The search for a bio-sensor as a witness of a human laying on of hands ritual

Roeland VAN WIJK [1,2] and Eduard P.A. VAN WIJK [2]

[1] *Faculty of Biology, Utrecht University (Utrecht, The Netherlands)*

[2] *International Institute of Biophysics (Neuss, Germany)*

Address for correspondence:

Roeland VAN WIJK, PhD.

Utrecht University

Department of Molecular Cell Biology

Padualaan 8

3584 CH Utrecht

The Netherlands

e-mail: meluna.wijk@wxs.nl

tel: +31-345-570080

fax: +31-345-570110

Context: Intentional healing by laying on of hands is a popular complementary therapy. Previous studies of this therapy have been focussed on the influence of laying on of hands with focussed intention on the patient or on a biological model that took the place of the patient.

Objective: Exploring the line of thinking that the consiousness-mediated act of healing during a healer-patient ritual changes a consciousness field that could be detected in another living non-human organism that was present only as a witness and was not the object of any directed intention.

Design: A comparison of a bio-sensor's behaviour during healer-patient ritual treatments that were alternated by non-healing periods.

Setting and Participants: An automatic device for measurement of ultra-weak emission of photons from algae was placed at the location of a healer during a series of experiments consisting of 36 healing sessions with human patients. Neither healer nor patients were aware of the type of measurements that took place.

Main Outcome Measures: The number and periodicity of photon counts .

Results: Primary data analysis show that the photon count distributions show some remarkable alterations during the ritual of healer-patient sessions. The data further suggest that during healing a shift in cyclical components of photon emission occurs.

Conclusions: The significance of the experiment lies in the posssibility to enter the discussion on quantitative basis with respect to the relevance of patient healer relationship in intentional healing.

1. Introduction

The influence of healers on living organisms has been studied for many years. A variety of bio-sensors, like enzymes, cells, plants, animals has been included in these studies. A bio-sensor can be considered as a simple model for the influence that is exerted on the human patient in healing rituals. In many systematic reviews and meta-analyses these

models for studying the influence of intentional healing on living organisms have been discussed [1)-5)] . More recently, a new application of bio-sensors in studies on intentional healing type has come into consideration. In order to introduce this second application, we present a short introduction about the two types of experiments that deal with the use of Random Event Generators (REG). More specifically, with the question if and how human beings mentally intend to force REG to behave in a certain way without an intermediary. The two types of experiments are distinguished by the role of the REG in the experiment, the REG being either the object of intention or the witness of changes in intention and consciousness.

In the first and most common type of application of REG in a mind matter interaction experiment the REG receives the operator's direct attention. Probably most famous is the application at the Princeton Engineering Anomalies Research Laboratory (PEAR) of microelectronic REG in research on mind matter interaction effects [6)]. The operator is well aware of the REG device and attention is focussed on the output of the REG device, trying to influence it. The REG device used by the researchers was designed to produce well-characterized output distributions. The influence of the human operator could be a shift of the means to higher or lower counts, or in the pattern of the output data. Extensive data analysis led to the observation of anomalous shifts of the distribution means with pre-stated operator intentions [6)-12)].

If we accept that we are able to mentally influence the REG to behave in a certain way when focussing intention on it, a next major question can be asked. This questions deals with the absolute requirement of a directed intention for the observed effects. In other words, are the small changes in REG perhaps indicative of a particular change in the state of consciousness that is manifested even in the absence of any REG-directed conscious attention. This question was approached in a second type of experiment with a REG device, in which the REG is only and nothing more than a witness. In this case, the experiment is characterized by a group of people that have focussed their mind on the same thing, not being the REG device. The REG device is present, but only as a witness of possible changes in the state of consciousness of the group of people in the meeting

event. In this second application, of a REG as witness, the REG is indicated as field REG system. Its application has been described for various separate applications, like religious or secular ceremonies and rituals, business meetings, sporting events, professional conferences, or other group processes with periods of unusually cohesive cognitive interaction, or emotional intensity. These experiments have strongly suggested that the REG device permits the monitoring of selected situations where people are engaged in shared cognitive or emotional activity without specific intention to influence the experimental device by the participants [13)-16)]. Even a small-sized group consisting of therapist and patient has been studied recently [17)]. The latter study suggested that the healing ritual in a doctor-patient relationship is sufficient to create an environment for influencing the REG output.

For a better understanding of intentional healing the two types of REG application, namely in controlled laboratory settings and in field experiments, may be crucially important. In particular Dossey pleaded at many occasions that consciousness-induced changes in random processes might be the mechanism underlying the stimulation of the healing process following directed mental intention [18)]. He considers the patient in a natural healing situation from the perspective of a biological (bio)-REG receiving the direct intention of the healer and regards the human body in many respects as a REG, because many events in physiology are basically spoken probabilistic phenomena. The idea becomes even more interesting when we consider a bio-REG in analogy with the electronic REG in the field experimental setting. In this second perspective, the patient can be considered as a participant of a small functional group of two persons involved in the ritual of a healing practice with its conscious interaction and emotional intensity. This particular situation of an emotional connection of therapist and patient is, to some degree, comparable with the situation in the field-REG experiment and might influence the patient as a field-REG like bio-sensor in addition to the influence he/she receives by the direct and focussed intention of the healer.

This double-sided functioning of the patient in the healing ritual is very fascinating and opens an avenue into the phenomenon that is named placebo phenomena. However, it is difficult to approach the double function in direct experimentation. We see no way so far

what measurements of a patient can distinguish between an influence of the ritual and an influence by direct intention. In order to solve the problem, at least partially, and distinguish the two influences in the human healing situation we searched for another biological organism as a bio-REG-like witness during the healing session. We speak of witness because the field-REG like bio-sensor should not be the subject of direct mental intention, but 'simply' a witness for measuring any change in the degree of order during the ritual of the healing practice. Furthermore we speak of a bio-sensor that is 'field-REG like' because it has still to be assessed whether the bio-sensor is able to produce a random output distribution.

The present paper reports on this line of research that aims to detect the influence of the small-sized group consisting of healer and patient on a field-REG like bio-sensor. The paper deals with three major questions. Firstly, the search for a bio-sensor that produces a well-characterized output distribution of a signal that can be measured non-invasively. Secondly, the application of this bio-sensor in a human healing study. Thirdly, the first steps in the analysis of the output data of the bio-sensor, in particular with respect to changes in order and periodicity of the system.

2. Spontaneous ultraweak photon emission of *Acetabularia acetabulans* as bio-sensor

We decided to focus on the process of photon emission of an organism in our search for a bio-sensor candidate. The very weak emission of light in the visible region was first detected in the 1950s. In 1955, Colli described weak visible region luminescence from seeds germinating in the dark [19]. In the 1960's several Russian groups studied the visible region luminescence from over 100 different species of organisms covering 8 systematic types, including many plants and animals, algal, yeast, and bacterial species [20)-21)]. They detected photon emission from about a third of the algae, bacteria, fungi and insects examined, but in the higher plants and vertebrates all the species investigated displayed luminescence. Only the protozoa gave no detectable photon emission from any of the species studied. However, it is interesting that for many species which gave no detectable luminescence, subsequent workers have observed significant photon emission, possibly

due to the greater sensitivity of the more recent photomultiplier tubes [22)-24)]. Nowadays photon emission is considered as a general feature of biological systems.

The output distribution of the photon emission of many organisms has been characterized. Popp and coworkers [25)] showed evidence of some basic characteristics of this radiation which seems to be common to all living systems. The photon emission of biological organisms displays a rather stable intensity that ranges from a few to several hundred photons per second per cm^2 surface area of the living system under investigation. It is temporarily increased after exposure of the living system to an external light illumination. The relaxation of the excited system, which is called delayed luminescence, follows generally a hyperbolic law rather than an exponential. The hyperbolicity of the delayed luminescence makes a distinction between the very long tail of delayed luminescence and ultraweak spontaneous photon emission difficult. The photon count statistics (the probability of getting 0, 1, 2,...., n photons within a preset time interval commonly displays a Poissonian distribution. However, this specific distribution might deviate from Poissonian when photon count densities approach the noise ratio of the measurement devices.

Furthermore, the process of spontaneous or very-long term delayed luminescence, with its well-characterizable distribution, can be measured in a non-invasive manner for a rather long period of time.

We decided to focus on the spontaneous emission from the algal cell *Acetabularia acetabulum* (L.). The emission of these cells, either spontaneous or delayed luminescence has been studied before [26)-27)]. *Acetabularia* is a single cell of giant dimensions, up to a few centimeters long. It has a basic structure comprised of a tube-like axis, called the stalk, a more or less branched rhizoid and, in the advanced growth stage, a reproductive cap. *Acetabularia* has the advantage of being a simple organism that can be easily grown in the laboratory, and allows culturing of populations of cells with uniform characteristics.

3. Design of experimental healing sessions

The experiments were carried out in cooperation with an experienced laying on of hands healer, who has a high reputation and large practise in The Netherlands.
The photon measurement device for the study on healing was installed in an office of the building where the practise of the healer was located. Patients who received treatment in the experimental sessions were mostly patients from his practice. Thus, healer and patients were in an environment that was familiar to them. The experimental sessions took place in an office room (approximately 4 x 4 m) in which on one side the healer and patient were located while on the other side of the room the biophoton measurement device was located. Neither healer nor patient were aware of the type of photon measurements that took place.

In fact, in the photon counting device, the radiation emission of *Acetabularia* cells was registrated. For this purposes and prior to the experiment, *Acetabularia* cells were cultured in artificial sea water at approximately 20^{o}C on a 12 h – 12 h light dark cycle [28)-29)]. The cells were used in their vegetative stage of growth that precedes cap formation. Cell length varied from 2 to 4 cm. Before the actual photon measurements started, approximately 50 *Acetabularia* cells were put in a petri dish (diameter 5 cm) containing 15 ml medium and placed in the complete darkness of the measuring chamber at a temperature of about 20 °C.

The radiation emitted from the sample of *Acetabularia* cells in the measuring chamber was detected by a Hamamatsu R550 photomultiplier that was located in a vertical position about 7 cm above the petri dish. The photocathode was 50 mm in diameter and is sensitive within the range of 280 to 850 nm. Optimal cooling temperature is produced at about -20°C. In addition, a metal cabinet surrounds the multiplier tube and the measuring chamber, and decreases the influence of magnetic and electric fields. A shutter system between the measuring chamber and the photomultiplier was closed until the experimental measurements started. The photon counts obtained with the closed shutter represent the electronic noise of the photomultiplier, amplifier and additional output

devices. The measurement system was completely automatic, and the operations of actuation, checking and acquisition were managed by dedicated software from an IBM compatible PC. The data presented in this paper have been obtained from the counts accumulated in periods of 1 s (dwell time 1 s).

The data in this report were derived from a series of experiments consisting of 7 days of experimentation including 36 experimental healing sessions. During the first day the experiment included the treatment of 6 patients. On the following six days of experimentation 5 patients were treated per day. The protocol for measurements was as follows. Before starting any experimental healing session background measurements were carried out to determine the electronic noise of the equipment. After the background measurement the actual experimental day started. In this case the *Acetabularia* cells were continuously present in the measurement chamber. Healing periods were 17 minutes and were alternated by non-healing periods of about the same duration. In the time period between the treatment periods the healer participated in other activities. In both periods the biophotons were counted with a sample time of 1 s. Healing and non-healing periods had runs of 1020 measurment points.

4. Results

Characterization of photon counts of *Acetabularia* cells has been carried out regularly in the absence of any healing. Photon emission is dependent for a long time of the previous excitation by illumination. The illumation resulted in delayed luminescence with a relaxation or decay that fits a hyperbolic law. This means that the time that a constant fraction of photons is lost (half life) is not constant but increases exponentially. From previous observations of the delayed luminescence of *Acetabularia* we expected that after 12 hours of darkness or more the decay of remaining photon emission is so low that more or less a constant level of photon counts is reached during the measurement periods of 17 minutes. This level of photon counts represents, at least in part, the weak spontaneous luminescence of the *Acetabularia* cells. The contribution of cellular photon emission is 30 - 40 counts per sec per 50 cells. When the state of low emission was reached the

sequence was initiated of 17 min healing periods and the non-healing periods interspersed between the treatment portions.

The primary analysis of the photon count data is based on a comparison of the counts during healing treatment against the data that were derived from interspersed, non-healing, segments. **Table 1** summarizes the data of the mean, variance, skewness, and kurtosis of the individual healing and non-healing segments. The comparison of mean values of subsequent segments in the different experimental days led to two remarks. Firstly, it can be seen that the individual days of experimentation are different with respect to the range of photon emissions values. Moreover within an individual day of experimentation the mean values of photon emission sometimes decrease during the experimental day, in particular in the experiments 1-3 long-term delayed luminescence has not completely reached its stationary value. The differences are mainly ascribed to the biological variation of the bio-sensor system, like the size of the *Acetabularia* cells, their metabolic status, and its influence on the characteristics of long-term delayed luminescence.

Due to the biological variability, our interest is not mainly focussed on the mean values. Instead we ask questions about the frequency distributions of counts as characterized by skewness and kurtosis. According to these parameters the distribution of photon counts has been slightly changed during the healing ritual. Both skewness and kurtosis values were found to be commonly increased in data sets obtained from the healing segments. Application of the Wilcoxon-test for all experimental sessions led to the conclusion that the increase in skewness as well as kurtosis during healing is highly significant ($p=.0001$).

Our interpretation was that in the healing segments a small shift in the frequency distribution has occurred. In order to test this we have focussed on the counts of the healing and non-healing segments 4-7. In these segments stable and almost identical levels of photon counts were reached. The combined counts of the healing segments 4-7 (a total of 20400) and those of the non-healing segments (a total of 20400) were used to visualize the frequency distribution. **Figure 1** illustrates the small shift in distribution.

The second type of analysis deals with the influence of the ritual on the order of the witness' photon counts. Along this line of thinking it can be argued that perhaps the intentional healing ritual interferes with some time regularity in the process of photon counting. For this second analysis it is of crucial importance that a regularity in the process of photon counting is established. In case of any regularity, this can be compared with the regularity in the healing conditions.

A method for exploration of cyclical patterns in photon counts, or data in general, is using spectrum analysis. The purpose of this analysis is to decompose a complex time series with cyclical components into a few underlying sinusoidal (sine and cosine) functions of particular wavelengths. The term 'spectrum' provides an appropriate metaphor for the nature of this analysis. Suppose we study a beam of white sun light, which at first looks like a random (white noise) accumulation of light of different wavelengths. However, when put through a prism, we can separate the different wave lengths or cyclical components that make up white sun light. In fact, via this technique we can now identify and distinguish between different sources of light. Thus, by identifying the important underlying cyclical components, we have learned something about the phenomenon of interest. In essence, performing spectrum analysis on a time series is like putting the series through a prism in order to identify the wave lengths or periods and importance (intensity or power) of underlying cyclical components. As a result of a successful analysis one might uncover just a few recurring cycles of different lengths in the time series of interest, which at first looked more or less like random noise. We suspected that given the high degree of organization of the bio-sensor and the data produced as a time series of one-second-counts, that some periodicity is hidden in the time series. It is evident that with 1 s counts our observations will tell nothing about photon count variations within 1 s. However, some periodicity between a few sec and a few min might be detectable in the time series of 1020 data.

As a first step we used the periodogram for estimating the power spectral density function. **Figure 2** presents an example of a spectrum based on the photon counts of a control session with the *Acetabularia* cells. The spectrum shows large variations in

power. Well defined and consistent peaks at frequencies specific for the healing or control segments are not detected easy by visual inspection. It means that a reasonable variability in the spectra can be seen for all three conditions – healing, non-healing and background. On the other hand, such peaks at specific frequencies were hardly expected because of the limited duration of our measurements. For this reason we were more interested in the major peaks of the power spectrum, and analysed the intensity and periods of these major peaks of all healing segments, and compared that with similar data obtained from control as well as from background time series. For each condition – healing, non-healing and background - the analysis was restricted to the 20 major peaks of the periodograms of each segment. The data with respect to the intensity of the major peaks are shown in **Table 2.** The Wilcoxon test showed highly significant differences between non-healing and background, healing and background, and between healing and non-healing segments.

A final step in the analysis deals with the range of periods of the combined set of major intensity peaks from all healing segments and the combined sets from all non-healing segments and background segments. The question was first asked whether the intensity distribution over the range of periods show any remarkable differences between the non-healing, healing and background conditions. The procedure was as follows. The total set of major intensity peaks obtained from these conditions was divided in specified period-ranges. We distinguished, arbitrarily, the following ranges: 2-6 sec, 6-15 sec, 15-50 sec, 50-1020 sec. The data presented in **Table 3** show the distribution of major intensity peaks over these four ranges for the non-healing, healing and background conditions. An increased percentage of peaks with periods between 50 and 1020 sec is evident for the conditions that *Acetabularia* cells were present – either in non-healing and healing conditions. This increase corresponds with a similar decrease in peak density in the range of 6-15 sec. The effect of healing, interestingly, results in less decrease of peak density in the 6-15 sec range. The compensation for this decrease, however, is for its major part observed in the lower peak density, in the 2-6 sec range.

Based on the number of peaks, we focussed on the period range of 2 – 6 sec for a detailed comparison of non-healing and healing conditions. For this purpose, the set of major intensity peaks in this range was systematically arranged in periods of defined length of 0.04 sec. This procedure was performed for non-healing, healing and background segments. Subsequently, the difference between the non-healing and background spectra was estimated (**Figure 3**). In this case, the background distribution curves of the period values of major peaks in the specified range have been subtracted from either the non-healing distribution curves or the healing distribution curves of the corresponding range. The resulting differential curve for the non-healing condition is representative for the pattern of *Acetabularia* cells; it shows periods with a relatively high number of high-intensity peaks, such as at a period of 2.5 sec. A similar procedure was carried out to characterize the healing condition (**Figure 4**). In the differential curve obtained by subtracting the background distribition curve from the healing condition curve we detect a number of peaks that are identical to the non-healing condition, but also some definite differences.

Finally, a subtraction of the non-healing from the specific healing curve gives an impression of the effect of healing (**Figure 5**). In case the distribution of major peaks over a period range is not influenced by healing the difference between the healing and control cumulative curve has a constant (almost zero) value. The data show a decrease in the period range at 2.5 s, which reflects a lower number of major intensity peaks in that period range during healing. The increase in the period range of 3.5 s reflects an increase of the number of major intensity peaks in that period range during healing.

5. Discussion and Conclusion

The significance of the presented experiment lies in the posssibility to enter the discussion on the influence of environments with sufficient high degree of subjective resonance (including care-taking) for the physiology of living organisms, and thus for humans.

The data presented in this paper were obtained under strictly controlled conditions. At the same time the experimental circumstances were identical with the practice, where healer and patient feel familiar and meet for the healing ritual. Neither the healer nor the patient was aware of the automatic registration of the photon emission of *Acetabularia* cells, and were not disturbed by the experimentator. In this respect this bio-sensor represents an example of an automatic photon counting device with a living organism in an arrangement that is identical with the application of a REG in field studies. However, with respect to output distribution there is a clear difference between *Acetabularia* and REG. Although the output distribution of photon counts is well-characterized, it is not a random event, and the bio-sensor can be better considered as a pseudo-REG.

Another point of discussion is to what extent the observed changes in photon counts during healing are determined by the biological material. Since the level of emission of *Acetabularia* cells is low, part of the photon counts is due to an intrinsic component of electronic noise from the photomultiplier tube. In particular, this plays a role in the interpretation of the shift in patterns following the analyses of periodograms. In the procedures of analysis of periodograms we have distinguished the specific *Acetabularia* patterns of major intensity peaks under non-healing and healing conditions by subtracting in both cases the background pattern. The strong similarity in these patterns suggests that it is the *Acetabularia* pattern that changes.

However, the experimental procedure is not absolute evidence that the photon count changes are due to an alteration of cell photon emission. Since the bio-sensor includes the photon counting device an alternative possibility is that the unknown consciousness-sensitive field influences the photon detetction system, or a combination of the background noise signal, and the cellular photon emission. The significance of the bio-sensor system is that it enables a comparison of the influence of the unknown field on the non-living device and the living system. This part of the reserach on the bio-sensor system is currently in preparation.

In order to increase the sensitivity of the biological part of the bio-sensor we have to increase the biological signal, for example by increasing the number of cells. This requires culturing at yet unknown conditions that should be optimal for long term

experimentation with high cell numbers. In order to produce identical output distributions, the biosensor system must be cultured and handled in a reproducible manner. Because *Acetabularia* cells grow very slow and require a time period for at least 4 month for full development, a culture of these cells can be used for a long time of experimentation. The main condition to be standardized is the light-dark cycle of the cells. Photon counts from *Acetabularia* cells reflect the transition from the long-term delayed luminescences to the basic level of spontaneous emission. It has been shown that such conditions can be reached but have not always been reached in the present experiments.

With respect to the registration of shifts in the bio-sensor's photon emission periodicity, we are aware of the fact that the application of modern spectral analysis in the last decennia, in particular in electrical engineering, physics and meteorology has offered alternative procedures for carrying out this analysis. It means that the trends we have described have to be analysed in more detail.

We have to realize that we have used the bio-sensor system in order to have a biological model for the detection of a change in the yet unknown, consciousness sensitive field when a healer-patient relationship is established. In summary, it is our opinion that the presented data support the idea that we have to continue in characterizing and refining the application of such bio-sensor devices in healing rituals. In many ways, this dimension may further complete our understanding of healing.

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Table 1. Summary of photon count data of the individual healing (H) and control (C) segments of 7 experimental days

		Mean		Standard deviation		Skewness		Kurtosis	
Day	Run	H	C	H	C	H	C	H	C
1	1	86.2	88.9	13.0	11.8	1.3	0.2	9.2	0.6
1	2	83.5	84.9	12.2	12.1	0.8	0.4	3.8	0.9
1	3	80.6	81.4	11.8	11.5	0.6	0.4	1.8	1.2
1	4	77.4	79.1	12.7	11.5	2.0	0.5	17.6	1.4
1	5	75.0	76.4	11.7	11.6	0.8	0.6	4.0	1.9
1	6	73.1	74.9	12.7	11.9	1.7	0.8	12.7	2.3
2	1	146.0	158.2	15.8	16.7	1.0	0.4	4.9	0.3
2	2	146.3	144.7	15.9	16.5	0.6	1.1	2.5	4.9
2	3	136.0	138.7	15.4	15.4	0.4	0.6	0.6	1.1
2	4	132.0	134.8	15.4	15.5	0.7	0.8	2.7	6.3
2	5	121.9	126.4	16.8	15.1	1.5	0.7	9.1	3.0
3	1	105.0	105.2	15.7	15.1	1.1	1.0	3.2	3.2
3	2	103.7	101.5	16.0	13.5	1.8	0.3	9.7	0.3
3	3	104.3	107.0	14.9	14.7	0.7	0.6	1.6	1.4
3	4	101.3	100.1	15.5	13.6	1.8	0.7	15.2	2.3
3	5	101.1	101.1	15.4	14.3	1.9	0.8	14.1	2.6
4	1	100.1	104.5	14.4	14.5	0.6	0.6	0.8	1.1
4	2	97.7	98.9	15.0	14.1	2.3	0.6	24.7	2.2
4	3	99.0	97.3	15.6	14.7	1.9	0.8	19.1	2.0
4	4	98.2	98.7	14.3	14.6	0.6	0.6	2.1	1.4
4	5	100.3	96.2	14.5	14.2	1.5	0.6	11.1	1.4
5	1	99.5	96.6	14.9	13.7	1.6	0.6	11.4	1.2
5	2	94.6	97.0	13.7	14.6	0.6	0.6	1.9	0.6
5	3	99.9	98.4	14.4	14.1	0.5	0.4	0.8	0.3
5	4	97.6	97.6	13.8	15.0	0.5	0.7	0.4	1.7
5	5	96.9	95.5	14.6	13.6	1.6	0.5	9.5	0.9
6	1	104	100.9	15.8	14.2	1.6	0.5	9.1	0.8
6	2	97.6	98.1	13.9	14.7	0.8	0.5	2.1	0.6
6	3	99.1	100.0	13.4	14.5	0.3	0.3	0.6	0.8
6	4	102.3	99.3	14.5	13.8	0.6	0.5	1.7	0.7
6	5	98.3	100.0	14.0	13.3	0.5	0.8	1.2	3.9
7	1	103.4	101.3	15.9	14.3	1.8	0.5	11.5	0.8
7	2	98.7	99.8	14.7	14.0	1.0	0.8	3.0	2.6
7	3	101.2	98.4	14.4	14.8	0.8	0.9	2.9	2.8
7	4	102.3	98.9	15.0	14.4	0.6	0.5	1.2	0.6
7	5	103.1	103.5	15.2	14.7	1.0	0.5	4.1	0.8

Table 2. Characteristics of the 20 highest peaks of all periodograms obtained from healing, non-healing and background segments

Characteristic	Healing	Non-Healing	Background
Mean value (S.D.)	1958 (722)	1843 (609)	1453 (401)
Number of peaks	720	720	720
Minimal value	1100.2	1076.3	939.7
Maximum value	8345.2	6704.8	4486.7

P values	Healing – Control	p = .000000
	Healing – Background	p = .000000
	Control – Background	p = .000000

Table 3. Distribution of 20 highest peaks of the periodograms obtained from healing, non-healing and background segments over 4 discrete period ranges

Period range	Healing	Non-Healing	Background
2 – 6 s	56.8 %	61.5 %	61.3 %
6 – 15 s	19.0 %	16.7 %	21.2 %
15 – 50 s	11.8 %	10.0 %	10.5 %
50 – 1020 s	12.3 %	11.8 %	7.0 %

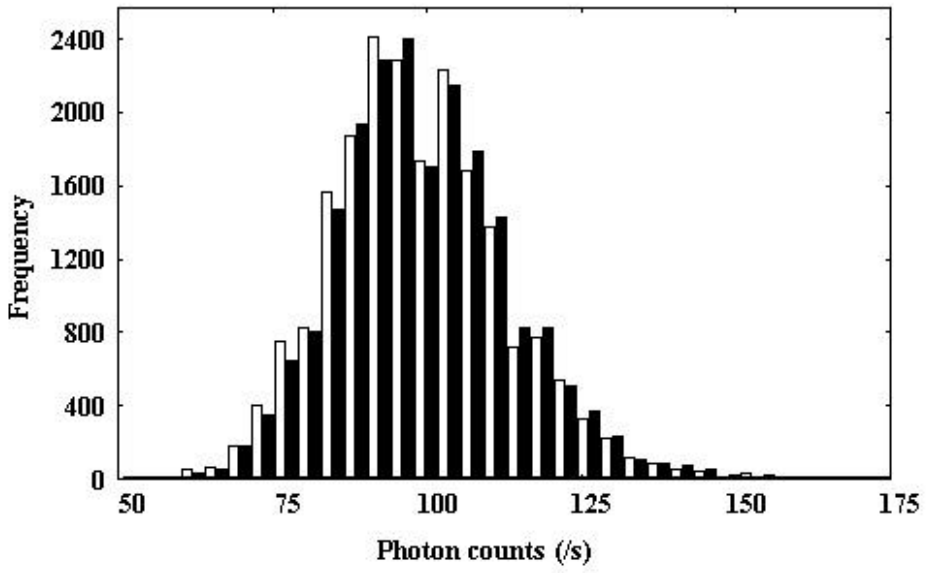

Figure 1: Frequency distribution of photon counts from experimental days 4-7. Open bars: control segments; black bars: healing segments.

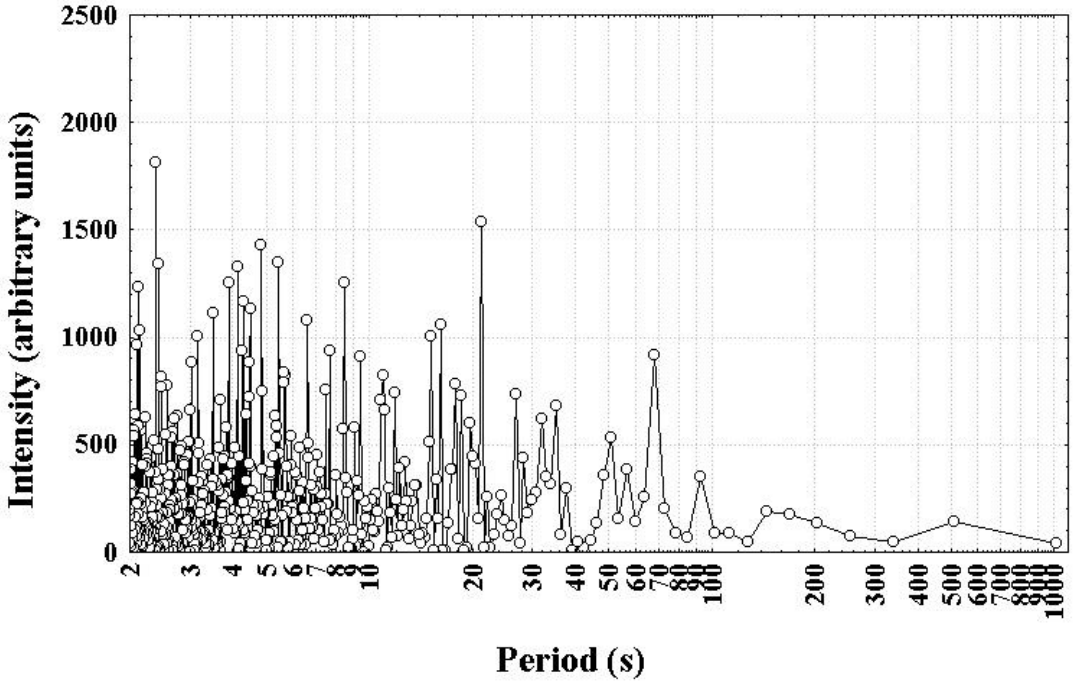

Figure 2: Example of power spectrum of photon emission of *Acetabularia*

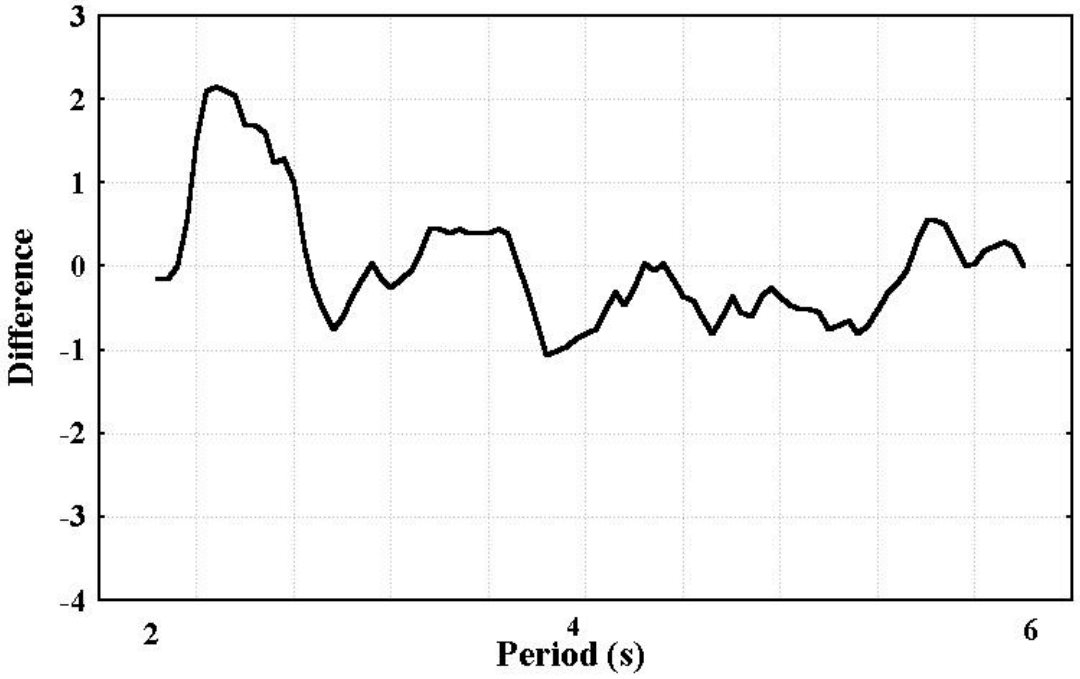

Figure 3: Difference between the non-healing and background spectrum in the period range 2-6 s.

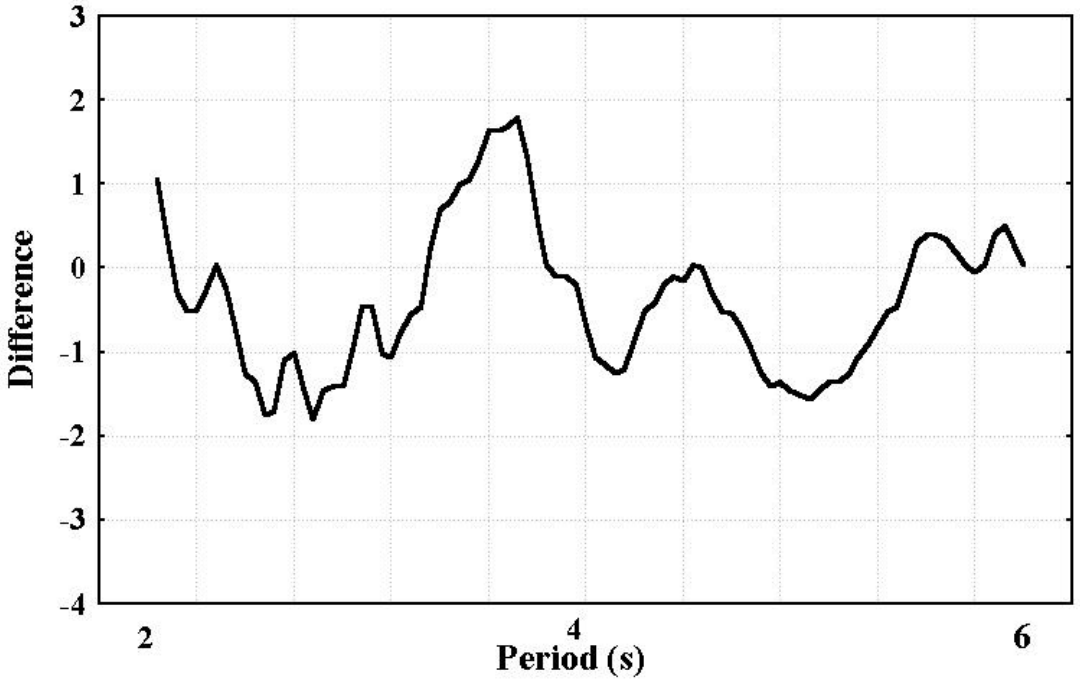

Figure 4: Difference between the healing and background spectrum in the period range 2-6 s.

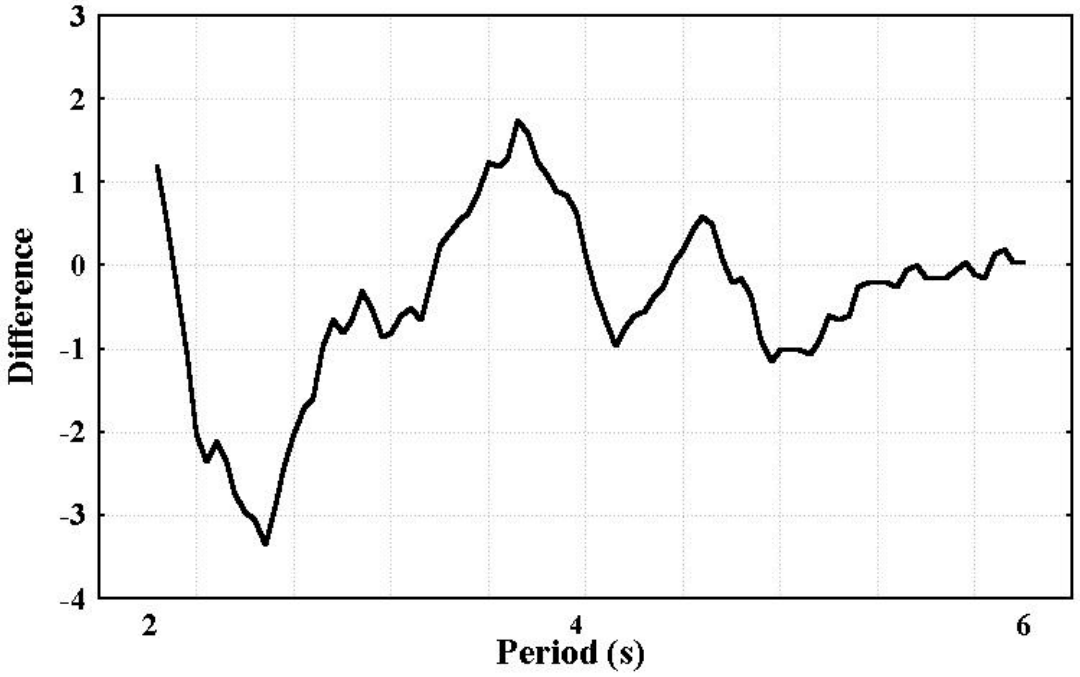

Figure 5: Difference between the healing and non-healing spectrum in the period range 2-6 s.