STATES OF WAKEFULNESS, MENTATION AND CONSCIOUSNESS ARE ACCOMPANIED BY THE CHARACTERISTIC ELECTRICAL ACTIVITY OF THE THALAMOCORTICAL MECHANISMS OF THE HUMAN BRAIN

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Abstract: This study explores the electrical activity of the thalamocortical system in the human brain during states of wakefulness, relaxation, and cognitive effort. Using non-invasive electroencephalography (EEG), we examined the dynamics of brain waves, particularly the alpha rhythm (8–13 Hz), and its variations during mental tasks. We introduced a novel metric, Quotus alpha (Qa), to quantify the asymmetry and slope of alpha waves. Our research included 26 participants across diverse groups: healthy adults, individuals with neurological abnormalities, and children diagnosed with ADHD. Results revealed distinct patterns of alpha wave asymmetry, with steeper left-sided slopes during cognitive tasks, correlating with increased mental effort and altered delta activity. These patterns differed notably between adults and children, suggesting developmental and functional distinctions in thalamocortical processing. The findings support the role of iterative thalamocortical interactions in cognitive processes, emphasizing their adaptability and complexity. In healthy adults, alpha dynamics reflected higher cognitive performance and recruitment of neural resources. Conversely, the atypical EEG patterns observed in children with ADHD and individuals with neurological conditions highlight potential diagnostic and therapeutic implications. This study enhances our understanding of the neural underpinnings of attention, cognition, and neurodevelopmental disorders while providing new methodological insights into EEG analysis.

Key words: *Brain, Thalamo-cortical system, Alpha rhythm, Cognition, ADHD, Quotus alpha*

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1. Introduction

Among other things, the brain of mammals and therefore of humans is characterized by the generation of electrical activity which is similar to the synchronous electrochemical changes at once on the cell membranes of the entire heart muscle. However, the specificity of the brain is the synchronous parallel and periodic (10 Hz) discharges (impulses) on the membranes of many billions of neurons (nerve cells). Impulses constantly circulate throughout our lives in cycles between the neurons of the large subcortical nucleus of the thalamus and the brain cortex (Fig. 1).

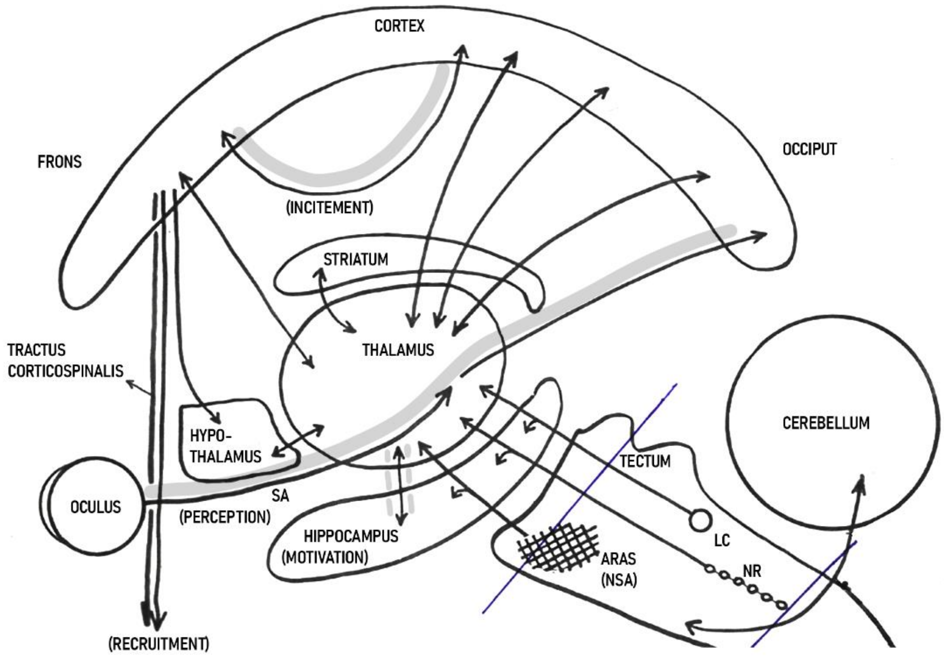

Fig. 1 *Description from top to bottom: cortex (cerebral cortex, seat of the highest psychic functions: cognition, creation, abstract thinking /mentation/, perception and speech production), elongated structure striatum (regulation and memory for movement), below it a large spherical structure thalamus, where all the stimuli from the senses (optical, acoustic, skin, muscle tone, etc.) converge and the seat of the genesis of rhythmic electrical activity sent to the cortex. Beneath it is the hippocampus: the seat of emotion and memory register for both events and bare facts (i.e., episodic and semantic memory). Bottom right: the "humped" formation is the outline of the brain stem with the seat of the centres that control the sensor-motor of the head area and cores for controlling wakefulness, synchronous and paradoxical sleep. Above the trunk is a circle representing the cerebellum, indicating, together with the striatum, a regular course of movement. The scheme also includes the scheme of Laufberge's impulse theory: perception - connections from the eye to the thalamus and occipital cortex, incitement - an arc in the subcortex representing associative connections between primary and secondary sensory areas, motivation - a connection between the hippocampus - thalamus and cortex, and finally recruiting - a straight double line from the cortex representing the cortico-striato-spinal motor fibres. This theory provides an improved reflex model from the 1940s.*

The main analyses of these impulse signals take place in the cortex, which are still unknown. They can be mathematical, logical, stochastic or „chaodynamic programs". So far, however, we know that it is mostly about digitizing data in binary code. If a person is in a calm, relaxed state, our devices (e.g. EEG, electroencephalography) record wave activity called alpha rhythm (hereafter referred to as alpha) [1]. This rhythm has a sinusoidal shape with a frequency of 8-13 Hz (usually 10 Hz) and an amplitude of 30 to 100 µV. Alphas tend to form sequences by increasing and decreasing amplitude, creating a spindle-like (fusiform) shape lasting 1 to 3 seconds. However, the mentioned parameters are not static, they change according to the situation, e.g. they are dampened significantly by opening the eyes, to a lesser extent by increased attention, they accelerate when thinking or when taking a deep, calm breath, i.e. hyperventilation. After all, the EEG rhythm is fundamentally completely different during sleep and during seizures (epilepsy, narcolepsy, with cardiac syncope) or during primarily extracerebral disease states, when there is a change in the internal environment (change in the activity of the thyroid gland, in diseases of the kidneys, liver, lack of oxygen, blood sugar) etc.), [2, 3]. The aim of this article more detail analysis of alpha rhythm for practical and research goals.

2. Clinical Cohort

Our group consists of 26 people, 16 men aged 22 to 34 (2 people were 18 and 48 years old). They were healthy individuals with above average intelligence except for the following persons: 1x hyperthyroidism, 2x ADD (concentration disorder), 1x aggression, 1x anxiety, 1x compensated epileptic seizures. In 16 men, the electroencephalogram (EEG) was 12 times normal, 4 times abnormal with episodes of high theta to delta waves (epileptic graphoelements were present 1 time). There were also 5 women in the group between the ages of 23 and 34, one of them was 60 years old. Subjectively, one woman each had symptoms of low intensity: depression, headache, organic psychosyndrome, ADHD and anxiety. There were 5 children in the group aged 7 to 11 years, all of whom had a diagnosis of ADHD (attention deficit / hyperactivity disorder) and at the same time a typically abnormal EEG recording of episodic theta and high sharp waves, but without epileptic manifestations.

3. Methods

All healthy probands and patients were examined using an EEG (electroencephalography) device of Czech origin, Alien Technik TruScan (CZ). As standard, we used 20 electrodes attached conductively, but non-invasively, to the surface of the head for a duration of 30 minutes. During the EEG registration, we tested individual persons by reading out ten two-digit numbers for adults or ten single-digit numbers for children, which the persons had to mentally add up and state the sum at the end of the test. Everything was done with the eyes closed, when the EEG alpha rhythm is relatively the most regular and the highest amplitude. Thus, the basic alpha activity, which was normal (symmetric) or deformed, is clearly visible. We most often used to analyse the curve from the channels of the parieto-temporo-occipital leads during the „state" of relaxation and counting, and always from one and the same area and hemisphere. We also described the method in work [2]. After the EEG examination, we printed the expanded EEG curve „off-line" after a five-fold „time prolongation" and after a two- to three-fold increase in its amplitude. (We are working on software automation of this process. The provisional results are identical to ours.) We analysed the vector orientation of alpha waves by geometrically measuring the ascendant to the descendent of the alpha wave, i.e. expressing the elapsed time between the beginning of the alpha wave from the local minimum in the range (π0) to the local maximum (π1) and between the local maximum (π1) to the local minimum (π2). By repeating this procedure, we captured the course of not only alpha, but also the entire sequence of waves for the duration of one spindle, i.e. usually 10 to 20 alpha waves [2, 3].

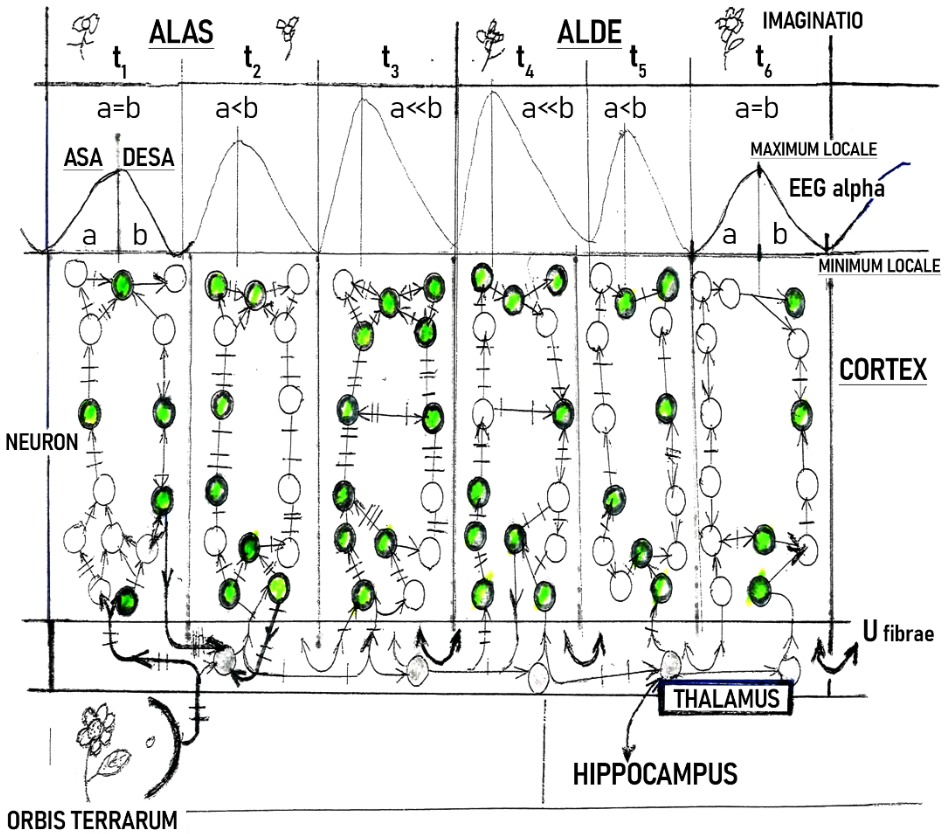

Fig. 2 *Description from top to bottom. ALAS means "alpha ascendant", i.e. the rising amplitude of alpha waves in the 1st half of the alpha spindle (the curves of alpha waves are below the indicated inscriptions ALAS, ALDE). In the 2nd half of the spindle there are decreasing amplitudes of alpha waves, i.e. ALDE. The strange drawings of flowers at the very top are imperfect representations of the intrapsychic IMAGINATION of the perceived real flower (bottom left). These ideas are improved through an iterative cognitive approximation process (left to right here). However, iteration is de facto very complex and takes a long time. We assume that it is realized during a sequence of time in t1…t6, each t lasts 100 msec and is "identical" to one alpha wave. Large waves represent an alpha rhythm whose sinusoidal shape can be asymmetric, i.e. segment a (ASA) has a shorter distance from point C to the maximum locale than segment b (DESA) having a distance from point C to the following minimum locale. Such asymmetry occurs during mentation. It means the slope of the alpha*

wave to the left. We calculate the slope (clivita, from the Latin clivitas = inclination, slant) as the ratio a/b. During relaxation (t1 and t6) the line segments a, b are equal and the waves are symmetrical. If a is longer than b, then the slope is greater than 1 and the slope of the wave is to the right. The inscription NEURON indicates any small black or green circles as nerve cells in the CORTEX. In the central part of the image there are 6 large sections of the CORTEX, each with 14 NEURONS and their connections, which do not change anatomically. (In fact, there are many millions to billions of them in a single Brodmann area.) But the functional connectivity of the neurons is variable with each alpha wave. In ALAS, perception begins (bottom left) at time t1. The altered image of the flower in the binary neuronal code of the retina is sent to the thalamus and from there directly to the CORTEX. 5 NEURONS are activated here (green color with strongly marked circles). Excitements or impulses continue to circulate between the neurons of the thalamus and the cortex. The short transverse lines in the diagram in the interneuron connections are excitations or impulses in the THCS (thalamo-cortical system). Through iteration, the committed neurons gradually increase up to t3 and t4 (ALAS), where there are a maximum of 9 (here only and in our imagination), but only some are sufficiently educated - competent. Therefore, the second phase of the process occurs, i.e. selection according to A.G. Ivakhnenko (1970) [4]. It is a matter of minimization and optimization, i.e. the elimination of some neurons not only for economic reasons, but also so that only those with the right cognitive ability and those untrained neurons remain in the neuronal network so that they do not interfere. Here, only 4 neurons remain at time t6, which are sufficient to imagine a meaningful cognitive analysis. To think without current perception, we need information of an older date, the brain finds it in the HIPPOCAMP, which serves as a memory register to store and equip older information. ORBIS TERRARUM is the external world (external criterion) that must be known. In fact, cognitive processes take many alpha waves and their spindles many months and even years before we acquire the right behavior and good education. At the very bottom, below the inscription CORTEX, there are arc arrows connecting individual parts of the cortex (columns and areas) called U fibrae. Each half of the spindle normally contains 5 to 15 alpha waves.

Technically, we calculated clivita as the fraction of ascendant time divided by the fraction of descendent time and called it Quotus alpha (Qα). For all analyses, we selected adequate and good sections without technical and biological artifacts in the EEG curve, i.e. at rest during relaxation and during mentation during counts. Neurophysiologically, one alpha wave corresponds to one cycle of impulses from the neurons of the thalamus to the neurons of the cortex, where the main analytical process takes place. The impulses then travel back to the thalamus and the cycle repeats. Amplitude, frequency and Qα thus represent the supreme values of brain function expressing the state of alertness, reactivity, thinking, fatigue or sleepiness. However, it is necessary to compare individual resting or active states individually. In mammals and therefore also in humans, the alpha frequency is in the range of 8 - 13 Hz, normally it is around 10 Hz. The amplitude measured on the surface of the head fluctuates most often between 30 and 100 µV.

We also used the manufacturer's original programs: FFT- Gabor (Fast Fourier Transformation) and coherence analysis (frequency and amplitude expression of the correspondence of each electrically monitored location with surrounding neighbouring locations). An indicative neurological and psychological examination did not find any serious topical, intellectual or psychotic symptoms. The small exception consisted of 3 adults (two men with a concentration disorder and one woman with an organic syndrome) and all 5 children with ADHD syndrome (Attention Defect / Hyperactivity Disorders) and ADD (Attention Defect Disorders).

4. Results

The 26 people took part in the EEG monitoring and psychological test: 16 men, 5 women and 5 children.

The 16 men, averages Qa whole alpha spindle in relaxation 0.94 ALAS 0.89 ALDE 0.82 in good calculation 0.74 ALAS 0.74 ALDE 0.84

The 12 men had a normal EEG with a good result in counting, 4 men had an abnormal EEG, two made mistakes in counting: 18-year-old with ADHD and Qa 0.90, ALAS 0,72, ALDE 1,04, 25-year-old with ADD and Qa 0,92, ALAS 0,95, ALDE 0,90 which are completely atypical valuses. A value of Qa above 1.0 in all 16 men appeared 4 times, of this number it occurred in 4 persons with an abnormal EEG. FFT analysis showed a typical mild normal rise in delta during mentation at counts, alpha was unchanged in 10 and rose by 0.5 to 1 Hz in 6 males.

The 4 women, averages Qa whole alpha spindle in relaxation 0.77 ALAS 0.78 ALDE 0.70 with good calculation 0.90 ALAS 0.90 ALDE 0.88

The 4 women had flawless counting and normal EEG. The fifth person was a 23-year-old woman with organic psychosyndrome and suspected temporal focal epilepsy. She had a markedly abnormal EEG and poor addition test scores. Qa for the entire spindle was 0.92 at rest, (at FS 0.83) ALAS 0.83, ALDE 1.13, the values are completely atypical. However, when counted, the Qa values improve: 0.80, ALAS 0.73, ALDE 0.81. During this counting situation, it is as if "THKRIS tried" to "normalize", to make the mentation more efficient with alpha activity. THKRIS behaves similarly in this woman during photostimulation (FS 10Hz) with a Qa of 0.83. In this case, FS is frequency-compatible with the alpha rhythm, which is thus facilitated during FS. The Qa averages quite atypically and paradoxically rise in 4 women with numbers, even though they had good numbers. As if women used slightly different mechanisms for counting. FFT showed a slight increase in delta activity and a slight decrease in alpha during counts, a finding more typical than in males (Faber, 2005).

The 5 children, averages Qa whole alpha spindle in relaxation 0.98 ALAS 0.90 ALDE 0.70 in good calculation 0.99 ALAS 0.91 ALDE 0.89

It can be said that the results are atypical, because comparison with adults is not possible due to biological and erudite immaturity, but they are opposite in terms of behaviour, we can say that all children had ADHD syndrome and a typical abnormal EEG recording, 2x single-digit sums of numbers were good, 3x erroneously. An attempt to calculate two-digit numbers was always at the beginning with an incorrect result. FFT showed in adults an increase in delta and a decrease in alpha in the power frequency EEG spectrum during 5-second segments concurrent with left-sided alpha waves (low Qa) during counting. This is the characteristic and expected response accompanying mentation. But in children, both Qa and the typical frequency changes of the EEG spectrum took place in different places of the brain and at different moments of time. The direct temporal connection between Qa and changes in the EEG spectrum in children was not evident, or its location changes, it is different than in adults. EEG calculations and graphs of a young healthy man (Fig. 3-6).

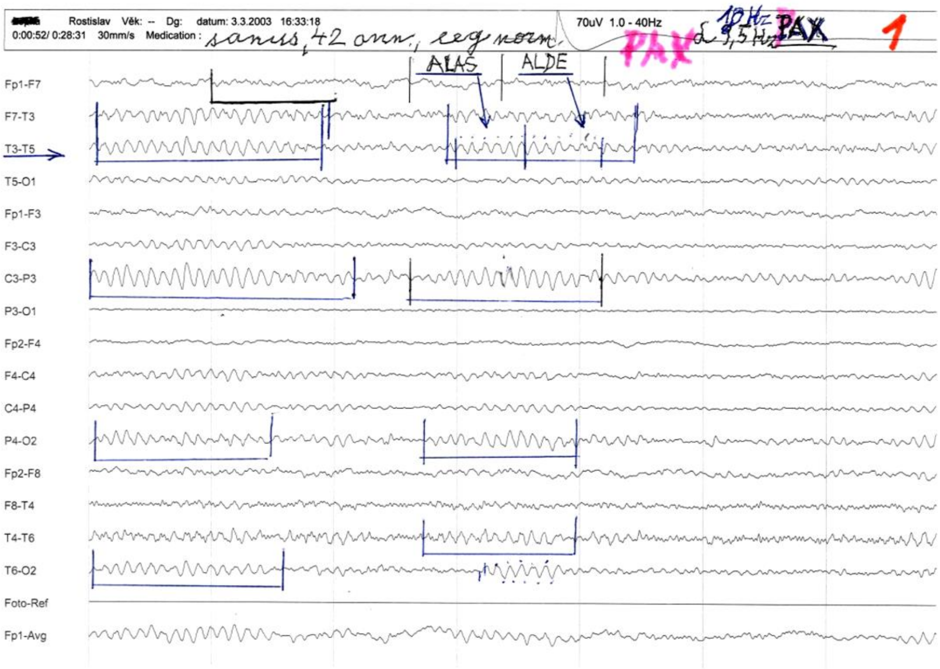

Fig. 3. EEG of a healthy man, 42 years old, EEG potential derivation is bipolar. In the image on the left: localization of electrodes on the surface of the head, the recording was taken at rest (PAX (1) with eyes closed. Alpha wave spindles are intended to be analysed as a whole with a tilt of 0.82 at PAX, or as the first half of the spindle (ALAS with tilt 0.73) and the second half of the spindle (ALDE with a slope of 0.93). Part (1, PAX): alpha frequency is 9.5-10 Hz, the amplitude is asymmetrically higher on the left by 30-50 µV, the spindles last 1-2 seconds and are mostly synchronous with ipsi- and altero-leads.

Fig. 4 *The same man as in Fig. 3, (42 years old and the same graph a minute later). The EEG recording is synchronized with the time of successful counting (CAL .C.B. 2): alpha has a frequency of 11 Hz with a clicity of 0.64, in ALAS 0.55 and in ALDE 0.76. The alpha amplitude is 10-20 µV lower and the alpha spindles are shorter than in the PAX part (1) and are not exactly synchronous with the different spindles in adjacent channels. Beta activity is frontotemprally superimposed on alpha during counting (CAL) or is completely self-contained.*

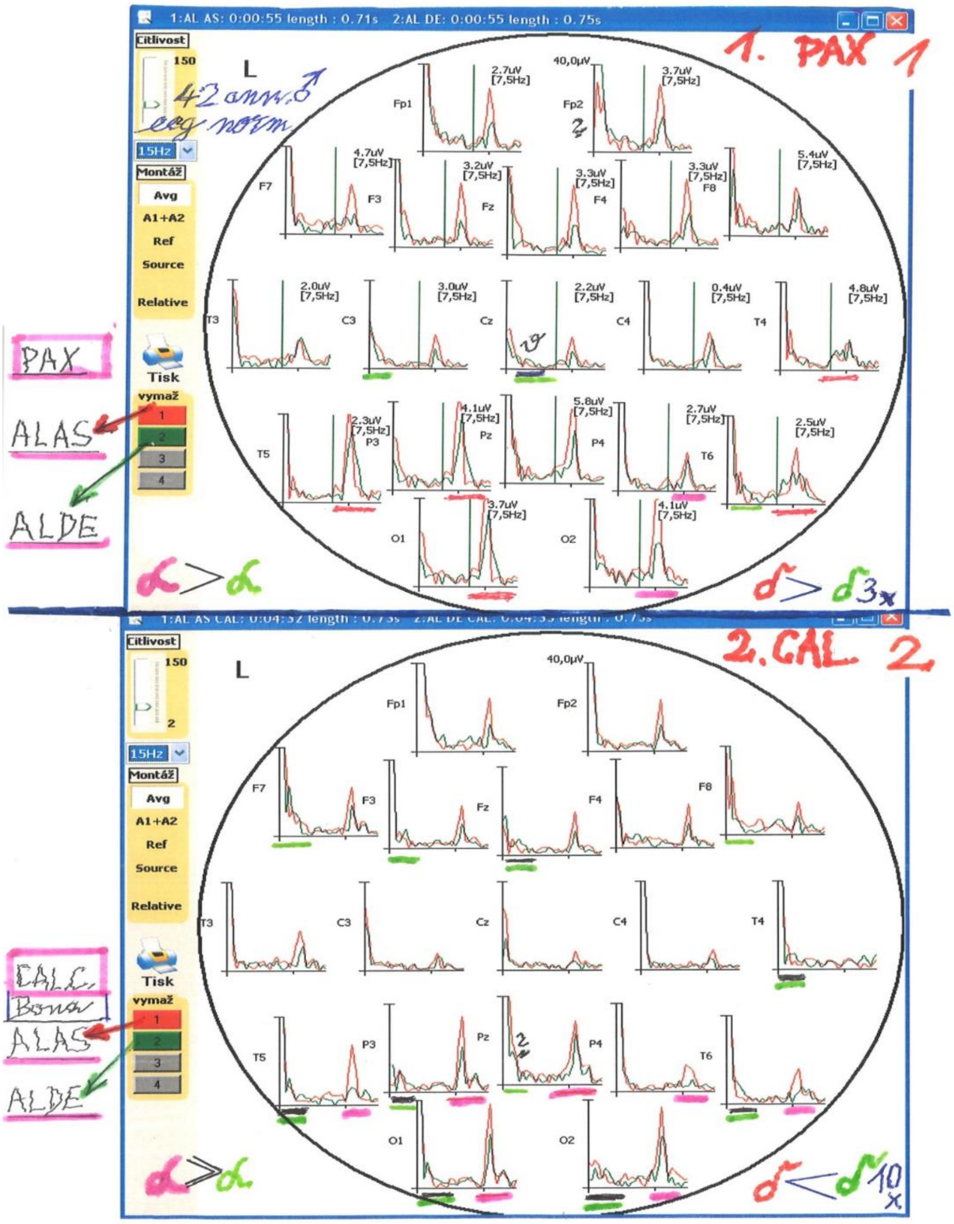

Fig. 5 *The upper part (1, PAX) shows the EEG spectra individually from all 19 channels in the range 1-15 Hz, the red curves are the results from the first half of the spindles (ALAS), the green curves are the results from the second half of the spindles (ALDE) in quiet proband status. ALAS: alpha magnitude predominates in all leads except T3 and T5, delta is increased only in 3 cnetroparietal leads (green underlined part of the spectrum). The lower part of the image (TEST 2), EEG spectrum, the description is the same as in the upper part. Alpha activity is again higher during counting as at rest (PAX), only bitemporally in ALAS (red spectrum curve) does not change. However, during ALDE (green curve) there is a 10 times higher delta. Thus, a decrease in alpha with increased concentration on the test task and an increase in delta activity with increased mental effort (higher mentation) are evident. These events take place on the same anatomical structures, i.e. in THCRIS (thalamocortical reverberation and iteration system), only the "software" changes during "data processing".*

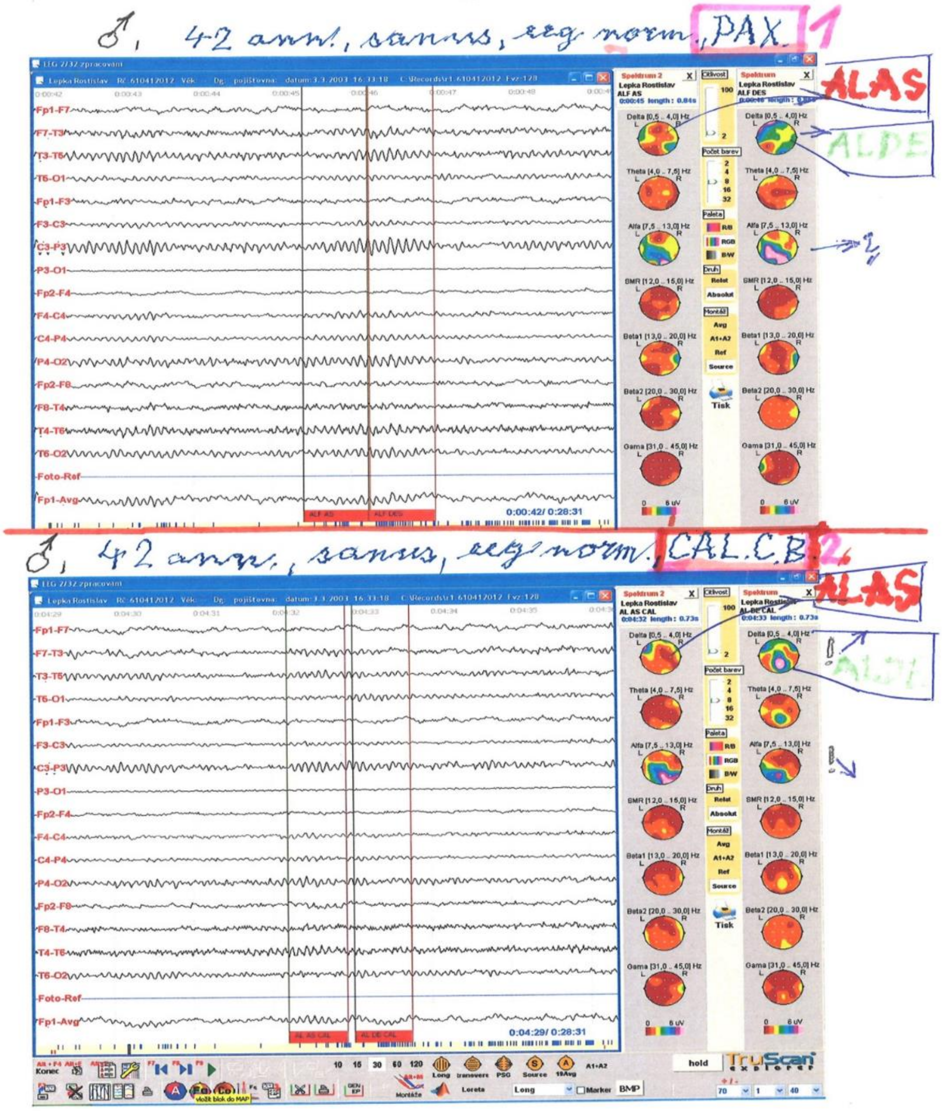

Fig. 6 *To facilitate the reading of the results of the EEG spectrum, we use BEAM (brain electric activity mapping) in the form of circles (far right) that depict the surface of the head and in pseudo-colors the magnitude of individual EEG frequency bands. Location and meaning of circles from top to bottom: delta (0.5 - 4 Hz), theta (4 - 5 Hz), alpha (8 - 13 Hz), three subbands beta (13 - 30 Hz) and gamma (31 - 45 Hz) . The top half of the image is the proband's resting EEG activity (PAX), the second column from the right is the spectrum of the red underlined spindle during ALAS with a low amount of delta and relatively the highest amount of alpha occipitally, more to the right in the form of blue to purple color. During ALDE the same spindle (first column of colored circles on the far right) has significantly increased delta frontotemporally left and temporooccipitally right, as we expected, but paradoxically increased alpha centrally left and parietotemporally right. We explain this by the very good intelligence of a person in the middle age of life, who is not forced to fulfill all the formal conditions of good mentation. In the lower half of the image is a technologically identical processed alpha spindle during a successful test (CAL). Alpha amplitude is generally reduced in amplitude. The second column of color BEAMs during ALAS shows low delta values (only a small increase frontally left) and high alpha values centrally left and occipitally right. The rightmost BEAM column shows high centrooccipitally medial delta activity and reduced alpha activity during ALDE versus ALAS. This answer is quite typical and we find it in 70% of our probands. It means increased attention (decrease in alpha even with closed eyes) and increase in delta. All this during*

mentation. The technical condition of the EEG waveforms is good and without artefacts, therefore we can also accept the participation of beta in the state of PAX ALAS and PAX ALDE temporally on the right and gamma temporally on the left. In both the CAL ALAS and CAL ALDE test conditions, beta is slightly increased centrally, but gamma is increased temporally on the right.

5. Discussion.

In 1924, the alpha and beta rhythm in a human was first seen on the screen in the university laboratory in Jena by professor J. Berger (1938) [1]. This year we should commemorate the centenary of this discovery. The genesis of delta activity was recognized by cortical activity later [5, 6]. Our results show that the number of left-leaning alpha waves with Quota alpha (Qa) varies, being less during relaxation (Qa increases from zero or greater than 1) or more and steeper during thinking (mentation) and Qa, on the other hand, approaches zero. The biggest difference is between the Qa of the entire spindle at rest (higher Qa) and mentation (lower Qa), when the number and their steepness of "left" alpha waves (LAV) are the highest. Data in men with above average intelligence aged 25-35 and with normal EEG show (lowest Qa values) i.e. the most LAV against all other Qa values in the first half of the spindle (ALAS). We explain it by the mechanism of recruitment (recruitment) in THCRIS (Thalamocortical reverberation and iteration system) in the alpha band and thus high mental effort. Recruitment demonstrates the activity of undamped oscillations with an increasing amplitude (and number) of alpha waves with a simultaneous increase in the number of neuronal impulses [7, 8, 9]. This takes place in ALAS and is reminiscent of our analogy between MIA (multilayered iterative algorithm), i.e. mathematical model THCRIS according to A.G. Ivachnenko in 1970 [4]. This is the first phase of the model: forming the structure of an artificial neural network with the construction of many new neurons according to the Ivachnenko polynomial. In the second phase of the alpha spindle in the EEG and in the evolution of the model, according to Ivachnenko's program, newly created neuroids are tested and the non-compliant ones are eliminated according to the mean square deviation, selection occurs. In the EEG, an analogy of selection is visible in the form of a decrease in alpha amplitude (ALDE) and a decrease in neuron impulse, which is graphically represented by damped oscillations of the mentioned alpha waves [5, 6, 9]. An increase in delta activity in the EEG during mentation was described by Dolce and Waldeier (1974) [10]. This indicates a very complex process of iteration. This is probably the reason why the power of alpha decreases in ALAS and delta increases in ALDE, which is also clearly visible in the EEG spectrum. In Lufberger's [15] terminology of impulse theory (perception, incitement, motivation, recruiting), this phase would correspond to incitement, see also Fig. 1.

Nontraditional models, e.g. “Bruselator” used in simulation of cyclic biochemical reactions reminded sequences of assertory syllogisms would be also useful (Prigogine a Stengers, 2001).

After the end of this operation, the same process with neuroid models will begin to repeat, i.e. configuration and selection and so on a new recruitment of impulses (ALAS, alpha synchronization) will begin in the thalamus to increase the probability of activating the most appropriate neurons. But after a certain number of increasingly higher alpha waves, this amplitude and the number of engaged neurons and their impulses in ALDE are followed by a decrease, because uncalled and unlearned neurons are excluded by screening in the selection. We can also talk about a slight decrease of synchronized neurons forming alpha waves, i.e. alpha desynchronization, but with the preservation of learned useful and competent neurons and their "meaningful" impulses. Quian Quiroga [11] similarly considers different but intertwining groups of "conceptual cells" of engaged neurons that form the core of cognition for knowing e.g. actress Jennifer Aniston or similar celebrities. Such a state arises from increasing the complexity of the system at the cost of its indeterminacy, as stated by Votruba [12], which can lead to "useful" emergences or a self-organizing process, but also to irreversible changes and degradation of the system. Further comparison of Qa with EEG waveform frequency analysis (FFT) showed a positive relationship between Qa values and alpha and delta band abundances. The left-sided skewness of alpha waves was more pronounced when adding numbers, parieto-occipitally, independently of the left or right hemisphere. Here, delta in ALDE was also increasing due to increased mentation and alpha was decreasing due to its decreased recruitment. This happened in 4 out of 5 women and similarly significantly in two thirds of men. Apparently, both phenomena, frequency analysis and alpha amplitude in the EEG curve have a common denominator and that is iteration in many places and at the same time (stereo iteration). In 5 children, there was no direct agreement of Qa with the acceleration of alpha activity during mentation, but delta was increasing. Half of the men showed faster alpha by half to 1Hz at the counts, but not the children. A similar situation occurred with alpha spindle synchronization, which was more pronounced in half of the men and three women, but not in the children. In the future, we want to focus on the description of the mutual rapid exchange of information between primary and secondary sensory (association)¨cortical areas (PSCA - SSCA), the connections of which are located in they are localized in the white subcortical matter of the hemispheres. Anatomically, they are represented by short "U" fibres and long fasciculations connecting adjacent and distant lobes of the brain. PSCA represents coding at the level of imagination, and in SSCA a very high abstraction of perceived "images" already occurs. The aforementioned cooperation of sensory areas has already been described by Jones et Powell [13], who report a gradual spread of information from unimodal areas (perhaps PSCS in our hypothesis) [14, 15] to multimodal areas (SSCS) with a graded increase in the abstraction of perceived information. To a certain extent, it was already postulated by Laufberger [16] in the form of an incentive. We took the liberty of describing their function in terms of the hierarchy of cognition [2, 14, 15], which is based on the interaction between PSCS and SSCS. However, we have also other possibilities, e.g. efapsis or micro electromagnetics field which can accelerated and randomized interneuronal processes (INPIM, see later.).

Perceived data or engrams evoked from memory are processed in THCRIS. This system produces the alpha rhythm as a manifestation of the interplay of billions of neurons with trillions of synapses and fibres in rhythmic iterative sequences. In the process of approximating the "image", these recordings express an optical, acoustic, somatovisceral or video form to "oneroid" intrapsychic imagination (INPIM) recalled from memory. The process works towards the similarity of imagination with real (but not identical) reality, i.e. with an external criterion. INPIM is a crucial term expressing a very vivid plastic four-dimensional idea, often surpassing the impression of actual real experience. INPIM is one of the phenomena of an almost isomorphic image of the external world and the experience of self-awareness, it is necessary for the existence of the illusion of consciousness (sensoria). It is difficult to assign structurally physical tools to the realization of such a sophisticated imagination combining a multivariate, dramatic and sensitive experience. However, it seems that a certain originally pathophysiological epileptic manifestation could fulfil the functions of INPIM. It is the phenomenon of EPHAPSE (efapto, Greek εφαπτω I connect, I connect mentally), which appears in areas with an unusual density of neurons and neuropil in rodents, where a strong electromagnetic field is created and impulses can jump independently of synapses, not dendrites or neurites and thus escalate current epileptogenesis. Let's not forget that the voltage of an 8-10 micron neuron is close to 1 millivolt when hyperpolarized. And it is this relatively strong electromagnetic field in the microcosm of the "dense" cortex that can very unorthodoxly and nonorthodromically transmit epileptic signals in the range of large populations of the small cortex of animals. In humans, the density of neurons and their organelles is smaller than e.g. in rats, and in addition, signals are propagated here perhaps with greater orderliness and complexity and therefore could generate INPIM in smaller electroparameters. After all, during diagnostic and therapeutic electrostimulation in humans, we get a double response, either a simple one such as a muscle twitch, local skin paresthesia, an epileptic discharge, or a complex response such as prodromes or aura, pseudo-hallucinations and real hallucinations with different emotions (We have seen derealization, mild and severe anxiety-phobic states, hallucinations of landscapes, but also hyperphoric voluptuous feelings, sometimes accompanied by epileptic graphoelements in SEEG.). To the structure of the sensorium, we would get not only time, but also electromagnetic ephapsis to the classical 3D space.

6. Conclusion.

We objectify the results of psychological tests (PT) in combination with the simultaneous recording of the electroencephalogram (EEG) and the analysis of its curve using the harmonic transformation. We find an interindividual varying degree of agreement between PT and EEG. In general, mental effort is accompanied by an increase in delta (0.5-3.5 Hz). Children often have Rolandic and less often lambda activity when solving tests. Increased attention reduces the magnitudes of alpha (8-13 Hz), sometimes beta (most often 18-22 Hz), there is a reduced amplitude and a slightly increased alpha frequency. Beta is superimposed on alpha waves with reduced amplitude during mentation. The effect is often accompanied by a shape asymmetry of alpha waves, which we call slope or slope (clivitas = Latin inclination, slant). We calculate this slope from the ratio of the length of the ascending part of the alpha wave to its descending part. In a relaxed state, the EEG tends to produce shape-symmetrical alpha waves, with a slope of around one. During mentation, left-sided alpha waves (LAV) increase, which is especially true for healthy younger men with normal EEG, higher intelligence, and skewness moving away from 1 to zero. The predominance of LAV is also more pronounced in the first part of the alpha spindle (ALAS) compared to the second part (ALDE), especially in the mentioned men. In middle-aged adults, thinking is accompanied by an acceleration of alpha, a decrease in its amplitude, less synchronization of alpha spindles, a higher number of LAVs with greater steepness, and an increase in delta activity. In women at rest, there is a reasonable amount of LAV, but paradoxically, during tests, these waves decrease significantly. All children are diagnosed with ADHD syndrome and on average have a small number of LAV, individual results are highly apparently related to the thalamocortical permanent reverberation cycle and its approximate iterative and convergent cognitive process.

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