Dependence of a Sleeping Parameter from the N-S or E-W Sleeping Direction

G. Ruhenstroth-Bauer

Max-Planck-Institut für Biochemie, D-8033 Martinsried bei München

E. Rüther and Th. Reinertshofer

Psychiatrische Klinik der Universität München, D-8000 München

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In an earlier study it was shown that an isotonic salt solution within a measuring chamber of a cytopherometer is rotating caused by Lorentz forces, if the magnetic earth field crosses the electric field in the chamber. This may be a model of the ability of certain higher organisms to recognize the direction of the magnetic earth field. The topic of this study was the possible effect of the magnetic earth field in humans. It is shown that the duration of REM latency is influenced by the position of sleepers in N-S or E-W direction: it is shortened in E-W direction ($p = 0.02$).

In 1978 it was shown by our group that a isotonic salt solution within a flat measuring chamber of a cytopherometer begins to rotate if a relatively low electrical field of 5 V/cm is sent through the solution and the chamber is orientated in a direction that the magnetic earth field crosses the chamber perpendicular to the electric field. This streaming is caused by Lorentz forces, since at the tapering ends of the chamber the Lorentz product ($F = q\ [v \times B]$; q = charge of ion, v = ion velocity in the electric field, B = strength of the magnetic field) is higher than in the flat middle part. Thus, the pressure of the gradient causes the ions to rotate through the chamber, which in turn leads to the rotation of the fluid. In the case of crossed fields this rotation results in a kind of liquid compass [1].

On the basis of these investigations we proposed that the susceptibility of certain organisms for geomagnetism could also be explained by Lorentz forces, influencing the streaming of fluids through the membrans of axons at different positions within the geomagnetic field. However, a rough estimate of the forces influencing the fluid and/or the permeability through the membrans gave values which are within the noise of the molecular movement. But if a greater number of axons is situated parallel it is possible that a geomagnetic signal could be registered by this ensemble. Recent experiments on pigeons could perhaps be interpreted in this way [2].

We were interested in finding an experimental situation in which we could examine if humans also react differently depending on their position to N-S or E-W. For such experiments the sleep position seemed best suited because the position of the sleeper is more or less fixed during several hours and it is possible to get a greater number of sleeping parameters in two identical neighboring sleeping laboratories for comparing the influence of the direction of the beds in relation to the magnetic earth field.

Methods

The sleep investigations have been performed as follows: Eight normal males (23 to 27 years, mean 24.75) participated in this experiment as paid volunteers. All subjects were in good health, none had a history of sleep disorder or psychiatric disorder. They were instructed to abstain from drugs, caffein, or alcohol during the experimental period. They were told that they were involved in experiments to define normal variations in sleep habits.

All-night polysomnographic recordings of the sleep were conducted by telemetry according to the recommended standardized techniques by Rechtschaffen and Kales [3]: one channel of EEG (C_4/A_1), two channels of EOG (electrodes placed lateral to right and left outer canthus), one channel of submental EMG.

Always two subjects slept for eight consecutive nights in two separated, identically equipped rooms (3.50×5.30 m). The beds were situated in the mid-

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Reprint requests to Prof. Dr. G. Ruhenstroth.

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dle of the rooms, one in N-S direction, the other in E-W direction. Their position was changed by turn of 90° every night, clockwise or counterclockwise by chance. So every night one subject slept in N-S direction, the other one in E-W direction.

The strength of magnetic earth field measured by a Feldmeßgerät typ GMH-2 with a Hallgenerator (Siemens-Schuckert-Werke, München) totaled to 45–50 μT as well in the whole rooms as above the matresses. The changing of the beds did not alter these values. Recordings were scored according to the Rechtschaffen and Kales criteria [3].

The significance of the intraindividual differences in sleep patterns was determined by a paired binomial test [4].

Results

Table I shows the mean sleep parameters for the two positions of bed in N-S and E-W direction. The only significant difference occurred in REM latency which was 5.5 min shorter in E-W direction ($p<0.02$). Other sleep parameters which could be interpreted as stress parameters (sleep latency, intermittent awakenings, percentage of stage 1, stageshifts, movement times) were not different between the two positions. The same goes for the other parameters.

A significant first night effect was not observed. Nevertheless there seemed to be an adaptation effect to the laboratory conditions: When we compared the first four nights *versus* the second four nights REM latency decreased from 91 to 69 min ($p<0.01$) (Table II). The other sleep parameters did not show any significant difference. It is worth mentioning that the standard deviation of the REM-latency in the first four nights is much higher than in the second four nights. That means that the interindividual differences were greater in the first four nights. The other sleep parameter did not show this effect.

Table I. Sleep parameters (mean and standard-deviation) for position of bed in N-S and E-W direction ($n=32$ for each mean: 8 subjects, 4 nights).

Sleep parameter	N-S	E-W
Time in Bed	474.86 (13.78)	473.65 (11.59)
Stage 1 (min)	38.84 (16.83)	39.24 (18.80)
Stage 2 (min)	225.66 (25.15)	221.97 (24.16)
Stage 3 (min)	25.75 (6.77)	24.04 (5.48)
Stage 4 (min)	61.13 (12.34)	57.81 (10.78)
Stage REM (min)	99.75 (8.97)	99.24 (9.99)
Wake (min)	23.75 (9.90)	26.72 (12.74)
Stage 1 (%)	8.03 (3.74)	8.43 (4.01)
Stage 2 (%)	49.34 (4.90)	49.20 (3.88)
Stage 3 (%)	5.31 (1.19)	4.95 (1.13)
Stage 4 (%)	13.09 (3.10)	13.19 (3.60)
Stage REM (%)	21.53 (2.08)	21.82 (2.70)
Wake (%)	4.53 (2.33)	5.28 (2.78)
Latency 1 (min)	13.53 (6.68)	16.59 (8.96)
Latency 1–2 (min)	6.66 (3.63)	5.84 (3.01)
REM latency (min)	83.13 (16.13)	77.66 (13.65)*
Intermittent awakenings	1.38 (0.57)	1.50 (0.90)
Stageshifts	52.91 (6.52)	51.63 (10.55)
Movement times	8.59 (4.99)	8.97 (4.86)
Sleep cycles	4.41 (0.40)	4.19 (0.26)

* = $p < 0.02$.

Table II. Sleep parameters (mean and standard-deviation) for the first four and second four nights ($n=32$ for each mean: 8 subjects, 4 nights).

Sleep parameters	Night_{1-4}	Night_{5-8}
Time in Bed	473.53 (18.28)	475.00 (6.87)
Stage 1 (min)	36.09 (15.00)	42.53 (19.49)
Stage 2 (min)	225.41 (27.14)	221.94 (21.15)
Stage 3 (min)	25.72 (6.27)	24.22 (5.65)
Stage 4 (min)	63.29 (12.83)	58.47 (13.30)
Stage REM (min)	99.65 (9.40)	98.72 (13.83)
Wake (min)	4.40 (2.66)	5.66 (2.56)
Stage 1 (%)	7.56 (3.46)	8.90 (4.20)
Stage 2 (%)	49.45 (4.22)	49.09 (4.37)
Stage 3 (%)	5.41 (1.30)	4.78 (1.10)
Stage 4 (%)	13.70 (3.74)	12.65 (3.20)
Stage REM (%)	21.56 (1.76)	21.66 (3.29)
Wake (%)	4.40 (2.66)	5.66 (2.56)
Latency 1 (min)	12.16 (5.83)	16.39 (8.38)
Latency 1–2 (min)	6.53 (4.12)	5.97 (3.33)
REM latency (min)	91.34 (20.95)	69.41 (11.93)*
Intermittent awakenings	1.63 (0.67)	1.59 (0.95)
Stageshifts	50.04 (9.79)	54.72 (8.73)
Movement times	8.28 (4.17)	9.28 (5.54)

* = $p < 0.01$.

Discussion

This result is an evidence that also humans are receptive though unconscious of the magnetic earth field. There exists an observation [5] of changes in brain electrophysiology caused by oscillating magnetic fields (additionally to the magnetic earth field) in the frequency range of 0.01 to 10 Hz and amplitudes of 5 to 50 nT, but only if the subjects heads are orientated to the north, whereas the heads orientated to the other three main directions are not influenced by the oscillating magnetic fields. In our observation however, with the magnetic earth field alone there was no difference whether the heads of the persons were orientated to north or south. The absence of a first night effect in the REM latency as well as the occurrance of adaptation effects between the first and the second half of observations could possibly be interpreted as irritation of the subjects by daily rotations of the beds. REM latency mainly seems the react to situational influences [6]. However, following points are to be considered: Only the REM latency is different in respect to the bed directions but not the other "stress" parameters. Though there was seen an adaptation effect of REM latency there could not be observed a transient and situational disorder of irritating and maintaining sleep [7]. The values of sleep onset, sleep efficiancy, percentage of sleep stages, stageshifts, movement times, and intermittent awakenings did not show significant differences between the first four nights and the second four nights, and they are comparable to values of a normal population [8]. The same arises from the fact that subjective sleep parameters as estimated sleep quality and estimated sleep latency had a marked first night effect. Furthermore, the higher standard-deviation of REM latency in the first four nights indicates that the subjects react to the rotation of bed in different degrees. On the other hand, the standard deviations of the N-S and E-W direction are comparable. The adaption effects are balanced out by the fact that two paired subjects slept always in different directions. The fact that among the sleep parameters REM latency is affected by the position of bed besides the irritation by rotating beds seems to support our interpretation because mainly REM latency reacts to external influences.

Therefore the most probable interpretation of our observation is the assumption that the geomagnetic field influences humans differently depending on their positions relative to the field direction.

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