Solar activity, revolutions and cultural prime in the history of mankind

Miroslav MɪᴋᴜʟᴇᴄᴋÝ

Department of Biometry and Statistics, Neuroendocrinology Letters, Stockholm-Bratislava

Correspondence to: Prof. Miroslav Mikulecký
Studenohorská 10, 84103 Bratislava 47
PHONE: +421 2 64780666
FAX: +421 2 59327 250
EMAIL: statistics@nel.edu

Abstract

BACKGROUND: Russian astronomer A.L. Tchijevsky published in the twenties of 20th century a study comparing the approximately 11-year cycling of "sunspot activity" and "historical process", analyzed globally since the 5th century B.C. to the 19th century A.D. According to him, phenomena of societal "excitation", as revolutions, occurred synchronously with the solar maxima, and, oppositely, those of peaceful activities of masses, as science and arts, with the solar minima. Recently, Slovak philosopher E. Páleš describes periodic fluctuation of historical events in mutually distant geographic areas during more than three millennia. The period lengths, however, are longer, one of the most pronounced being around 500 years.

THE QUESTION was therefore posed: does a similar correlation with sunspot activity, as found for 11-year cycles, exist also in the 500-year cycling?

MATERIAL AND METHODS: The historical data consisted of two time series concerning revolutions in Europe and China, and of eight time series from activities in science and arts registered from five geographic areas. For the comparison, parallel time series of sunspot (Wolf) numbers, available since IInd century B.C., were constructed. Using periodic regression function, the times of peaking were estimated for each data set.

RESULTS: In agreement with Tchijevsky's hypothesis, revolutions culminated near to solar maxima while cultural flourishing usually distinctly near to solar minima. This conclusion is based on the level of statistical significance α=0.05.

CONCLUSION: Solar impact on geomagnetic field could be one of elucidating mechanisms. Recently, electromagnetic influencing of brain function has been realized artificially.

INTRODUCTION

The Russian astronomer A.L. Tchijevsky [15] formulated in the twenties of the last century the law stating that historical processes are governed by the cyclically varying sun activity. He dealt with sunspot activity cycles between 9 and 13, in average 11 years long. Analyzing the world history since the 5th century B.C. till to year 1900 A.D., he found the highest universal human activity as revolutions etc. at sunspots maxima, and the maximal peacefulness of the masses during sunspots minima. Tchijevsky's

ORIGINAL ARTICLE

evidence was the graph of the global "universal historical process" compared by eye with the times of sunspots maxima, since 17th century also with those of sunspots minima. The author of the present article (M.M.) added statistical evaluation: from 176 cases in the graph, counted by himself, he found coincidence of the historical and sunspots maxima 95-times and, oppositely, coincidence of historical minima and sunspots maxima 32-times; the difference is highly statistically significant (the test based on the Poisson distribution, $p < 10^{-7}$) in favour of Tchijevsky's hypothesis. For the last three centuries, the agreement is perfect.

The first impulse for Tchijevsky to begin his research was the simultaneous occurrence of large sunspots, of exceedingly powerful aurora borealis, of exceptionally strong magnetic storms and of the hardest fights of the first world war in the middle of June 1915. No wonder that he considered the physical-chemical processes to be the basis of nervous activity and thought connected with activity of masses. Besides, he mentions ancient thinkers as Hippocrates and Aristotle trying "to find correlation between the condition of human organism and the fluctuations of surrounding physical nature which in a certain way depend upon the sun". Tchijevsky's ideas "led in the field of Russian biology to an increasing interest in magnetic fields, based on an intimate connection between solar activity and life on the Earth, and which determined the peculiar development of Russian magnetobiology" [16]. At present, the molecular to psychosocial aspects of living beings, exposed to their socio-economic environs, are studied including "...heliogeophysical signatures built into individuals and/or populations…" [5]. In this context, for example, the association of mood – a variable obviously important for social behaviour of masses – with cardiovascular, hormonal and geophysical variables monitored concomitantly was studied [8].

Recently, the parallel and periodic phenomena in the world history since prehistoric times were investigated [9]. The estimated periods, however, are longer, of the order of hundreds years. They were revealed by eye inspection of graphs, usually with a convincing periodicity. For the great physicians of ancient Greece, India and China [10], as well as for poets in Arabia, Persia, China and Japan [11], the domination of an approximately 500-years cycle has been validated by inferentially statistical methods. This cycling, according to [9], has been known already to priests of Babylon who explained it by influence of seven Gods, identified with seven heavenly bodies; nowadays, after 5000 years of history, the presence of such cycling appears to be verified.

In the present paper, the question is posed whether there exists also a relationship between the mentioned 500-year historical cycling and sunspots periods as that suggested by Tchijevsky [15] for the period length of 11 years. If so, revolutions should culminate at the 500-year sunspots maxima, and peaceful activities in science and arts around the sunspots minima.

MATERIALS AND METHODS

The historical data were taken from [9] who extracted them from [6,14]. They cover various time spans between as early as 1200 B.C. and 1901 A.D. They comprise (Table 1) revolutions in Europe and in China, emergence of great physicians in ancient Greece and Rome, in India and China, of outstanding historians in ancient Greece and Rome and in China, and of famous poets in Arabia and Persia, in China and in Japan.

The average yearly sunspots (Wolf) numbers were taken from [13]. Their time range was adjusted to the widest time range of the corresponding social activity. The measured or estimated sunspots data, however, are

Table 1. Historical data processed in the present contribution.

SOCIAL ACTIVITY	COUNTRY	TIME RANGE (years)	No.OF YEARS WITH OBSERVATION	TOTAL No. OF CASES	MEAN YEARLY No.OF CASES
Revolutions	Europe	525 A.D.–1901 A.D.	56	9 275	166
	China	225 B.C.–1900 A.D.	86	401	5
Physicians	Greece, Rome	700 B.C.–600 A.D.	27	58	2
	India	700 B.C.–1200 A.D.	20	8	0.4
	China	700 B.C.–1200 A.D.	20	18	0.9
Historians	Greece, Rome	700 B.C.–450 A.D.	24	58	2
	China	700 B.C.–1400 A.D.	43	32	0.7
Poets	Arabia, Persia	400 A.D.–1650 A.D.	26	133	5
	China	1200 B.C.–1850 A.D.	62	93	2
	Japan	500 A.D.–1850 A.D.	28	66	2
TOTAL		1200 B.C.–1901 A.D.	392	10 142	–

not available before 199 B.C. Accordingly, the sunspots data time span extends between 199 B.C. and 1901 A.D. for revolutions, between 199 B.C. and 1200 A.D. for physicians, between 199 B.C. and 1400 A.D. for historians and between 199 B.C. and 1851 A.D. for poets.

The yearly frequencies of social activities as well as the yearly averages of sunspots numbers *(y)* were plotted versus time *(t)* and processed by Halberg cosinor regression [1] using original software [7]. In this way, the presence of a general trend and of the 500-year periodicity was tested. Trend was identified as the linear or parabolic one, using the point and confidence estimates of the regression coefficients *b* $(y=a+b.t)$ and *c* $(y=a+b.t+c.t^2)$. The 500-year periodicity was quantified with the aid of the point and confidence estimate for amplitude of cycling around the mesor (for equidistant observations identical with mean) and for its peaking times. The regression function was displayed graphically together with its 95% confidence (for means, narrower) and tolerance (for one observation, wider) corridors. The quality of the regression approximation was expressed by the coefficient of determination (0=minimum, 1=maximum quality), telling the proportion of the total variance in the data, explained by the regression. The level of statistical significance was set at α=0.05; nevertheless, the p-values will be differentiated also on those under 0.01 and under 0.001.

The principal question, posed in the present paper, was answered by mutual comparing of peaking times for sunspots and for corresponding social activity. The deciding criterion is the time difference *D* (social minus sunspots peaking time), kept between zero and +250 years (social peak later than sunspots peak) or between −250 years and zero (social peak earlier than sunspots peak). The significance of the deviation of *D* from zero is evaluated by p-value and by 95% confidence interval for *D* (non-overlapping of the zero value means significance). According to the Tchijevsky's hypothesis [15], the *D* estimate should depart from zero non-significantly for revolutions and significantly for each other social activity.

Taking into account the ten combinations of social activity and country, the results of testing the difference *D* will be evaluated also globally using the sign test for symmetry based on the „exact" confidence limits for Np of the binomial distribution [2].

All evaluations are based consequently on the principle of statistical induction from sample to population [4].

RESULTS

The observed data for separate social activities in corresponding countries, accompanied by sunspots (Wolf) numbers during corresponding time span, are shown, together with the regression approximation by the periodic mathematical function, on Figures 1–4. The time coincidence of peaks of Wolf numbers and revolutions in either geographic area can be clearly traced by eye. A reverse – time coincidence of troughs in Wolf numbers with peaks for physicians in all three areas – is also striking, similarly as for Arabic-Persian poets.

The results obtained for the Wolf numbers' time series, arranged to separate four social activities, are in Table 2. The 500-year cycling approaches statistical significance (p<0.07) only for the Wolf data corresponding with the time span for famous physicians.

The general trends in registered yearly frequencies, amplitudes of the 500-year cycling, its peaking times and quality of regression approximation are evaluated for all 10 combinations of social activity and country in Table 3. Thus, significant parabolic trend with increase followed by decrease was found for ancient Greco-Roman physicians and for poets in Arabic-Persian cultural sphere and in China. For these three combinations, also the 500-year periodic fluctuation of the frequencies was significant. The latter was true for Chinese physicians, for both Greco-Roman and Chinese historians and for Japanese poets, too. The peaking times for revolutions differ usually strikingly from those for other, peaceful social activities. The best approximation of data by the periodic regression function was achieved for Greco-Roman physicians, Arabic-Persian poets and Greco-Roman historians.

The main outcome of the present paper offers Table 4 evaluating the differences *D* in sunspots' and social peaking times. As anticipated according to Tchijevsky's hypothesis, applied by the present author on 500- instead of original 11-years' periodicity, there is no significant difference in peaking times for sunspots and revolutions in either geographic area while in all eight combinations of social activity and country this difference is significant.

Summing up, in all ten social-country combinations, the result does agree with the tested hypothesis. For the test of symmetry, the outcome is 10:0 in favour of the agreement. This result is significant with p<0.01.

Table 2. Yearly registered Wolf numbers' time series and results of their cosinor analysis.

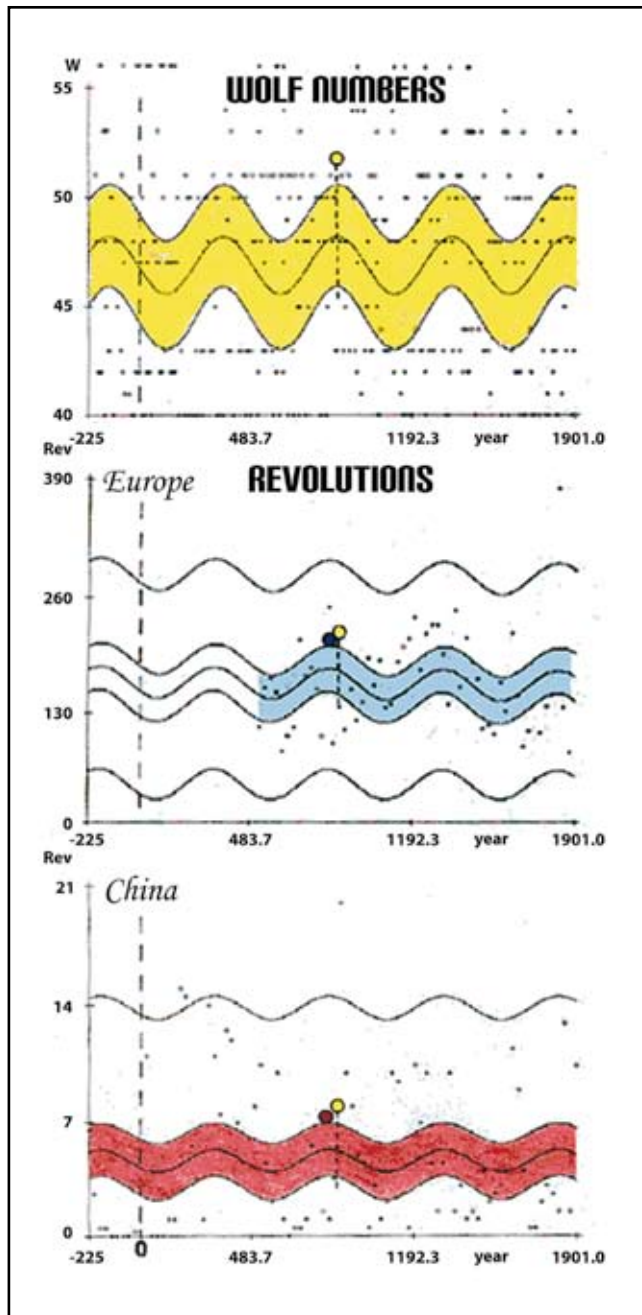| SOCIAL ACTIVITY TO BE COMPARED	TIME RANGE (years)	AMPLITUDE/MESOR	PEAKING YEARS	CD
Revolutions	199 B.C.–1901 A.D.	1 / 47	−134, 366, 866, 1366, 1866	0.001
Physicians	199 B.C.–1200 A.D.	2* / 48	−148, 352, 852	0.002
Historians	199 B.C.–1400 A.D.	2 / 48	−113, 387, 887, 1387	0.001
Poets	199 B.C.–1851 A.D.	1 / 47	−131, 369, 869, 1369	0.001

CD=Coefficient of Determination; *p<0.07

Figure 1. Wolf numbers' yearly averages (top) and yearly numbers of registered revolutions (middle, Europe; bottom, China) plotted versus time. The data (dots) were approximated by cosinor regression with the period length of 500 years. The point estimate (middle curve), its 95% confidence corridor (for means, narrower) and 95% tolerance corridor (for one observation, wider) are shown. The long-dashed vertical straight line indicates the year zero, the short-dashed one with empty circle the time position of the first relevant Wolf maximum, the full circles indicate the comparable social peaks.

Figure 2. Analogy of Figure 1 for physicians in ancient Greece and Rome (first middle), in India (second middle) and in China (bottom).Besides the 500 year period, also the parabolic trend is significant for Greece and ancient Rome.

DISCUSSION

It could be objected that each from the four sunspots' time series (Table 2) and three time series from the ten social-country combinations (both revolutions and Indian physicians, Table 3) lack a statistically significant 500-years cycling. The goal of the present paper, however,
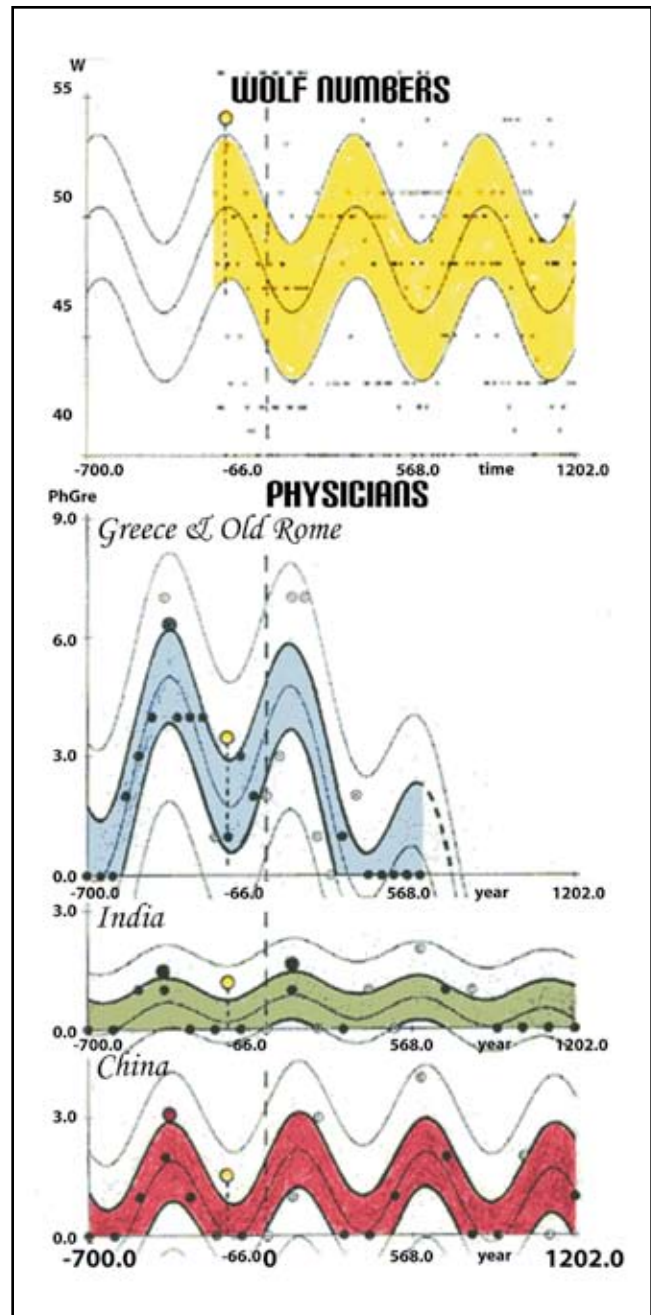
was not to prove a significant cycling in the data but to compare the times of peaking in sunspots and in social activities. The result of this comparison is evidently unequivocal.

John A. Eddy [3], analyzing "the case of the missing sunspots", reports about "at least 12 solar excursions over the past 5000 years", their period lengths thus approach-
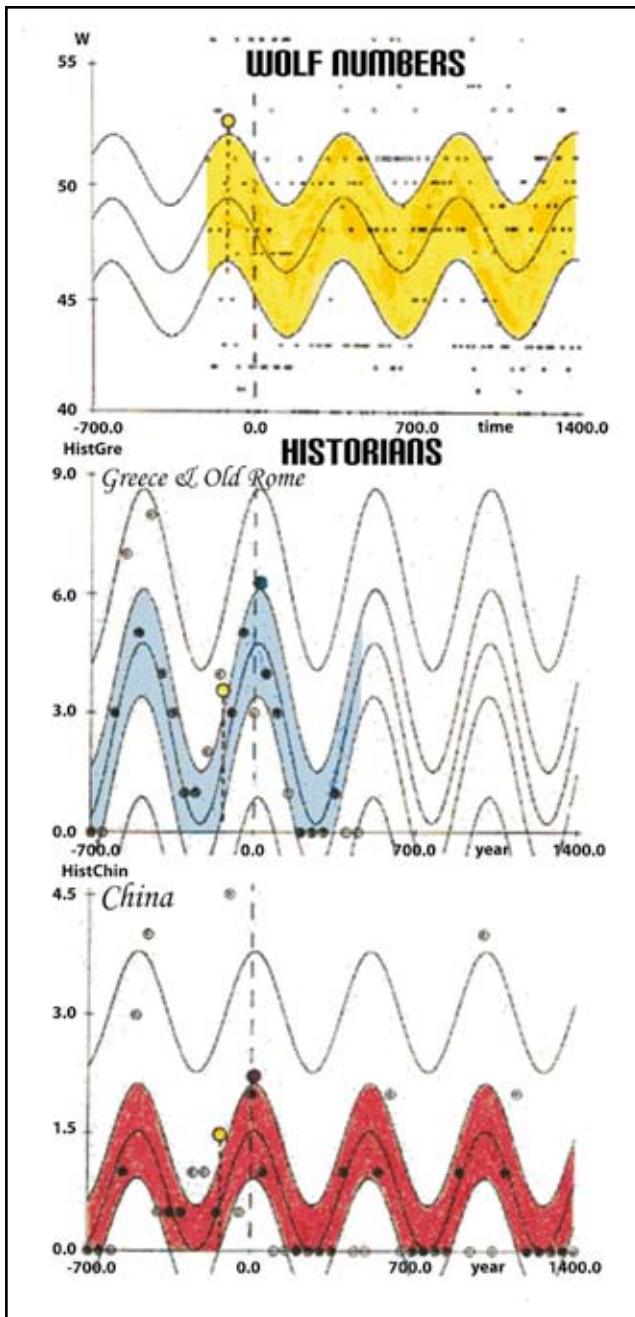
Figure 3. Analogy of Figure 1 for historians in ancient Greece and Rome (middle) and in China (bottom).
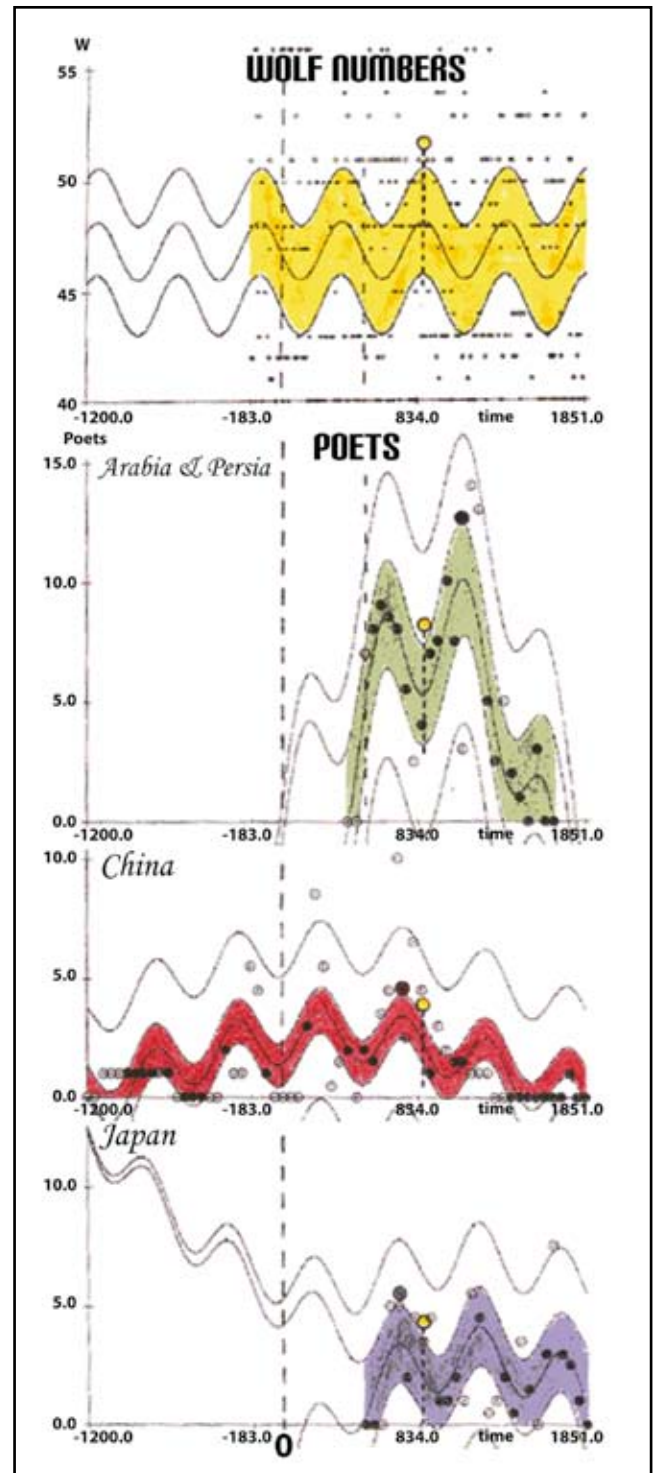

Figure 4. Analogy of Figure1 for poets in Arabia and Persia (first middle), in China (second middle) and in Japan (bottom). Significant parabolic trend is present in the data from Arabia and Persia and from China, non-significant in those from Japan.

ing roughly almost half millennium and several of them being near to 500 years' cycle.

The mechanism of some putative action coming from the sun, perhaps in the form of a physical field, is unknown. This is obviously one of reasons why an idea of cosmic influence on human behaviour is sometimes rejected *a priori* as some kind of astrologic misbelieves.

Recently, however, an argument in favour of a possible global psychological influencing of masses was presented: the possibility of electromagnetic induction of fundamental algorithms in human brain was shown [12]. The latter author speaks about "...the technical capability to influence directly the major portion of the approximately six billion brains of the human species without mediation

Table 3. Results from cosinor analysis of historical data.

SOCIAL ACTIVITY	COUNTRY	TREND COEFFICIENT / MYNC		AMPLITUDE/ MYNC	PEAKING YEARS.	CD
		Linear (b, year^{-1})	Parabolic (c, year^{-2})			
Revolutions	Europe	0/166	–	18/166	828, 1328, 1828	0.049
	China	0/5	–	0.7/5	–175, 325, 825, 1325, 1825	0.012
Physicians	Greece, Rome	+0.003***/2	–0.00001***/2	2***/2	–390, 110	0.679
	India	0/0.4	–	0.3/0.4	–398, 102, 602, 1102	0.142
	China	0/0.9	–	1**/0.9	–379, 121, 621, 1121	0.444
Historians	Greece, Rome	0/2	–	2***/2	–478, 22	0.487
	China	0/0.7	–	0.8**/0.7	–488, 12, 512, 1012	0.212
Poets	Arabia, Persia	+0.04***/5	–0.00002***/5	3**/5	602, 1102, 1602	0.638
	China	+0.001*/2	< 0***/2	1**/2	–766, –266, 234, 734, 1234, 1734	0.335
	Japan	+0.01/2	<0/2	1*/2	683, 1183, 1683	0.228

MYNC=mean yearly number of cases. CD=Coefficient of Determination.
*p<0.05; **p<0.01; ***p<0.001; [<0 means that a non-zero digit was on a nonprinted decimal place].

Table 4. Differences (D) between peaking times of Wolf numbers and those of corresponding social activities in the separate countries.

SOCIAL ACTIVITY	COUNTRY	SOCIAL MINUS WOLF PEAKING TIME D (years)	95% CONFIDENCE INTERVAL for D (years)
Revolutions	Europe	–38	–195; +119
	China	–41	–239; +158
Physicians	Greece, Rome	–242***	–338; –145
	India	–249***	–379; –119
	China	–232***	–332; –132
Historians	Greece, Rome	+135*	+13; +257
	China	+125*	+1; +251
Poets	Arabia, Persia	+232***	+101; +362
	China	–139*	–268; –9
	Japan	–189**	–325; –53

*p<0.05; **p<0.01; ***p<0.001.

through classical sensory modalities by generating neural information within a physical medium within which all members of the species are immersed". He warns against inappropriate application of these technologies and calls for "...the continued and open discussion of their <u>realistic</u> feasibility and implications within the scientific and public domain".

It seems therefore possible that some periodic impulses from the sun could operate similarly. Traces of this natural action can be inscribed in the history of mankind. Unfortunately, studies of putative connections between the cosmos and the psyche are rare and usually ignored. The author of the present contribution believes that more deep and exact research in this field will be scientifically fruitful, possibly in favour of wellbeing of human society.

The sequence of such milestones as the Babylonian priests – Hippocrates and Aristotle – Tchijevsky should be continued also in the third millennium A.D.

CONCLUSION

Tchijevsky's hypothesis about synchronism between sunspots maxima and exciting events in history on one side and sunspots minima and peaceful, creative periods on the other, elaborated for the sunspots cycles with period length of 11 years in average, was now supported for 500-year periodic fluctuation in either component – sun and society – on the level of 5% error α. One mechanism of these putative actions could be given by changes in electromagnetic field.

ACKNOWLEDGEMENTS

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