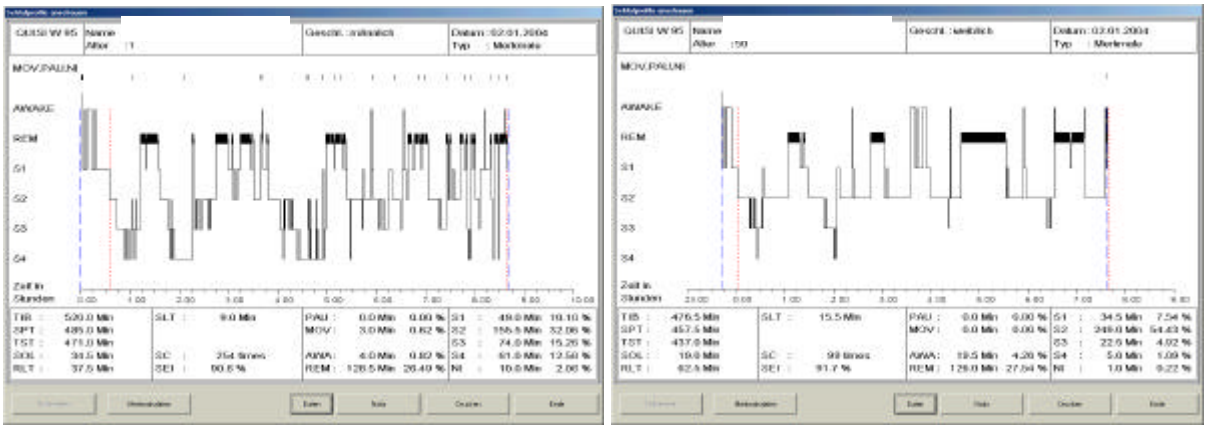


Picture 27: Frequency spreading of all different sleep parameters over all

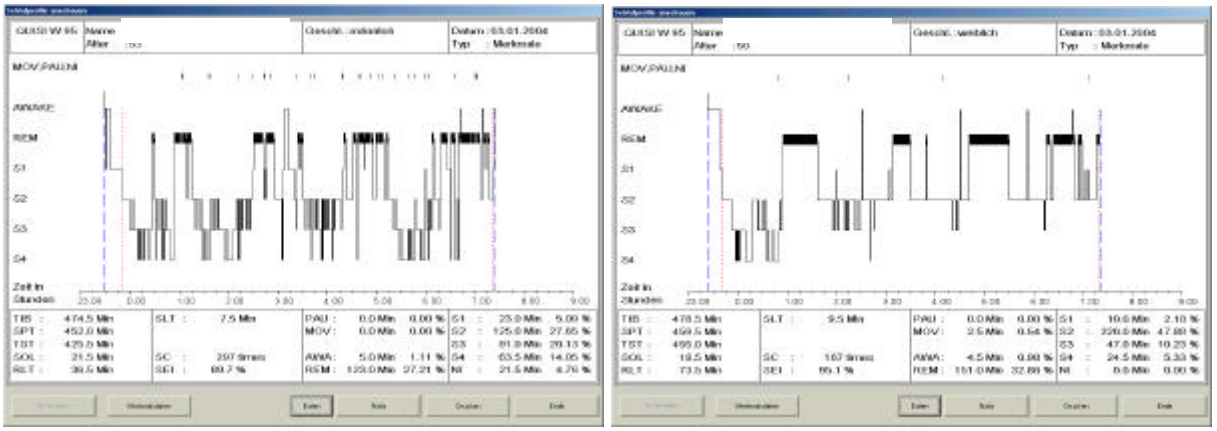
In this picture we demonstrate how frequent the different sleep parameters of rhythm and periodic length are spread over the time, and we have recorded 28 consecutive nights right after that. Here we are able to make evident that there is dominating a circaseptane rhythm. In some parameters, as e.g. sleep onset-latency and REM-sleep, there is a semicircaseptane rhythm dominating all. This will substantiate our requirement to take for realistic sleep diagnostic unconditional at least 7-night recordings.

Sleep problems of a couple: The wife, age of 50, always had a healthy and good sleep, what is proven by her sleep profile. But her husband Gerhard, 53 years old, does have sleep disorders since he was a child. This pathology is well represented by the recorded sleep profile. Finally we want to point out, that when using the automated sleep stage classification device, on can measure by comparing the REM-sleep cycles the harmony resp. disharmony of sleep in marriage.

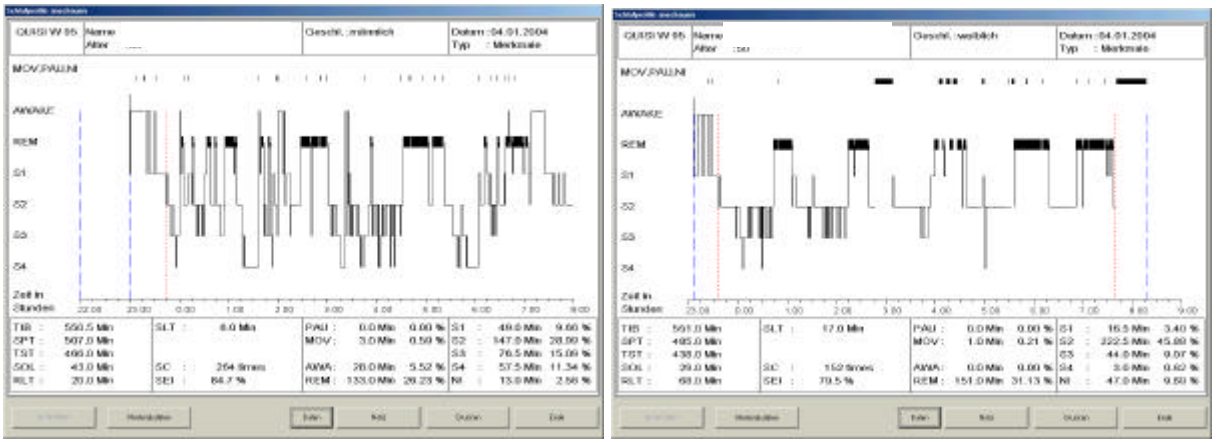
husband 02.01.04 wife 02.01.04



husband 03.01.04 wife 03.01.04



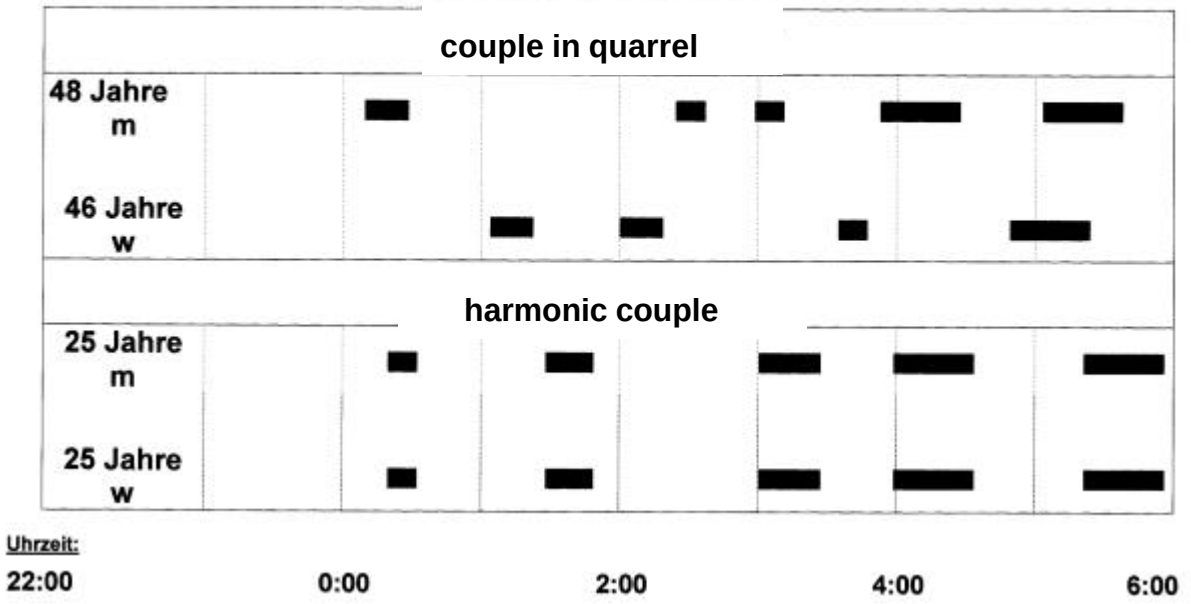
husband 04.01.04 wife 04.01.04



Picture 28: sleep profiles of a couple, he with sleep problems, she healthy sleep

On top you can see the REM-cycles of a couple living in quarrel, REM-cycles showing a desynchronized disharmonic form. Below you see the recorded REM-cycles of a young enamored, harmonic couple, showing a synchronic and harmonic run. This example demonstrates that with the cyclic function even social relationship can be measured.

REM-sleep of couples



Picture 29: sleep profile of couples, harmonic and disharmonic

Conclusions:

1. The world does not exist, she happens and is in motion.
2. Universe, planets, nature and life consist of control circuits producing oscillations.
3. The oscillation (cyclicity) is the basic element of psychobiological regulations of the human body. It will guaranty the self regulation.
4. These oscillations guaranty for all creatures the exchange of information and energy, the ability to live, preserving health and every species.
5. The physiology of sleep is based on this cyclicity. This cyclicity is able to differentiate the quality of sleep and recovery.
6. Therefore the night-diagnostic is as important as the day-time diagnostic.
7. Sleep is the stepchild in medicine, besides sleep medicine night diagnostic is mostly ignored. On the other hand studies are demonstrating that not restorative sleep is one of the main factors causing most of the chronic diseases. Therefore we need adequate and scientific based diagnosis and therapy.
8. At the level of what we know today about control circuits and the characters of periodicity does not allow to think and act statically in medicine. And this puts a signal for a urgently needed change of paradigm in diagnostic, prophylaxis and therapy.

Literature

Aserinsky, E.; N. Kleitmann (1953): Regularly occurring periods of eye motility and concomitant phenomena during sleep. *Science* **118**, S. 273-274

Babloyantz, A. (1986): *Molecules, Dynamics and Life*. Wiley, New York

Balzer, H.-U.; K. Hecht (1989a): Ist Stress noninvasiv zu messen? *Wissenschaftliche Zeitschrift der Humboldt-Universität zu Berlin, Reihe Medizin* **38/4**, S. 456-460

Balzer, 2H.-U.; K. Hecht (1989b): Konzeption zur Entwicklung eines diagnostischen Stufenprogramms zur objektiven Beurteilung der Schlafqualität in Beziehung zur Leistungsfähigkeit und Stress am Tage. *Wissenschaftliche Zeitschrift der Humboldt-Universität zu Berlin, Reihe Medizin* **38/4**, S. 441-445

Billard, M. (1993): Die Zukunft der Schlafmedizin in Europa. In: K. Meier-Evert; E. Rüther (Hrsg.): *Schlafmedizin*. Gustav Fischer Verlag, Stuttgart, Jena, S. 3-6

Coveney, P.; R. Highfield (1994): *Anti-Chaos - Der Pfeil in der Zeit der Selbstorganisation des Lebens*. Rowohlt, Reinbeck bei Hamburg

Golenhofen, K. (1962): Physiologie des menschlichen Muskelkreislaufs. Sitzungsberichte der Gesellschaft zur Beförderung der gesamten Naturwissenschaften zu Marburg 83/84, S. 167-254

Halberg, F. (1960): The 24-hour scale: A time dimension of adaptive functional organization. *Perspect. Biol. Med*. **3**, S. 491

Halberg, F. (1962): Physiologic 24-hour Rhythms: A determinant of response to environmental agents. In: E. Schaefer (Hrsg.): *Man's Dependence on the Earthly Atmosphere* 48. The MacMillan Company, New York

Halberg, F.; G. Cornélissen; J. Halberg; H. Fink; Ch. H. Chen; K. Otsuka; Y. Watanabe; Y. Kumagai; E. V. Syutkina; T. Kawasaki; K. Uezono; Z. Khao; O. Schwartzkopff (1996b): Circadian Hyper-Amplitude-Tension (CHAT); a disease risk, syndrome of anti-aging medicine. *J. Anti-Aging Med*. **1**, S. 239-259

Halberg, F.; G. Cornélissen; J. Halberg; M. Fink; C.-M. Chen; K. Otsuku; Y. Watanabe; Y. Jumagai; E. v. Syutkina; T. Kawasaki; K. Uezona; Z. Zhao; O. Schwartzkopff (1998): Circadian Hyper-Amplitude-Tension (CHAT): A disease risk syndrome of anti-aging medicine. *Journal of Anti-Aging Medicine* **1/3**, S. 239-259

Hecht, K.; M. Peschel (1964a): Zur Periodizität der Latenzzeiten des „nichterlöschbaren" bedingten Fluchtreflexes und der Versuch einer hybernetischen Deutung. *Acta biol. med. germ*. **13**, S. 504-512

Hecht, K.; M. Peschel (1964c): Die Rolle der Unbestimmtheit des Reizverhältnisses eines Stereotyps bei der Analyse und Synthese des ZNS. *Acta biol. med. germ*. **13**, S. 734-744

Hecht, K.; M. Peschel (1965): Periodizitäten im Verlaufe der Reaktionszeiten des „unauslöschbaren" bedingten Fluchtreflexes der Ratte bei halbminütiger Reizung und „backward conditioning". *Acta biol. med. germ*. **14**, S. 511-518

Hecht, K.; K. Treptow; S. Choinowski; M. Peschel (1972a): Die raumzeitliche Organisation der Reiz-Reaktions-Beziehungen bedingt-reflektorischer Prozesse. *Brain and Behaviour Research, Monograph Series* **5**, VEB Verlag Gustav Fischer, Jena

Hecht, K.; Treptow; M. Poppei; T. Hecht (1972b): Ein Modell für die Entwicklung hyperton ausgelenkter Blutdruckdysregulationen durch fehlgesteuertes Lernen. *Acta biol. med. germ*. **27**, S. 869-883

Hecht, K.; S. Choinowski; D. Kunde; R. Meyer; V. Moritz; T. Schlegel; K. Wenzlides; J. Götze (1976b): Lernen und chronobiologische Regulation nach experimentell verursachter Schädigung der Koronararterienwand von Albinoratten. *Acta biol. med. germ*. **35**, S. 559

Hecht, K.; K. Treptow; M. Poppei; T. Hecht; S. Choinowski, M. Peschel (1976c): *Über die Rolle zyklischer Verläufe von Körperfunktionen im Organismus-Umwelt-Kommunikationsprozess*. Umweltbiophysik. Abhandlungen der Akademie der Wissenschaften der DDR Jahrgang 1974, Akademie-Verlag, Berlin, S. 247-261

Hecht, K.; H. van Ngugen, V. Morik, T. Hecht (1976d): Zur Bedeutung der Stressintensität für die emotionale und viszerale Reaktivität insbesondere für die Blutdruckregulation. Acta biol. med. Germ. 34, S. 23-33

Hecht, K. (1984a): Dynamik der Wechselbeziehungen zwischen Gesundheit und Krankheit. In: M. M. Chananaschwili; K. Hecht: *Neurosen*. Akademie Verlag Berlin, S. 93-99

Hecht, K. (1984b): *Zeitverhalten/Chronobiologie*, 1. Lehrbrief, Physiologie zur Ausbildung der Grundstudienrichtung Medizinpädagogik. Herausgegeben von der Zentralstelle für das Hochschulstudium des Ministeriums für Hoch- und Fachschulwesen

Hecht, K. (1984d): Die Zeitregulation im Krankheitsgeschehen. In: M. M. Chananaschwili; K. Hecht (Hrsg.): *Neurosen*. Akademie-Verlag, Berlin, S. 391-436

Hecht, K. (1993a): *Selbsthilfe bei Schlafstörungen*. Ullstein Medicus, Frankfurt/Main, Berlin

Hecht, K. (1993b): Schlaf und die Gesundheits-Krankheits-Beziehung unter dem Aspekt des Regulationsbegriffes von Virchow. In: K. Hecht (Hrsg.); A. Engfer; J. H. Peter; M. Poppei: *Schlaf, Gesundheit, Leistungsfähigkeit*. Springer Verlag, Berlin u. a., S. 3-12

Hecht, K. (2001a): Chronopsychobiologische Regulationsdiagnostik zur Verifizierung von funktionellen Zuständen und Störungen. In: K. Hecht; H.-P. Scherf; O. König (Hrsg.): *Emotioneller Stress durch Überforderung und Unterforderung*. Schibri Verlag, Berlin, Milow, Strasburg

Hecht, K. (2001d): *Kurzbericht über Verträglichkeitsprüfung der Nanopartikel* – Mineralkapseln an gesunden Freiwilligen. In: Information für Ärzte und Medizin. Heilberufe. Info-Material, Nano GmbH

Hildebrandt, G. (1962a): Zur Frage der rhythmischen Funktionsordnung beim Menschen. In L. Delius; H. Koepchen; E. Witzleb (Hrsg.): *Probleme der zentralnervösen Regulation*. Berlin, Göttingen, Heidelberg, S. 22-28

Hildebrandt, G. (1962b): Biologische Rhythmen und ihre Bedeutung für die Bäder- und Klimaheilkunde. In: W. Amelung; A. Evers (Hrsg.): *Handbuch der Bäder- und Klimaheilkunde*. Schattauer, Stuttgart, S. 730-785

Hildebrandt, G. (1962c): Reaktive Perioden und Spontanrhythmik. *Reports 7. Conference of the Society for Biological Rhythm*. Siena 1960, Panminerva Medica, Torino, S. 75-82

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Randoll, R. G.; K. S. Zänker et al. (1992): Ultrastrukturelle zelluläre Membranprozesse online im Vitalmikroskop. *Dtsch. Zschr. Onkol*. **24**, S. 120-126

Rensing, L. (1973): *Biologische Rhythmen und Regulation*. VEB Gustav Fischer Verlag, Jena, S. 217-229

Schweiger, H. G. (1987): Die Zelle und ihre Rhythmen. In: J. Schult; R. Gattermann; J. A. Romanow: *Chronobiologie - Chronomedizin*. Martin-Luther-Universität, Wissenschaftliche Beiträge 36(P30), Halle/Saale, Wittenberg, S. 170-177

Sinz, R.; G. Isenberg (1972): Minutenrhythmische Spontandepolarisation des Ruhe-Membran-Potentials von Skelettmuskelfasern. *Acta biol. med. germ*. **29**, S. 247-257

Sinz, R.; G. Goldhahn, A. Hendel; P. Oehler-Beckert (1975): Quantitative Bewertung von neuro-vegetativen Systemänderungen anhand des minutenrhythmischen Kopplungsgrades und der Regelgüte während akuter und chronischer Diazepamtherapie bei neurotischen Patienten. *Acta biol. med. germ*. **34**, S. 289