CHRONOBIOLOGY AND AFFECTIVE DISORDERS – CORRELATION WITH THE SOLAR CYCLE

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The paper represents an actualization of a study from 2002 that referred to a possible correlation between the biorythms with low frequency and the affective disorders; the autohor took into consideration the solar cycle; the hypothesis consists that the multiannual oscillations of the solar activity influences the affective disorders.
It started from a simple item, i.e. the number od admission/year with Bipolar Affective Disorders in Psychiatric Clinic Timisoara during 21 years (1986-2006), correlated with the solar activity (number od sunspots). It observes an non-linear overlapping of the curves that show the multiannual oscillations of the number of admissions. The clearest correlation appeared between the increasing of the solar activity and the manic episodes (more than 3 times). It also appeared a period of „latency” of one year between the time of „the solar attack” and the peak of the admissions with affective disorders, fact that could support the hypothesis that the maximum of solar activity would represent a factor of circumstantial vulnerability for the affective disorders.

Key words : - chronobiology, affective disorders, solar cycle

I. Introduction

The study of the biological and psychological rythms belongs to the field of the chronobiology, a border-sience; its importance was emphasised from the antiquity, especially by the Eastern-Oriental Chinese Medicine.

The Modern Medicine and the Psychiatry, too fully benefit from the part of the Chronobiology; its applications are numerous and useful (1); the researches from the last 30 years lead to interesting results, especially in the field of the affective disorders; so, Rosenthal identified a new distinct nosological disorder called winter depression (seasonal affective disorder (2)). It was also identified some disregulations (desynchronizations) of the bio-psycho-rythms with medium and high frequency and it was analysed many Zeitgerbers (time-synchronisers) that induce changes of the bio-psycho-rythms.

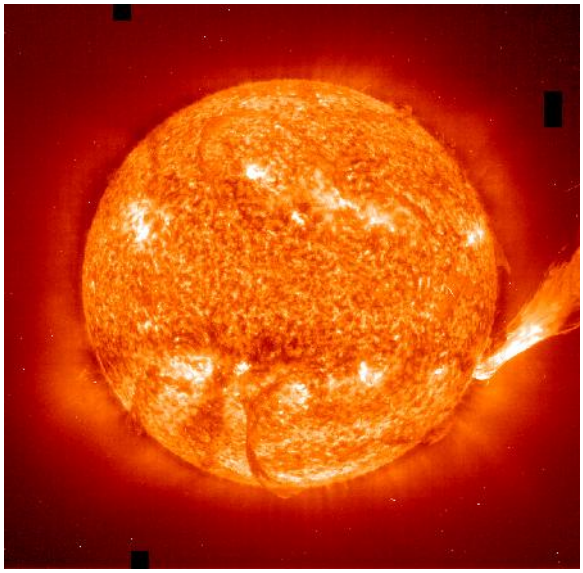
The author synthetised two main and distinct perspectives applied to the affective disorders as follows:

1. The chronobiology of the bio-psycho-rythms with low frequency (multiannuals); the exogenous Zeitgerbers are represented by the multiannual oscillations of the solar activity.
2. The vulnerability-stress theory (3) (Zubin and Rutter), despite the fact that this theory is less used (from pragmatical reasons); the author proposes a possible model of “chronobiological vulnerability” with prospective and predictible value in the framework of the so-called „circumstantial vulnerability”(M. Lăzărescu) (4). The prediction of the periods of increased chronobiological vulnerability would have a big importance in the area of therapy and even in secondary profilaxy of the affective patients, with the possibility to increase their quality of life.

II. Notions of astrophysics

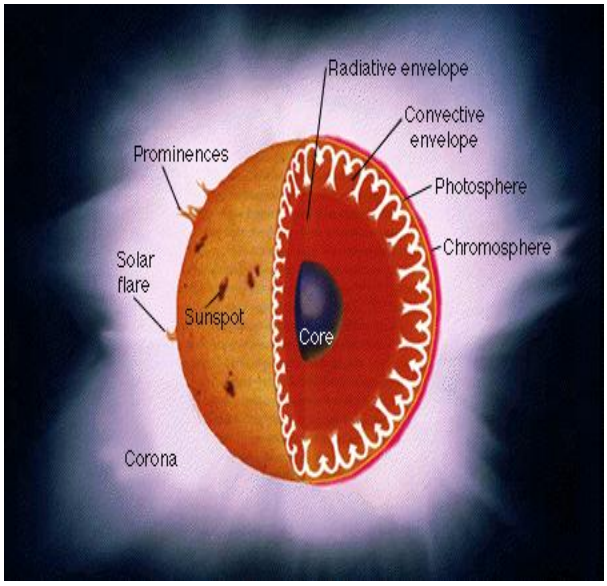
The Sun is a star peripheriсaly located in a galaxy from the Milky Way; it is surrounded by 9 planets that form the Solar System. Because of its emanation of light and heat (photons), the Sun sustains the life from our planet Earth. The age of the Sun is estimated at 4.5 billion years (5). The distance between Sun and Earth is approximately 100 million miles. The Sun is of 300 000 times heavier than the Earth and he has an own rotation movement of 27 days.

Figure nr. 1 A big Sun Picture



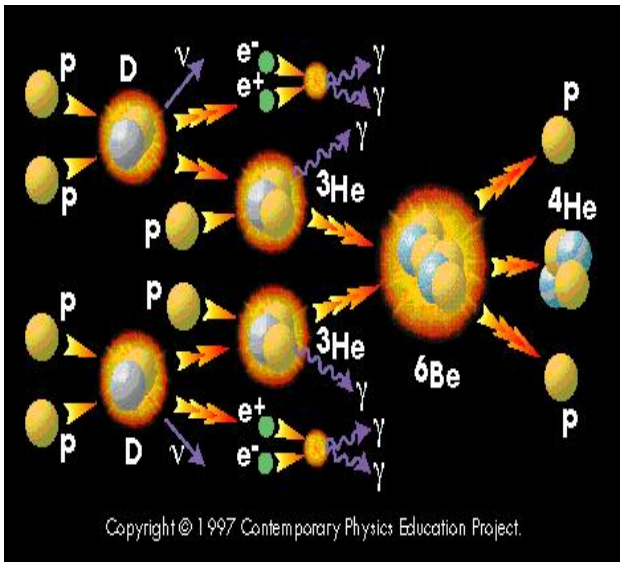
1. The Sun core: its density is huge (160 g/cm^3), it is gaseous and its temperature is of 15 Million degrees Kelvin. In the core it produces reactions of nuclear fusion that emanate energy (Gamma radiations and neutrino particles). The Gamma radiations are photons with a very high energy and frequency and “neutrino” are non-reactive elementary particles (6).

Figure nr. 2 The Sun Structure



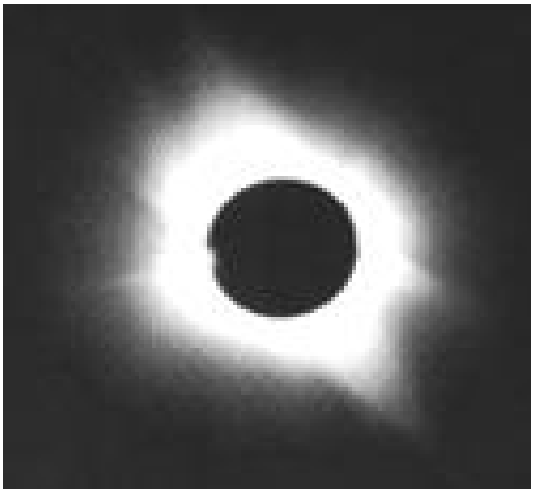
2. The “Solar Envelope” covers the core and it consists in two components: - an internal one “radiant” and an external one “convective”. Its temperature is of 400 Millions Kelvin degrees and its density is lower than the core’s density. The core represents 40 percent from the Sun mass and 10 percent from the Sun volume. The envelope represents 60 percent from the Sun mass and 90 percent from the Sun volume; the envelope is “colder” and more “opaque” than the core (7).
3. The Photosphere is the layer that emits the solar light from the visible spectrum. It is thinner (hunderd miles) and it is formed by gases of low pressure with a temperature of “only” 6 000 degrees Kelvin. The main gas of the photosphere is the Helium an inert gas discovered by W. Ramsay in 1896.
4. The Chromosphere is a layer formed by Hydrogene and it is visible as a red circle during the eclipses; its temperature is of 7000 degrees Kelvin.

Figure nr. 3. Two fusion reactions



5. The Corona is the external Sun layer. It becomes visible only during the total eclipses. The corona is formed by low-density plasma and its temperature is of 1-3 millions Kelvin degrees. In the interior of the corona, it is possible to be observed the solar proeminences, violent emanations of energy with huge dimensions and the temperature of 11 millions Kelvin degrees. The extreme heat produces X radiations that generates light when these radiations kick the gases from the corona.

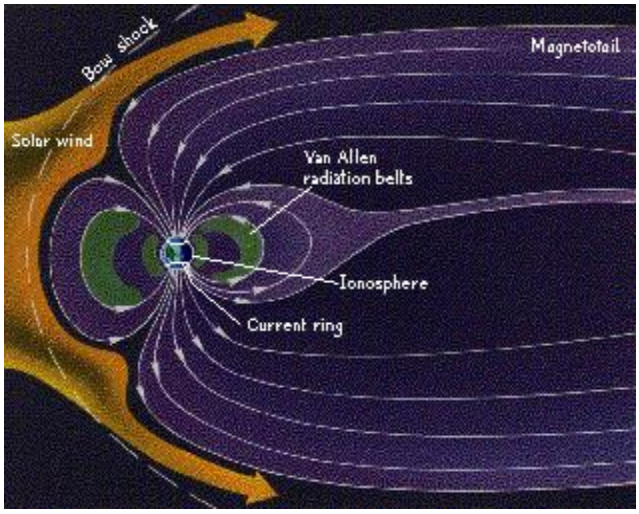
Figure nr. 4 The solar corona



The Solar corona constantly looses particles. It constantly evaporates from the Sun protons and electrons with a speed of 300 miles/second. This flux of particles was called “solar wind” (8).

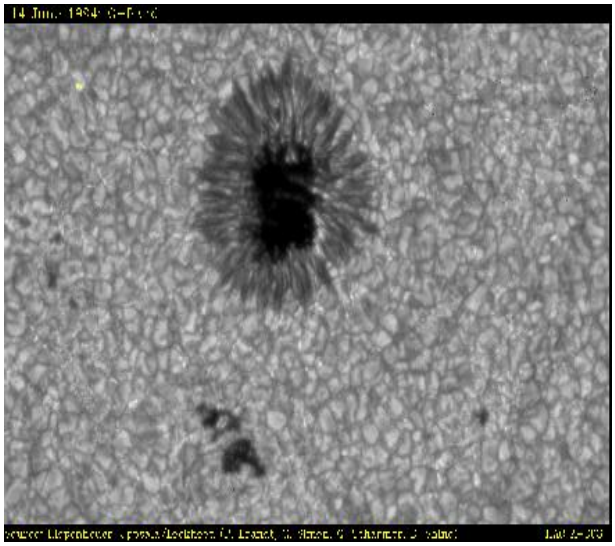
The Solar wind influences the magnetic fields of all the planets of the Solar System, including the Earth one; the pressure exert by the solar wind of the Earth magnetic field is called “Bow Shock” (8). The solar particles are partially captured by the radiation belt Van Allen.

Figure nr. 5 The Solar Wind



6. The Sunspots are dark zones in the photosphere with a diametre similar with the Earth diametre and with a lower temperature. The first description of the solar spots was performed by Chinese astronomers in the Great Chinese Encyclopedia (322 aC). There were first time observed by the telescope in 1610 (Gallileo Galilei). H. Schwabe demonstrated that the average number of sun spots has a cyclical variability; the periodicity is of 11 years. G. E. Hale (1908 Mount Wilson Observatory) demonstrated that the solar spots are associated with very intense magnetic fields.

Figure nr. 6 Solar spot

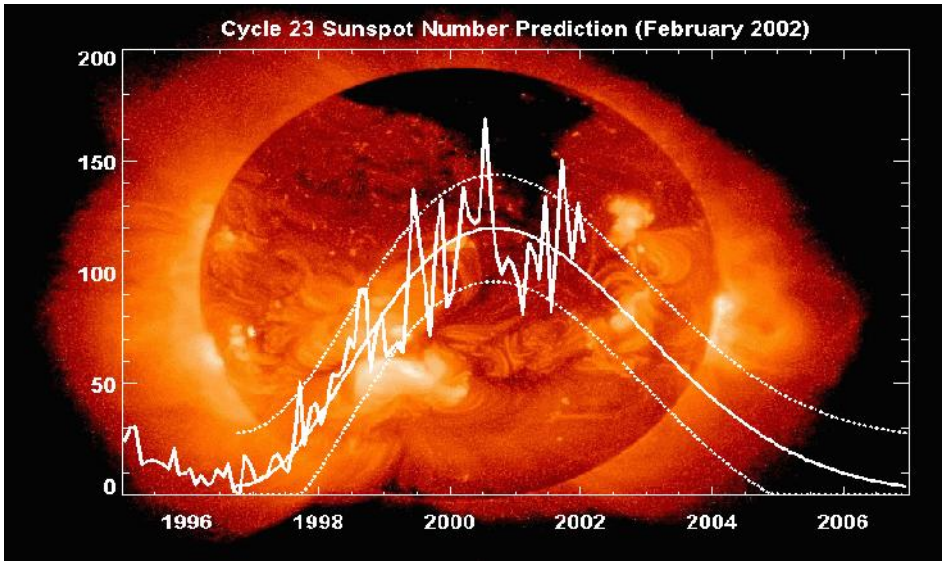


7. A Solar cycle has a periodicity of 11 years. In 2008 it began the 24-th known Solar cycle. As a general rule, at the beginning of a solar cycle, the number of the sunspots are low, it gradually increases during 5.5 years and it progressively decreases in the next 5.5 years.

The number of the sunspots is collected by different astronomic observatories and sent to the Index Centre of Sunspots from Brussels (Belgium). The final calculation is made by NOAA (National Oceanic and Atmospheric Administration) – USA. The number of the sunspots is very variable from a day

to another. The graphics that show the solar activity contain curves that indicate the daily, monthly and annual variations of the number of the sunspots; the medium annuale values are named “smooth” values.

Figure nr 7 Solar cycle 23



The scientists were preoccupied by the correlations between the solar activity, historical events and the human disease. For ex. Dimitrov (9) in a recent study, using statistical linear and non-linear methods, shows that it exists a significant statistical relation between the incidence of the meningococical meningitis and the oscillations of the solar activity in Bulgaria during 1940-1990.

Kharnaukova and Sergievich (10) show a decrease of the functional activity of the immunocompetent cells in the peripherical blood of the lab animals during the increasing solar activity. Seah et all (1997 (11) show that the number of the attacks of glaucoma increase in the time of intense solar activity.

A very serious research (12, 13) in Israel and Latvia (Stroupel and Israelevici) shows a very interesting correlation between the deaths caused by hearts attacks, suicide, the blood level of the cholesterol and the serotonine, cosmic factors (solar activity) and telurical ones, with the collaboration of the Goddard Centre (USA) and The Izmiran Institute (Russian Academy of Science). The results showed that a flux of protons higher

than 90 MeV would influence the instalment of the monthly deaths by heart attack and suicide.

Other researches (14) show correlations between the solar activity and social disorders. A very interesting study (Ertel - 15) (in the framework of the Institute of Psychology Göttingen) about the poetry, picture and scientific discoveries from two parallel cultures (1400-1800 aC): the Chinese and the European show an identical periodicity of creative activity, including the "peaks", despite the fact that the connection between the two cultures were very low. Ertel suggests the existence of an external syncronizator factor, i.e. the oscillations of the solar activity.

Persinger (16) tried to demonstrate that it exists a direct correlation between the increasing of the human aggressiveness (discharged in wars), the oscillation of the solar activity and of the geomagnetic field; the results were inconsistent.

III. Material and method

The present study represents a continuation of a retrospective study published in 2002. The author didn't find in the disponible international literature something similar. In 2005 it was published in Chile (17) a study with a similar design and with similar results concerning the manic episodes, but not concerning the depressive ones(perhaps due to the fact that the above-mentioned study takes into considerations both types of depression,mono and bipolar); the Chilean study took into consideration a so called Wolf number for the Solar Cycle. The author prefered to use the "Smooth" annual values of the sunspots.

The author tried to answer at a following question: Do the multiannual oscillation of the solar activity influence the course of the affective disorders? If yes, how? For this purpose, it proceeded as follows:

a) It was taken into considerations the admissions for a period of 21 years (1986-2006) with the diagnostic categories F30-F31.2 – ICD-10.(It excluded the clinical forms of mixed states and rapid cycling ones).

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b) The number of admissions was limited into the catchment area of the Psychiatric Clinic "E. Pamfil" Timişoara. The main advantage was the diagnostic accuracy

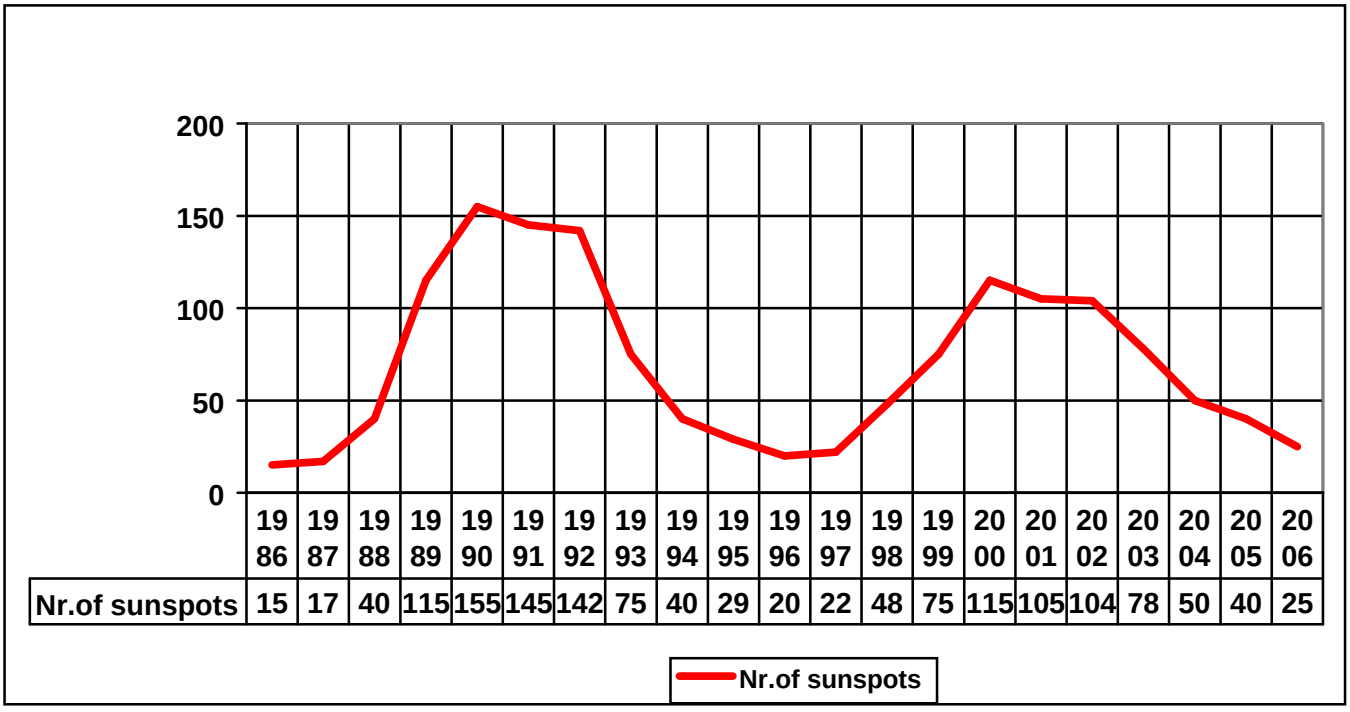
and a very good database. The number of admissions was shared on the above – mentioned diagnostic categories. On this basis of this, it formed more diagrams; on the abscissa were registered the years and on the ordinate, the number of admissions from the above-mentioned categories and the "smooth" number of sunspots. So, on the ordinate it is founded two variables (independent ones), but conventionally both received the same initial value "0".

Note: The diagnostic category F33 (Reccurent depressive disorder) has different chronobiologic features, so it will separately into consideration in a future study.

Results and discussions

Diagram nr. 1

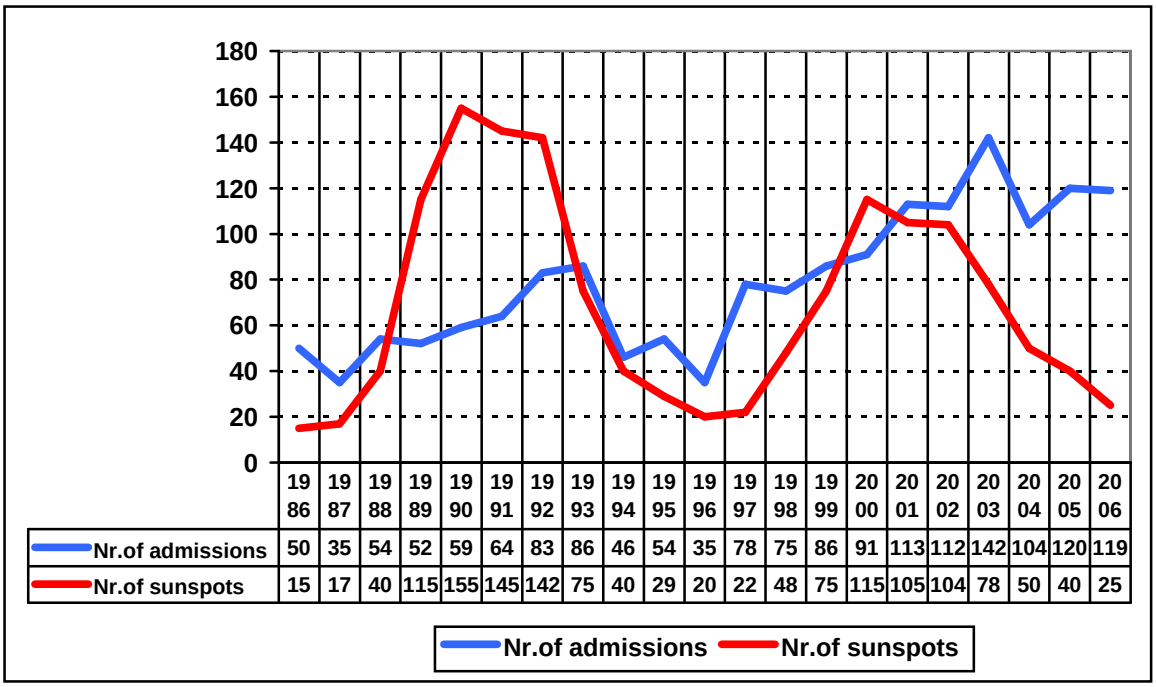
Diagram of the solar activity in the period 1986-2006 (smooth value of the sunspots);between 1986-1996-solar cycle nr.22;between 1996-2006-solar cycle nr.23



It clearly appears 2 maximum values (1990 and 2000) and 3 minimum values (1986, 1996 and 2006).

Diagram nr. 2

The multiannual oscillation of the admissions in the Psychiatric Clinic Timişoara – Romania. (Bipolar affective disorders F30-F31).



Comment. After 1996, the number of the admissions in the Psychiatric Clinic Timişoara significantly increased, the yearly average between 1986 and 1996 was 60 admissions; between 1997 and 2006 the yearly average was 100 admission (an increasing of 60 percent).

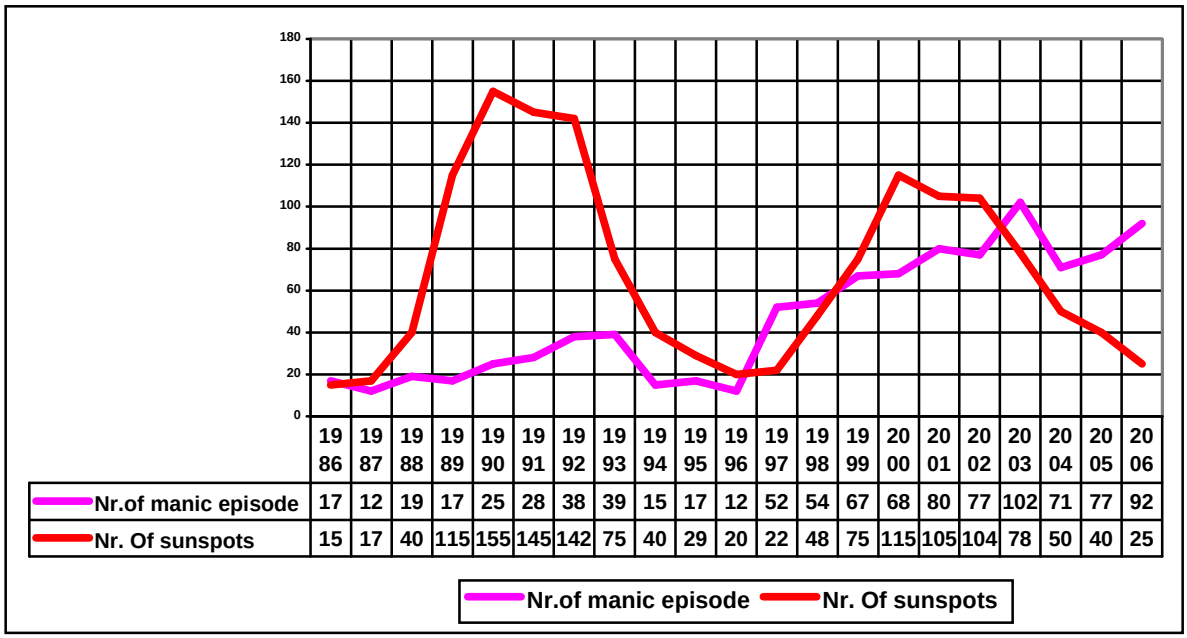
The diagram also shows an non-linear overlapping of the curves that indicate the multiannual oscillation of the solar activity. It observes a phase difference between the maximum of the solar activity (1990 and 2000) and the maximum number of admissions (1993-2003).

For the solar cycle nr. 22 (1986-1996) the year 1993 has the maximum number of admissions – 83. The percentage increasing of the admissions was high more than 100 percent (between the minimum and the maximum), this value consider to be significant.

For the solar cycle nr. 23, the year 2003 has the maximum of admissions – 142. the percentage increasing between the minimum and maximum number of admission is 90 per cent, also this value we consider to be significant.

Diagram nr. 3

The multiannual oscillation of the admissions with manic episodes in the Psychiatric Clinic Timişoara Romania.



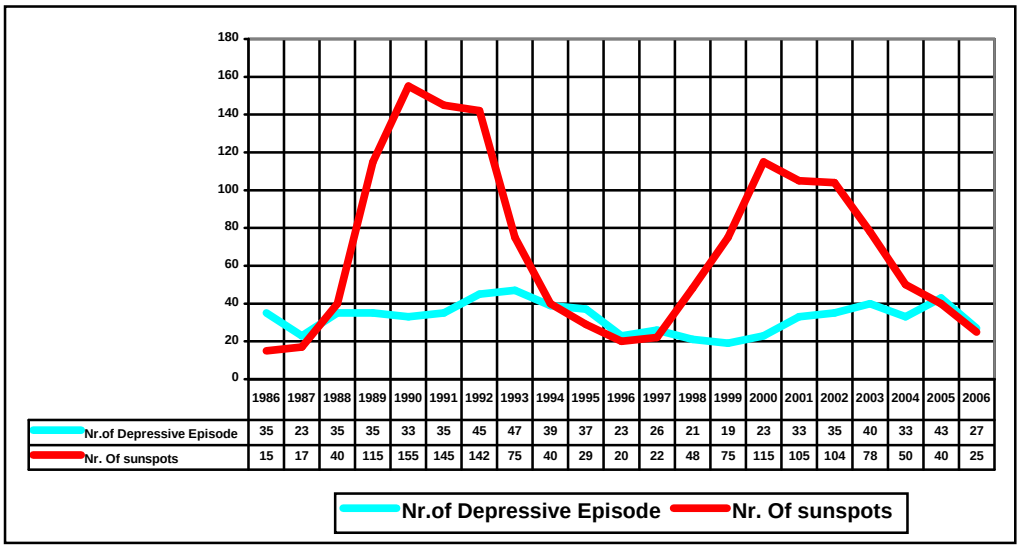
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Nr.of manic episode	17	12	19	17	25	28	38	39	15	17	12	52	54	67	68	80	77	102	71	77	92
Nr. Of sunspots	15	17	40	115	155	145	142	75	40	29	20	22	48	75	115	105	104	78	50	40	25

The multiannual oscillation of the number of admissions with manic episodes are similar with the multiannual oscillations of the total admissions with bipolar disorders. It also observes a similar phase difference (1990 and 2000 solar and 2000 and 2003

admissions). The percentage of increasing of the admissions was over 200 percent for the solar cycle nr. 22 (1986-1996) and almost 100 percent for the solar cycle nr. 23, with high significance, too.

Diagram nr. 4

The multiannual oscillation of the number of admissions with bipolar depression in the Psychiatric Clinic Timişoara Romania.



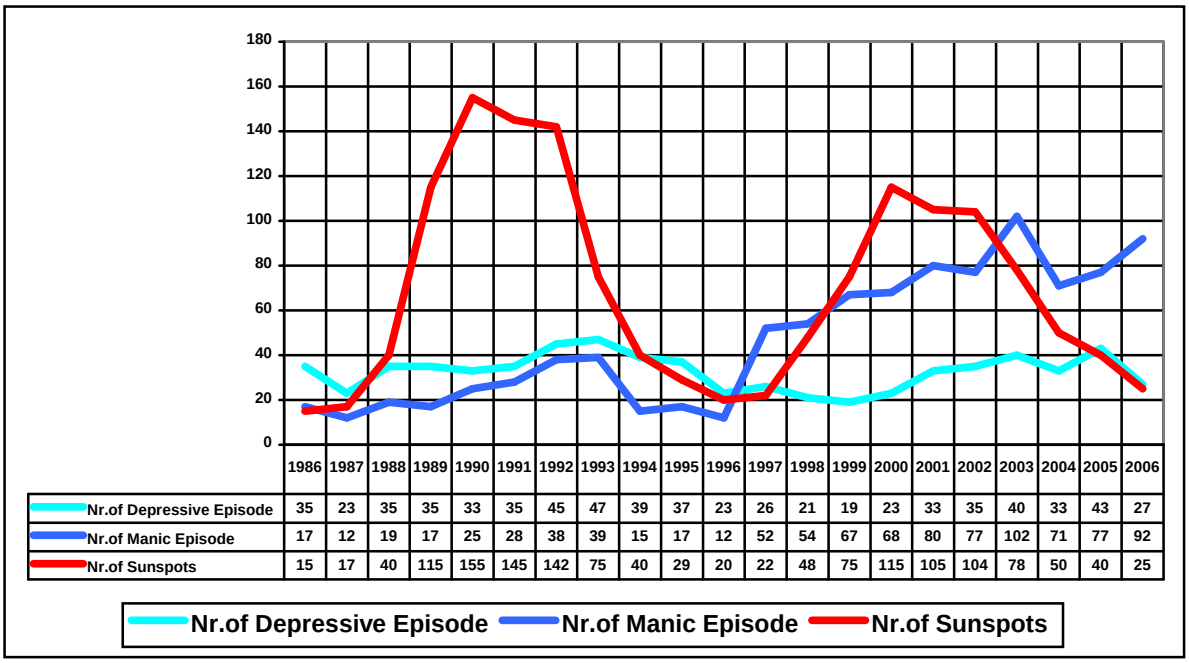
	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Nr.of Depressive Episode	35	23	35	35	33	35	45	47	39	37	23	26	21	19	23	33	35	40	33	43	27
Nr. Of sunspots	15	17	40	115	155	145	142	75	40	29	20	22	48	75	115	105	104	78	50	40	25

The curve that shows the multiannual oscillations of the admissions with bipolar depression has a similar trend with the curve that shows the multiannual oscillations of the admissions with the manic episodes, but less typical; it observe 3 “peaks” (1993, 2003 and 2005 – an atypical aspect). Still, the difference between minimum and maximum is relevant: for the solar cycle nr. 22 and 23 a percentage difference of 100 per cent.

The next diagram shows the differences between the multiannual oscillations of the admissions with bipolar mania and depression.

Diagram nr. 5

The multiannual oscillations of the admissions with bipolar mania and bipolar depression in the Psychiatric Clinic Timişoara Romania.



	1986	1987	1988	1989	1990	1991	1992	1993	1994	1995	1996	1997	1998	1999	2000	2001	2002	2003	2004	2005	2006
Nr.of Depressive Episode	35	23	35	35	33	35	45	47	39	37	23	26	21	19	23	33	35	40	33	43	27
Nr.of Manic Episode	17	12	19	17	25	28	38	39	15	17	12	52	54	67	68	80	77	102	71	77	92
Nr.of Sunspots	15	17	40	115	155	145	142	75	40	29	20	22	48	75	115	105	104	78	50	40	25

Comment:it clearly appears that the number of the admissions with BAD that significantly increased in the period of the 23-th solar cycle,increased on the basis of the manic episodes,the number of the depressive bipolar disorders having a more constant oscillation.The author have not yet a clear explanation of this phenomenon.

Conclusions

The present study is able to offer interesting practical conclusions. Due to the fact that this study was performed with a relatively small number of cases and in a limited cachment area, its conclusion are not definitive, but there would be a good beginning for new thorough researches.

So, the hypothesis of a so-called “chronobiological” vulnerability could be seriously taken into consideration into the “circumstantial vulnerability”. The cyclic exogenous Zeitgerbers (time syncronizators) are able to dissynchronise the bio-psycho-rhythms with low frequency (multiannual) at the subjects with affective disorders. These disorders has a clear genetical determinism; so, it is very possible that the biological rhythms to be distorted at the level of he pace-makers; their dissynchronization appears under the action of certain exogenous Zeitgerbers.

It is very interesting that the number of the admission with bipolar affective disorders significantly increases in the period of the maximum solar activity; the maximum of admissions is recorded after 3 years of the maximum solar activity. This results leads to the hypothesis of a “latency period” between the cosmic event (Zeitgerber) – in this case the maximum of dissynchronization. This hypothesis is confirmed by a study of Kay(18) that shows that the number of the admissions with depression in a British Psychiatric Hospital significantly increased after a geomagnetic storm, with a maximum after 14 days.

So, it is possible to affirm that the year with maximum solar activity can be considered that a year maximum chronobiologic vulnerability for the bipolar disorders.

If we take into considerations the dissynchronizations of the circadian and seasoned bio-psycho-rhythms in the case of the affective disorder, it is possible to conclude that the evolution of the affective disorders are in connection with the solar

activity both circadian and seasonal (already known) and multiannual, too ,confirmed by this study and the Chilian one (17).

Bibliography.

1. D.ŞTEFLEA : “Cronobiologia şi medicina”, Ed.Medicală Bucureşti, 1986, Vol.I-II
2. ROSENTHAL, N.E. – Diagnostic and treatment of seasonal affective disorder, J. of A.M.A., 270, 2717, Dec.1993
3. ZUBIN, J., SPRING, B. – Vulnerability – a new view of schizophrenia, Journ. Of Abnorm. Psychol. 88, 103-126, 1977
4. LĂZĂRESCU, M., OGODESCU, D.: “Îndreptar de Psihiatrie”, Ed.Helicon Timişoara, 1995
5. KALER, JAMES, B.: “Stars”, New York, Scientific American Library, 1992
6. BAHCALL, J.N.: “Neutrino Astrophysics” Cambridge University Press, 1989
7. EDDY, J.:”A New Sun : The Solar result from Skylab, NASA, S.p. 402,1979
8. BARNES, A.: “Acceleration of the Solar Wind”, Reviews of Geophysics, 30, pg.43-55, 1992
9. DIMITROV, B.D.:”Cyclicity in Incidence Variations of Meningococcal Infections in Bulgaria and similar to that of solar activity”, Central European Journal of Public Health, May 2000,8 (2), pg.114-116.
10. KARNAUKHOVA N.A. et all: “Quantity and Quality of Animal Immunocompetent Cells in relation with variations in solar activity”, Biofizika (Russia), mar-apr., 1999, 44 (2) pg.313-317
11. SEAH et all: “Incidence of Acute primary angle-closure glaucoma in Singapore. In Island – wide survey”, Arch.Ophtalmol.(USA), Nov.1997 115 (11), pg.1437
12. STOUPEL, E. et all:”Heart-mood-death: The clinical expression of the cholesterol-serotonin controversy by the temporal distribution of deaths from coronary heart disease snd suicide”, Journal of Clinical and Basic Cardiology, 2000, 3/3 (173-176)
13. STOUPEL, E., ISRAELEVICH, P.:”Correlation of two levels of space proton flux with monthly distribution of deaths from cardiovascular disease and suicide”, Journal of Basic and Clinical Physiology and Pharmacology, 2000, 11/1 (63-71).

14. VLADIMIRSKI B.M., KISLOVSKI, L.D.:"Biophysics and History : Biofizika Russia, Sept.-Oct.1998, 43 (5), pg.757-760

15. ERTEL, S.: "Cosmophysical correlations of creative activity in the History of culture", Biofizika Russia, jul.-aug.1998, 43 (4), pg.736-741

16. PERSINGER, M.A.: "Wars and Increase Solar-Geomagnetic activity agression or change in intraspecies dominance", Perceptual and motor skills, June 1999, 88 (3 Pt 2), pg.1351

17. IVANOVIC- ZUVIC, R. De la Vega, IVANOVIC-ZUVIC, N.:"Enfermedades afectivas y actividad solar"; Actas Esp. Psiquiatr.2005;33(1):7-12

18. KAY,R.V., /Geomagnetic storms-association with incidence of depression as measured by hospital admission, British Journal of Psych..,164 ,403 ,Mar.1994