

ISSN: 1062-4767.

Studies on the Interaction Between Electromagnetic Fields and Living Matter Neoplastic Cellular Culture

Suleyman Seckiner Gorgun
Collegno, Italy

Neoplastic Cell Culture

The study of the interactions between electromagnetic fields and living matter has become a fertile field for research in the last century, even though these phenomena have been empirically observed by various civilisations since ancient times (1, 2). Considerable experimental evidence today points to the possibility of modulating biological functions and structures in a controlled way by applying electromagnetic fields and, vice versa, the possibility of detecting and measuring endogenous electrical currents in living organisms and their components (3, 4).

There are two types of electromagnetic effects on living matter: thermal effects and non-thermal effects (5, 6, and 7). Thermal effects induce an increase of entropic disorder in the target, until at adequate frequencies and power levels, the effects of ionisation develop. The non-thermal effects are not the result of the transfer of erratic movement by means of an increase of kinetic energy, but rather, in line with the theories of the coherence of condensed matter, they can transmit information that would produce order in the bio-structures involved. The information content of the electromagnetic waves would depend strictly and specifically on the waveform, the string of waves, and the time sequence of their modulation. In fact, specific variations in the configuration and temporal exposure patterns of extremely weak electromagnetic fields can produce highly specific biological responses, similar to pharmaceutical products (8, 9). These effects are attracting considerable scientific interest mainly because an electromagnetic wave is easily modulated and thus is an excellent means for the transmission of information. (10) Studies carried out by various writers suggest the possibility of non-thermal effects; they include Gorgun (16, 17, 18), Frohlich (11, 12), and Tsong (13, 23, 24, 25, 26).

Based on these studies, it is reasonable to consider patterns in living matter that take into account the electromagnetic components of biological structures. Every cell, for instance, is made up of biological and chemical components that can be described in simpler and simpler terms down to the cell's elementary molecular constituents. But the cell itself and its internal and external interactions can also be considered in terms of electric and electromagnetic interactions and relationships (1, 3, 6, 27, 28, 29, 30, 84, and 85). Numerous experimental works have shown the possibility of modifying and controlling the selective permeability of the cell membrane by transmitting electromagnetic waves. This leads to the possibility of verifying the specific reactions of healthy cells compared to the reactions of pathological



Fig. 1

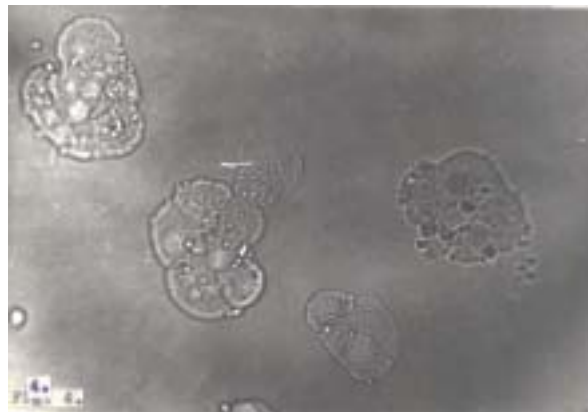


Fig. 4

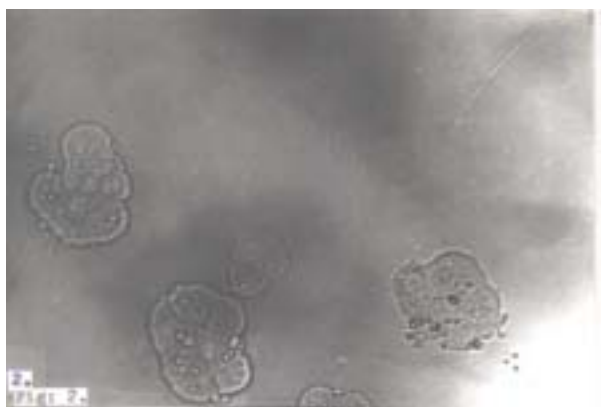


Fig. 2

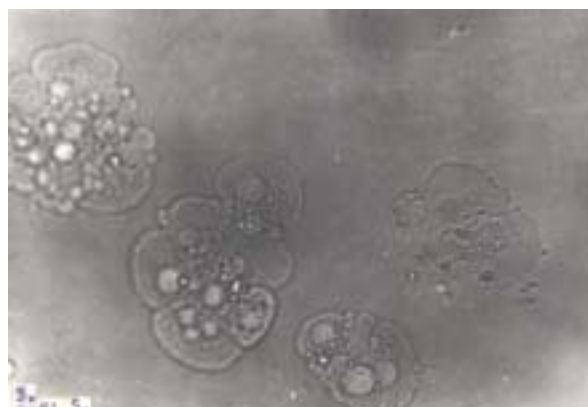


Fig. 5



Fig. 3

cells and subsequently to select target cells on which to act for clinical purposes. Pathological cells resonate differently from healthy cells due to a different tissue composition.

On these bases, various authors have noted the modulation of some cell functions, from ionic membrane pumps to many cytoplasmic enzyme reactions, including those connected with cell replication (6, 13, 14, 16, 69, 84, 85). From these studies it has been seen that these effects can be obtained from low intensity electromagnetic waves (under 1 watt) and specific frequencies (within the range of 1 Hz to 50 MHz). Along this line, preliminary observations performed in vitro have shown alterations of the cell morphology, the halt to proliferation, fusion, and necrosis in lymphoblastoid cell lines and some neoplastic lines subjected to specifically modulated electromagnetic radiation.

Reported here are some demonstrative examples to show the biological effects of electromagnetic fields. The electromagnetic waves have a power of 0.25 watts and are in the kilo- and megahertz ranges. They do not produce thermal effects on the bio-structures and have been modulated according to the

Electromagnetic Fields and Living Matter Neoplastic Cellular Culture

patterns elaborated by Gorgun. The examples presented here are indicative of significant biological and clinical effects both in vitro and in vivo. The action of these electromagnetic waves on neoplastic cell culture produces fusion and takes place through alteration of the cell potential (Grade 1), whereas cell necrosis takes place with the alteration of the cell structure (Grade 2).

Cell Fusion (Grade 1)

In figures 1 through 5 the effects on neoplastic HeLa cells in contrast phase can be seen through the microscope. The culture was exposed to electromagnetic waves with a frequency in the megahertz range and a power of 0.25 watts for a period of about three hours. The electromagnetic energy modulated in this way brings about cytoplasmic cell fusion, which produces up to a maximum of five cells, after which cell necrosis occurs. In these figures the approach of the two cell structures, located in the center of the picture, can be seen until their fusion occurs. In figure 3 the membranes come into contact at which point the potential cell alteration can be noted (Grade 1). The above phenomenon was first noticed in 1970 and has been repeated a number of times; it was also reported at the Balcanico International Congress of 1979.

Cell Fusion and Necrosis (Grade 2)

Figures 6 through 9 indicate the progressive fusion and necrosis in vitro of cancer cells of the CC-178 line. These observations were conducted by the Department of Haematology and Oncology at the University of Hannover by subjecting the cells to electromagnetic waves with frequencies in the megahertz range at a power of 0.25 watts for a period of about two hours.

Influence of Electromagnetic Fields on Cell Functions

The preliminary observations conducted in vitro show an alteration of cell morphology, a halt to proliferation, fusion, and necrosis in lymphoblastoid cell lines, and in some neoplastic lines, after treatment with specifically modulated electromagnetic fields (HeLa, mammary carcinoma, CCL-178, colon adenocarcinoma, H 23, H 32, h 12.1, 1411 H, testicle carcinoma, M 5, M51, stomach carcinoma, MCF-7 human Caucasian breast adenocarcinoma ECACC 86012803, normal cell line, and MDBK bovine kidney cells) (16).

It is known that cells communicate with each other by means of direct metabolic exchanges or through the transfer of ions or molecules that act as messengers. Multi-cell signals which originate in the interaction of ligands with membrane receptors can activate a closely connected series of biochemical reactions. The biological membranes represent multi-molecular operative structures, and even a slight alteration in the composition of the membrane can lead to significant changes in its functions. Electromagnetic fields can influence this communication between cells and within the cells themselves due to their ability to activate or change the motion of the electrical charges. In fact, an increasing amount of literature illustrates the possibility of inducing biological effects in cells when appropriate electrical and magnetic fields are applied to have a direct effect on the membranes (94, 95, 96, 97).

Among the various effects obtained are those on Na⁺ and K⁺ dynamics and their role in ATPase, as well as the effects on the intermembrane exchanges of the Ca⁺⁺ ion, which, because of its presence in most biomolecular processes, has earned the name of second messenger (94). Moreover, exposure conditions that have led to effects on the membrane permeability of the Ca⁺⁺ ion have shown a negative influence on the mitotic fuso, and this influence is selectively tied to the characteristic of the magnetic field used. Up to now, the results obtained imply that the membrane receptors (e.g., the gluco-protein complexes), are able to decipher electrical signals at a well defined frequency and amplitude by reacting in a specific way. The energy transformed from the electrical fields is absorbed and directly coupled to guide

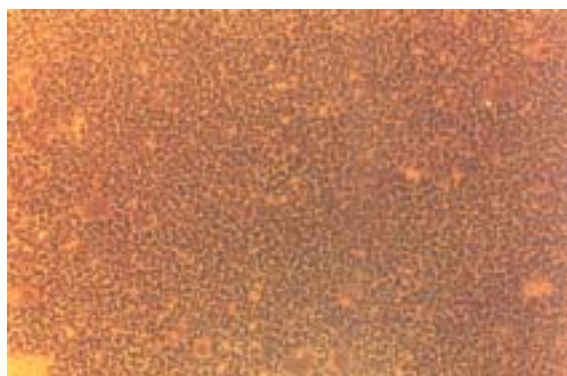


Fig. 6

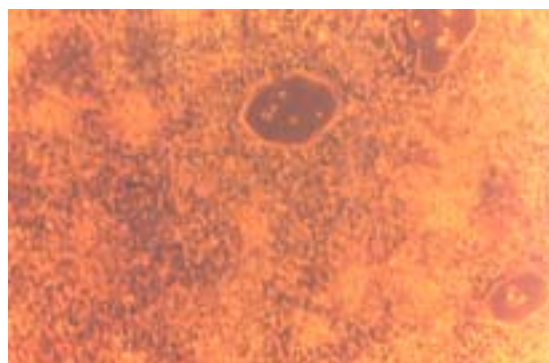


Fig. 8

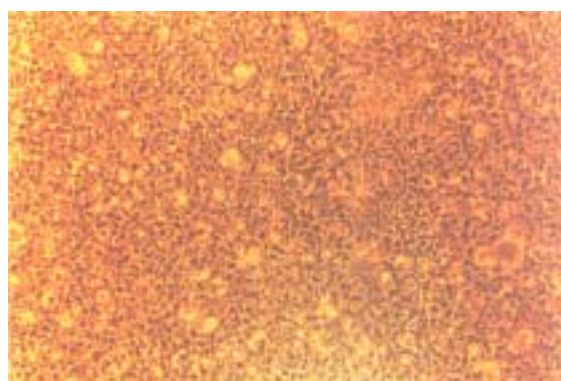


Fig. 7

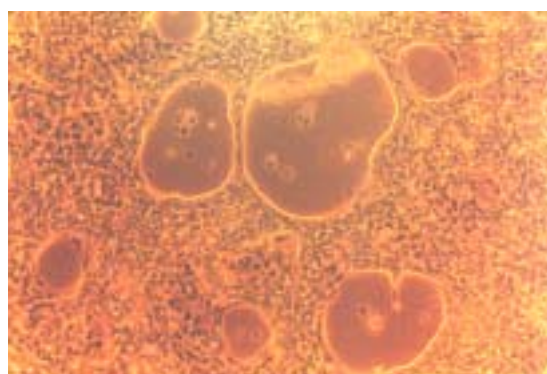


Fig. 9

biochemical reactions. These results have served as the bases for some applications in the therapeutic field, particularly in the reproduction of bone tissue. (98) This is due to the fact that the activation of some cell functions is bound to electrical potentials of the on/off type, that is, not with linear but with rectangular waveshapes.

Electromagnetic Fields and Living Matter Neoplastic Cellular Culture

Cell Fusion and Necrosis (Grade 2)

The possibility that weak electric or magnetic fields can send signals past the strong potential barrier of the cytoplasmic membrane (100 KV/cm) can be explained by the hypothesis of the phenomena of resonance on certain kinds of ions (101), the co-operative gapjunction type phenomena (102, 103), and the amplification effects explained by the set up of a field gradient between the inside and outside of a spherical shell made up of three layers of dielectric properties (95). The treated cells were examined with an electron microscope that showed ultrastructural alterations in the following areas:

- Cytoskeleton fiber—at the structure alteration level with an increase in fibers compared to the control and with a more irregular disposition and orientation
- Mitochondrion—a different orientation of the mitochondrion crests and an alteration of the mitochondrion matrix which appears dishomogeneous and pycnotic compared to the control
- Autophages—intra-cytoplasmic bodies in many cells

Moreover, the following can be noted:

- Chromatin degeneration
- Thickening of the chromatin at the nuclear membrane level
- Nucleus vacuolisation
- Mitochondrial degeneration

These types of alterations, especially at the nuclear level, suggest the hypothesis that an apoptotic type of phenomenon was induced by the treatment.

The characteristic of the equipment for these studies was as follows: low power (0.25 watts) electromagnetic waves with frequencies in the kilohertz range and magnetic fields and electrostatic fields specifically modulated according to the Gorgun method (GEMM: Modulated electro-magnetic generator).

Hypothesised Mechanism

It is thought that the chromosomes, following the messages received as a results of the variations of potential in the cytoplasmic membrane, activate through electromechanical effects the emission of messages by the genes that regulate cell dynamics for normal cell functions or for the mitochondrial activities for ATP production. An electrical circuit composed of a zener diode attached to the base of a bipolar transistor is offered as a model for the operation of the mitochondrion. The zener diode represents the on/off pulse operation of some cell functions, the combined circuit impedance represents the impedance of the glycoproteinic sensors present on the mitochondrial membrane, and the transistor represents the ATP activation process.

It is supposed that the excessive production of ATP is related to an alteration of the glycoproteinic sensors present on the mitochondrion membrane with consequent lowering of the impedance that in turn does not discriminate between the signals in frequency and activates the production of ATP in an almost continual way. The cancer cell would therefore go into mitosis due to the excess of ATP. Static magnetic fields and square wave pulsed electric fields are used to act on the mitochondrial membrane, increasing the impedance of the glycoproteinic sensors through the lengthening of the polyglycidic chain. A pulsed electromagnetic field in phase with the electrical signal is used to interfere with the communications between the genes and the protoplasmic glycoproteinic complexes involved in the promotion of cell mitosis.

It is thought that the impedance of the mitochondrial membrane to the messages coming from the genes increases with the electromagnetic treatment and with increases in the malignancy (the highest impedance for undifferentiated tumours). This is related to a greater alteration of the sensors of the

Electromagnetic Fields and Living Matter Neoplastic Cellular Culture

undifferentiated tumours and therefore to their greater predisposition to the bond with polyglycidic chains. The undifferentiated cancer cells, because of the high impedance induced on the mitochondrial membrane by the electromagnetic treatment, stop producing ATP and therefore enter into necrosis. Following the treatment the differentiated cancer cells have an impedance which is still sensitive to some messages coming from the chromosomes promoting the normal production of ATP, so these cells change their state of mitosis; however, they continue to live in a quiescent state (vegetative form of life).

The normal cells are not influenced by the electromagnetic treatment as the impedance of their mitochondrial sensors is not modified and remain sensitive to messages that arrive from the chromosomes for the activation of the ATP synthesis.

Clinical Application

Studies recently carried out reinforce the hypothesis that different classes of proteins change in response to electrical field forces induced by oscillating electric and electromagnetic fields at predetermined frequencies and intensities, and suggest that there could be biological effects that might halt the mitosis of neoplastic cells. The use of a static magnetic field of 5 mT for 50 to 60 minutes has changed the lectin bonds of specific sites on the membrane surface of erythrocytes with a consequent alteration of the ATP content (104). The variation of the lectin bonds is considered by the changes of the glycoproteinic complex.

Pulsed square wave magnetic fields with a frequency of 10 Hz and an intensity of 10 mT on animals in vivo modified some biochemical blood parameters and produced significant effects on the erythrocyte count and the concentration of haemoglobin, calcium, and plasmatic proteins. The mechanisms of the observed effects are probably tied to the influence of the magnetic fields on the ionic permeability and capacitive reactance of the membrane due to changes in its lipid component, on the liquid crystalline structure, and on the enzymatic activity of the ionic pumps dependent on ATPase (105).

Fields of 2 KV/m with frequencies from 1 KHz up to 1 MHz activate the Na⁺ and K⁺ pumps in the ATPase in human erythrocytes. The authors suggest that the interactions that permit the free energetic coupling between the hydrolysis of the ATP and the pumping of the ions are of the coulomb type.

The results obtained indicate that only the ionic modes of transport necessary for the synthesis of the ATP for specific physiological conditions were influenced by the applied electrical field, and some types of reactions are not explicable in chemical terms but only as related to electrogenic effects (106). The use of pulsed square wave electric fields with an amplitude of 1050 volts, an impulse width of 100 microseconds, and a frequency of 1 Hz have strengthened the anti-neoplastic effect of the bleomycin in the growth of fibro-sarcoma SA-1, malignant melanoma B16, and Ehrlich ascitic tumours (EAT) (107, 108). Electromagnetic fields at a frequency of 7 MHz have been measured concomitant with cell mitosis in culture yeast cells (109). It is known that the cyclins (e.g., P16 and P21) have an important role in the processes of mitosis on cancer cells (110). The cyclins use the gamma P. of the ATP.

Classically this second type of interpretation has produced fundamental clinical instruments, such as, for example the electrocardiogram, the electroencephalogram, and more recently the nuclear magnetic resonance (2, 31, 32). The interest in the study of the interactions between electromagnetic fields and living Matter is placed, therefore, on three levels:

- Prevention—the way electromagnetic fields influence the development of illnesses (33, 47)
- Diagnosis—the way endogenous bio-electric signals and weak electrical and magnetic fields, associated with bio-molecules correlate to the state of health (11, 48, 49, 50, 51)
- Treatment—the way biological structures and functions can be modulated by means of electromagnetic fields (16, 17, 18, 19, 52, 53, 54, 55, 56, 57, 58, 59, 60, 61, 62, 63, 64, 65, 66, 67, 68, 69, 70, 71, 72, 73, 74, 75)

The following applications illustrate the therapeutic aspects:

- Illnesses of the locomotor organs—electromagnetic fields are used for accelerating bone regeneration especially in fractures that do not heal spontaneously and for analgesic effects. The results reported in literature relate no side effects to the treatment (62, 65, 71, 76, 77, 78). Especially noteworthy is the study of cartilage regeneration and osteoporosis.
- Illnesses of the vascular apparatus—excellent results are described in cases of phlebitis and related after-effects; varicose ulcers react positively to the treatment in 90% of the cases with rare recurrences. Also obstructive arterio-pathology of the lower limbs responds well to electromagnetic treatment, showing both subjective and objective improvements (79)
- Dermatological illnesses—both atrophic dermatitis and psoriasis respond to the treatment with satisfactory results in the latter in 60% of the cases. Bedsores can also benefit from electromagnetic treatment (79)
- Surgery—electromagnetic fields promote the healing of surgical wounds (79)
- Inflammatory illnesses—all types of acute and chronic phlogosis that were tested showed benefits from treatment with electromagnetic fields (80, 81)
- Neurological illnesses—positive effects were noted on neuritis irritation and on post-herpetic neuropathologies (82)
- Analgesic treatment—there are numerous observations and applications of the analgesic effects of electromagnetic treatments not only in inflammatory and degenerative pathologies like arthritis, but also in neoplastic pathologies (53, 83)

A growing literature proposes the use of electromagnetic energy with cancer patients. Non-ionising electromagnetic radiation is used in the oncological field with various objectives depending on the frequency range (86, 87). Their use, besides the analgesic effects already described, can make use of the antiproliferative action that can be direct or indirect, or they can be applied toward the reduction of the histrogenic effects of radio and chemotherapy (16, 17, 69, 87, 88). The therapeutic effects mentioned above often use the thermal effect of the induction of disorder in the target tissue; however, the major interest lies in the non-thermal effects, which, paraphrasing Adey, might allow interventions on cell functions using the language of the cells themselves (89, 90) by means of a highly specific modulation of frequency and intensity.

The characteristics of the equipment were as follows: low-power electromagnetic waves (0.25 watt). With frequencies in the kilohertz range and specifically modulated according to the Gorgun (GEMM: Modulated Electromagnetic Generator).

In Vivo Effects

Modulated electromagnetic fields were applied to mice in 1974. The observations were conducted at the Marburg Universität Klinik und Poliklinik für Nuclearmedizin, Radiologiezentrum der Philippsuniversität Marburg/Lahn at the Institute for Biophysics and Nuclear Medicine. Before being subjected to electromagnetic fields, the mice were inoculated with three different types of histopathological material:

- Yoshida Solid
- Asditis
- Walker

A regression of the pathology was observed after the application of the electromagnetic fields. Some clinical cases are presented below, which indicate biological effects from modulated electromagnetic fields not only in cells in vitro, but also in organisms in vivo. Histopathological examinations showed that the index of proliferation decreased. Treatments were applied to patients suffering from different types of malignant neoplasia. The treatment applied was highly specific for each patient, based on the type of histopathology, the stage of the illness, and a series of personalised clinical, biophysical and environmental parameters.

The electromagnetic waves used had a frequency in the kilohertz range, a power of 0.25 watts, and were applied daily for a period of time specifically determined for each case. All the studies that follow were carried out under the direction and responsibility of medical personnel.

Case 1

Patient B.G., female, age 49, affected by ductile infiltrating carcinoma of the breast. After surgery and chemotherapy, metastases were noted in the axillary region. A month of treatment was performed in 1989 during which time the metastases regressed. X-ray examinations following the treatment showed no pathological alterations.

Case 2

Patient V. G., female, age 45, affected by a stomach carcinoma (adenocarcinoma slightly differentiated with ring cells and castone). Material was drawn from a voluminous subangular gastric ulcer, and the patient underwent a total gastrectomy. Before the therapy, metastases were present in the loco-regionallymph glands, and the patient exhibited a compromised general condition. Treatment with electromagnetic energy was applied in 1988 for about forty-five days. The metastases disappeared, and in the following check-ups no recurrence was observed.

Case 3

Patient V.A., female, age 45, affected by leiomyosarcoma retro peritoneale that in 1984 showed a diameter of over 40cm. Before the treatment the patient complained of strong abdominal pains and generally poor health, edemas in the lower limbs due to the compression of the lower vena cava, and hydronephrosis due to uretral compression. Chemotherapy had no effect and surgery was impossible because of the adherence of the mass to vital organs, in particular the aorta. After about two months of treatment in 1987 her condition had improved and the mass seemed to have been reduced by more



Figure 10 and 11 show the x-rays before and after the treatment.

than half. A surgical biopsy showed fibrous muscular type cells of modest density with no cell abnormality or mitosis. In 1991 an echography showed that the volume of the mass had further reduced to about 12 to 13 cm. The mass subsequently reduced further, and in 1993 echography showed a mass diameter under 8 cm.

Case 4

Patient N. M., female, age 41, had undergone a mastectomy in 1988 for infiltrating breast carcinoma followed by chemotherapy. After two years multiple bone metastases were observed in the pelvis and thigh. Figures 10 and 11 show the outcome of the X-ray examinations before and after the treatment with electromagnetic fields in 1990 (lasting about one month). The medical report (referring to Figure 11) stated: "Compared to the last observation there are evident signs of calcifying bone repair at the endosteal and e periosteal levels. The reconstruction is apparent at the level of the right proximate metafisi, at the level of the right ischio, and corresponding to the neck of the left thigh."

Case 5

Patient S. M., female, age 64, suffered from infiltrating ductile carcinoma of the breast. Surgery, chemotherapy, and radiotherapy were performed, but the illness progressed to the presence of metastases in the axial area and in the lungs (the chest X-ray showed small round opacities of the secondary type in both lung regions, more numerous in the lower median third right side). The treatment in 1989 with electromagnetic energy lasted two months. The metastases began to regress, although the signs in the lungs remained visible on subsequent X-ray checks. By 1993, the pulmonary lesions had disappeared, and "no infiltrating parenchimali lesions can be observed." A radiological inspection in 1994 confirmed this result.

Case 6

Patient E. P., male, age 59, was diagnosed with pulmonary adenocarcinoma in 1988. The patient had undergone surgery with the removal of the median and lower lobes of the right lung. Subsequently extensive recurrence was observed in the right thoracic cavity and in the mediastinum (Figure 12) He suffered from a generally poor physical condition and intense thoracic pain. The clinical conditions did not permit further surgery, chemotherapy, or radiological treatments. Treatment with electromagnetic fields in 1989, which lasted approximately two months, brought about an improvement in the clinical conditions, disappearance of the pain, and reduction of the neoplastic mass. in figure 13, the thoracic x-ray following treatment can be seen, where it is evident that there was a reduction of the mediastinic volume and expansion of the upper right pulmonary lobe.

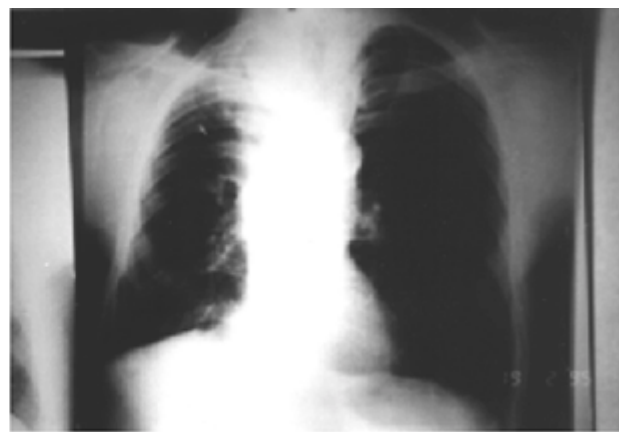


Figure 12 and 13 show the x-ray examinations before and after the treatment.

Case 7

Patient S. A., male, age 44, was diagnosed with peritoneal carcinosis in 1989, having a mass with a maximum diameter of 40 cm. An echograph report in 1990 stated: "...liver... with dishomogeneous structure due to secondary localisation's, the largest of which in the left lobe has a diameter of about 4 cm.

...Kidneys had moderate dilatation of the calico peliche structures. Upper and lower abdomen was completely occupied by expansive formation of mixed structure, part liquid, part solid that compresses also the bladder and does not permit a precise evaluation of the bladder walls and the prostate." The patient was inoperable and underwent treatment in 1990 with electromagnetic energy. The echography report in 1991 stated: "...the liver is enlarged with diffused disomogeneous structure. Definite signs of nodular lesions are not identifiable at different acoustic impedances... The pelvis and partially the abdomen are occupied by a voluminous expansive formation with an maximum longitudinal diameter of approximately 20 cm., with an echostructure that is strongly dishomogeneous, referable to discariocinetic lesions. The bladder appears to have conserved regular walls. The dimensions and the echostructure of the prostate are within normal limits."

Case 8

Patient N. M., female, age 56, was diagnosed with lobular carcinoma of the breast in 1988. She underwent a surgical operation and chemotherapy. At the time of the treatment with electromagnetic energy in 1991, she was suffering from a serious decline of general health, a hepatic metastases and a costal metastases. The treatment lasted almost two months during which time the main hepatic localisation reduced to a diameter of about 3 cm., and the other metastases disappeared. The upper abdominal echotomography report in 1991 stated, "an hypoechogenous area is visible, with irregular margins and a diameter of 3.3 cm. Referable, as first hypothesised, to metastases and numerous other hypoechogenous areas." An echography report described "a delimited hypoechogenous nodular formation, with a diameter of 3 cm, of irregular shape and an endolesional hyperefectant formation..." The remaining parenchima did not show alterations of the echogenous structure. In figure 14, a bone scintigraphy, taken in 1991, shows the examination made in 1992, in which it was pointed out, "the anomalous finding, reported in the previous examination of 28 Jan 1991 is practically no longer recognisable; the other parameters, within normal limits, have not varied."

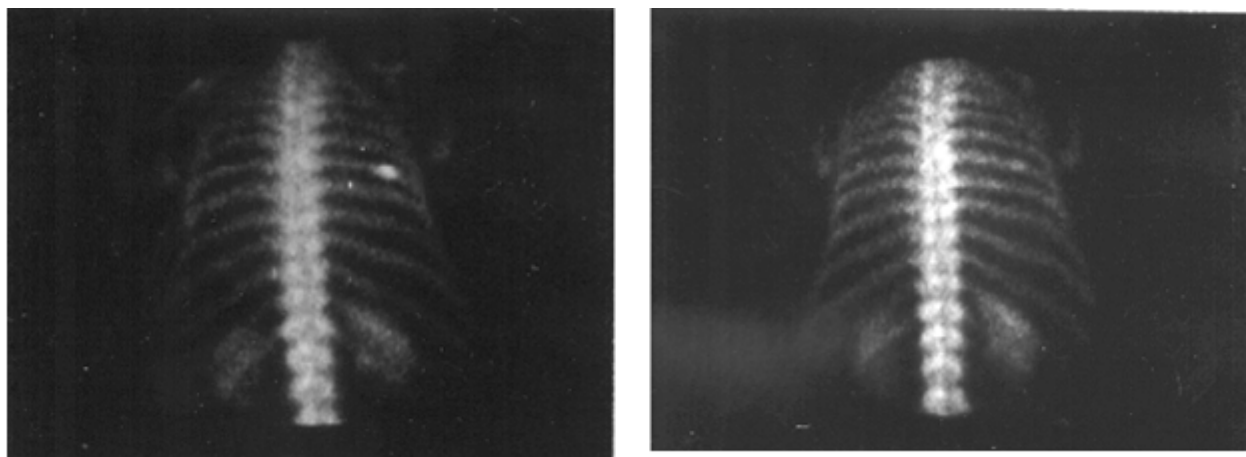
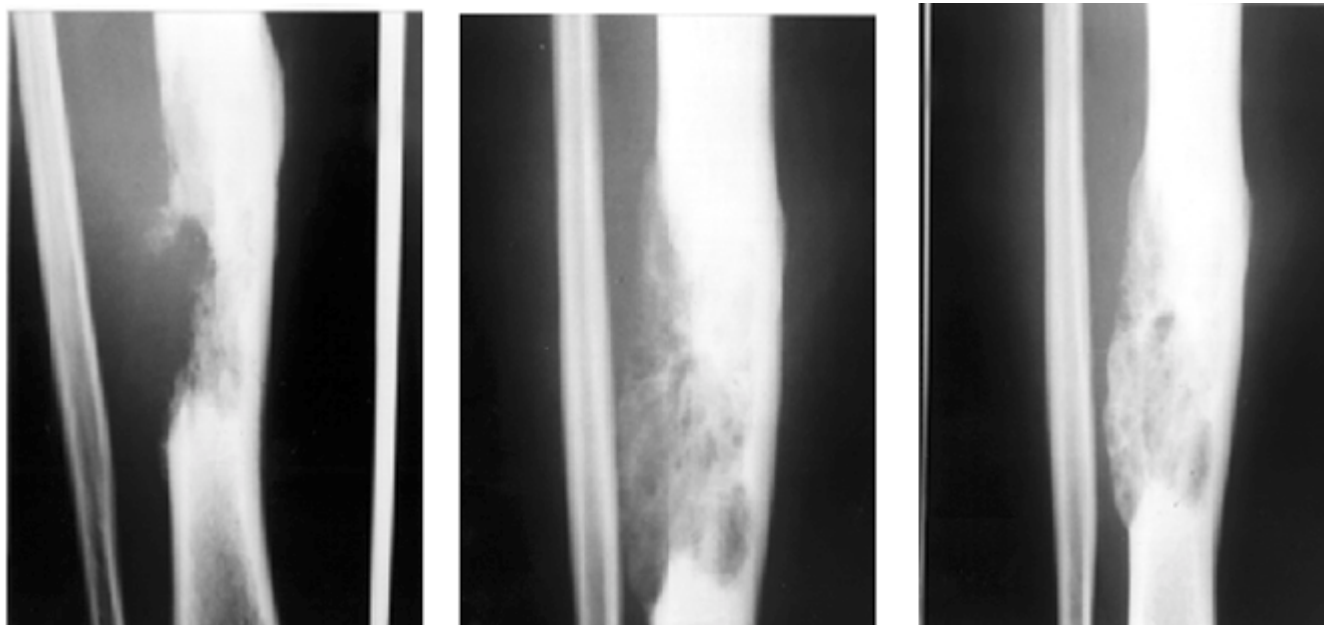


Figure 14 and 15 show the x-rays before and after the treatment.

Case 9

Patient D. A., female age 69, was diagnosed with papillary cistoadenocarcinoma of the ovary, metastatic and infiltrating in 1987. Chemotherapy was performed, but to no avail. When the patient was subjected to electromagnetic therapy in 1990, she had metastases in the peritoneum, and the echograph showed that the "the parametrium appeared to be occupied by a voluminous mass with a diameter of about 15 cm. and mixed structure, irregular polycystic with vegetating solid formations, that were referred to ovarian adenocarcinoma". Her general condition was seriously compromised. The treatment lasted approximately two months. The progression of the illness stopped and the mass progressively reduced in volume. The echotomograph report of November 1990 stated: "...Posterior to the uterus occupying the Douglas, - an expansive formation with diameter over 12 cm. And mixed structure part liquid and part solid of probable annexial origin."



Figures 16 through 18 show x-rays before, during, and after the treatment.

Case 10

Patent M. M., male, age 20, was diagnosed with plasmocitoma in the tibial region. The patient complained of serious pain in the tibia and was unable to walk. The tibia showed decalcification and serious bone erosion. Conventional chemotherapy and radiotherapy had already been tried and no further therapeutic programs were planned.

After the electromagnetic treatment performed in 1988, the pain disappeared; the patient was able to walk again, the bone recalcified and the pathological erosions disappeared. Figure 16 shows the x-Ray before the treatment. The third radiological examination in 1989 was accompanied by the following medical analysis: "The present examination, compared to the preceding one (no. 2061) of 1 December 1988, shows that the large destructive area at the medial diaphysis, is mostly occupied by structural bone growth from bone repair under way with fixed appearance of hardened bone in formation." The treatment consisted of approximately 25 applications.

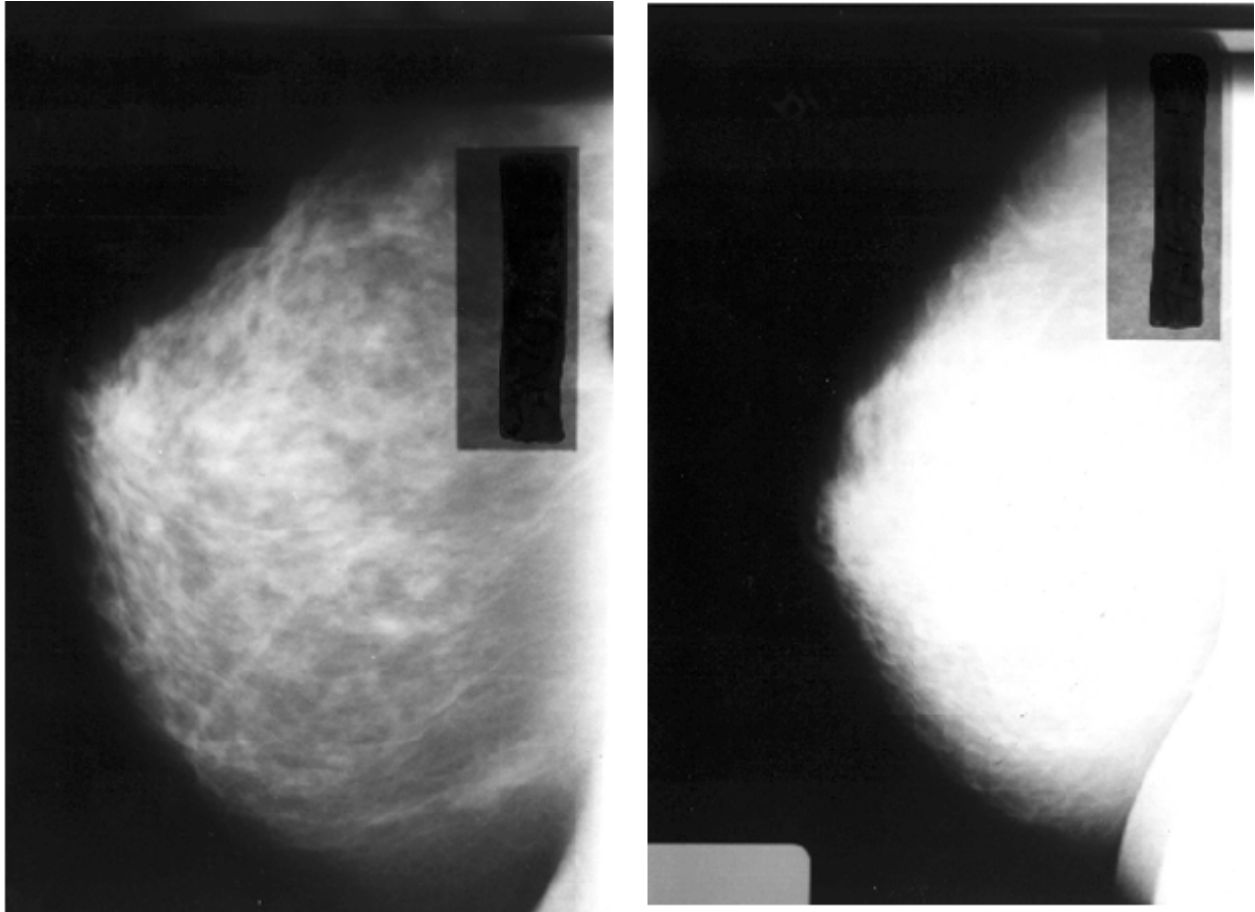


Figure 19 and 20 show the x-rays before and after the treatment.

Case 11

Patient, B. M., female, age 49, was diagnosed with carcinoma of the breast. The patient had had a mammography on May 11, 1994 (Figure 19), which indicated on the right retro-aureolar region a nodular formation with a diameter of about 1 cm with a radiating outline. Excision was recommended. Ago-aspiration confirmed the malignant nature of the lesion and surgery was planned for two weeks later. Waiting for the operation, the patient asked to be subjected to electromagnetic therapy and after eleven sittings the mammography was repeated. The results can be seen in Figure 20. The medical report described granulose breasts of fibromicrocystic type with no evidence of suspicious radiological character nor microcalcifications. Moreover, the cutaneous profile seemed normal.

Properties of the signals Used

Most of the signals used in the clinical field of the rectangular wave shape type (99). This is due to the fact that the activation of some cell functions is bound to on/off type electrical potentials, that is not of the linear type but with waveforms of the rectangular type (100). The electromagnetic treatment last on average about twenty minutes per day with single daily sittings. The duration of the sitting is regulated by the application program and its parameters.

During the first half of the treatment, the static or variable magnetic field at 50 Hz, the pulsed electric field, and the pulse electromagnetic field are all present simultaneously. In the second half, the static or variable magnetic field is not applied. The electromagnetic pulsed field and the electric pulsed field are kept in phase or in counter-phase. The frequency of the electromagnetic field, as well as the temporal width of the square carrier wave, are fixed according to the histological type of tumour, grade of differentiation, mass, and location.

2.4. BIBLIOGRAPHY

1. BISTOLFI F., Campi magnetici in medicina, Ed. Minerva Medica, Torino 1993
2. FROHLICH H., KREMER F., (Eds), Coherent excitation in biological systems, Springer, 1983.
3. SMITH C.W., BEST S., Electromagnetic Man, J.M. Dent & Sons, London, 1989.
4. BARNOTHY M. F. Biological Effects of magnetic Fields, Plenum Press, New York, 1969.
5. LI K.H. Physical Basis of coherent radiations from bio molecules, in: Proc. 1° Intl. Symp. on photon Emission from Biological Systems, Wroclaw, Poland, Ed. Jezowska-Trzebiatowska, pp. 63-95, 1987.
6. BISTOLFI F. Radiazioni non ionizzanti, ordine, disordine e biostruttura, Ed. Minerva Medica, Torino, 1989.
7. COLLOT F. Valeur informationnelle d'une modulation. Information et interaction, Proceed. Intern Symp. on Wave Therapeutics, Versailles, may 1979, pp. 32-42, Z. W. Wolkowski ed., Paris.
8. RUBIK B. BEMS, Symposium explores Mechanisms for ELF electromagnetic Bio effects, Frontier Perspectives, 2 (2), pp. 1-24, 1991.
9. POPP F.A., LI K.H., GU Q. Recent Advances in Bio photon Research, World Scientific, 1992.
10. POPP F.A. Photons, and their Importance to Biology, Proceed. Intern Symp. on Wave Therapeutics, Versailles, may 1979, pp. 43-59, Z.W. Wolcowski ed., Paris.
11. FROHLICH H. The extraordinary dielectric properties of biological molecules and the action of enzymes, Proc. Nat. Acad. Sci. USA, 72, 4211-15, 1975.
12. FROHLICH H. Coherent excitation in active biological systems. In: Modern Bio electro chemistry, Gutman and Keyzer Ads., Plenum P., New York, pp. 241-261, 1986.
13. LIU D.S., ASTUMIAN R.D., ISONG T.Y. Activation of Na⁺ and K⁺ Pumping Modes of (Na-K)-ATPase by an Oscillating Electric Field, The Journal of Biological Chemistry, Vol. 265, No. 13, pp. 7260-7, 1990.
14. TSONG T.Y. Deciphering the Language of Cells, Trends in Bio chemical Sciences, 14, March 1989.
15. POPP F.A. Electromagnetic control of cell processes, Come in, 263, 60-94, 1980.
16. GORGUN S. Arrest of the cellular proliferation in neoplastic cells, Report of experimental work of Univ. of Hannover, Dep. Hematology and Oncology, Hannover, 1990.
17. GORGUN S., UNSAC B. Clinical application of electromagnetic fields for cancer treatment, Report of Academic Commission of Numune Hospital, Ankara, 1980.
18. GORGUN S., BANKO E. In vitro control of the cancer cell mitosis with the modulated electromagnetic energy, National Cancer Institute, Report in International Medical Congress, Sept. 1979.
19. ADEY W. R. Frequency and power windowing in tissue interaction with weak electromagnetic fields, Proc. IEEE., 68, 1, pp. 119-25, 1980.
20. ADEY W.R. Collective properties of cell membranes. In: Interaction Mechanisms of low-level Electromagnetic Fields in Living Systems, Norden and Ramel eds., Royal Swedish Academy of Sciences, Oxford University Press, pp. 47-77, 1989.
21. ADEY W.R. ELF Magnetic Fields and Promotion of Cancer: experimental studies. In Interaction Mechanisms of Low-Level Electromagnetic Fields in Living systems, Norden and Ramel eds., Royal Swedish Academy of Sciences, Oxford University Press, pp.23-46, 1989.
22. ADEY W.R. Tissue interactions with non ionising electromagnetic fields, Physiol. Rev., 61, 435-514.
23. DEL GIUDICE E., DOGLIA S., MILANI M., VITIELLO G. in Coherence in Biology and Response to External Stimuli, H. Frohlich ed., Springer - Verlag, Berlin, 1988.
24. DEL GIUDICE E., DOGLIA S., MILANI M., SMITH C.W., VITIELLO G. Magnetic flux quantization and Josephson Behaviour in living systems, Physica Scripta, Vol. 40, 786-791, 1989.

25. DEL GIUDICE E. Coherence in condensed and living matter, *The Centre for Frontier Sciences*, Vol. 3, N°2, pp. 16-20, 1993.
26. DEL GIUDICE E., PREPARATA G. Coherent dynamics in water as a possible explanation of biological membranes formation, *Proceedings of the Trieste Conference on the Origins of Life*, Kluwer Academic Press, in Press, 1994.
27. WALLACH D.F.H. in: *Biological membranes*, Vol. II, D. Chapman, D:F:N. Wallach eds., Acad. Press, London, pp. 253, 1973.
28. GUYTON A.C. *Textbook of Medical Physiology*, W.B. Saunders Comp. Philadelphia, 1976.
29. ERKOCAK, Genel Histoloji, DAG OKAN, Yay ltd. sti., Istanbul, 1983.
30. CIRELI, Genel Histoloji, Beta Bas. Yay. Dag., Istanbul, 1983.
31. BURR H.S., NORTHROP F.S. The electro dynamic Theory of Life, in: *Quarterly Review of Biology*, N° 10, pp. 322,1935.
32. BISTOLFI F. Radiazioni non ionizzanti, ordine, disordine e biostrutture, Ed. Minerva Medica, Cap. 6-9, Torino, 1989.
33. AARHOLT E., FLINN E.A., SMITH C.W. Biological effects of extremely low-frequency non ionising radiation, *Intl. Symp. RSI/CNFRS, electromagnetic Waves and Biology*, Jouyen-Josas, Parigi, 1980.
34. ASANOVA T.P., RAKOV A.I. The state of health of persons working in electrical fields of outdoor 400 and 500 KV switchyards, in: G.Knickerbocker, *Hygiene of labour and Professional diseases*, Vol.5, Special Publication N° 10, Piscataway NJ: IEEE Power Engineering Society, p. 1966. 1975.
35. BACON H. The hazards on high-voltage power lines, in: E. Goldsmith, N. Hildyard, *Green Britain or Industrial Wasteland*. Oxford, Polity Press, Basic Blackwell, 1986.
36. COLEMAN M., BELL J., SKEET R. Leukemia incidence in electrical workers, *Lancet*, 2, 932-3.
37. DELGADO J.M.R., LEAL J., MONTEAGUDO J.L., GRACIA M.C. Embriological changes induces by weak, extremely low frequency electromagnetic fields, *J. of Anatomy*, 134, 3, 533, 51, 1982.
38. MCDOWALL. T.W: Leukemia mortality in electrical workers in England and Wales, *Lancet*, January 29, 246, 1983.
39. SAVITZ D.A., CALLE E.E. Leukemia and occupational exposure to electromagnetic fields: review of epidemiological surveys, *J. Occ. Med.*, 29, 47-51, 1987.
40. SAVITZ D.A. Childhood cancer and electromagnetic field exposure, *Am. J. Epidemiol.*, 128, 21-38, 1988.
41. WERTHEIMER N., LEEPER E. Adult cancer related to electrical wires near the home, *Int. J. Epidemiol.*, 109, 273-84, 1982.
42. WEWER R.A. Human circadian rhythms under the influence of weak electric fields and the different aspects of these studies, *Intl. J. Biometereology*, 17(3), 227-32, 1973.
43. AHLBOM A. et al., *Biological effects of power lines fields*. New York State Power Lines Project Scientific Advisory Panel Final Report. New York S. Dept of Health, Corning Tower, Empire State Plaza, Albany, 1987.
44. LIN R.S. et al., Occupational exposure to electromagnetic fields and the occurrence of brain tumours, *J. Occ. Med.*, 27, 413-19 1985.
45. PERRY F.S. et al., Environmental power-frequency magnetic fields and suicide, *Health Physics*, 41, 267-77, 1981.
46. WERTHEIMER N., LEEPER E. Magnetic field exposure related to cancer sub types, *Ann. NY. Acad. Sci.*, 502, 43-54, 1987.
47. WILSON B. et al., Chronic exposure to ELF fields may induce depression, *Bio electro magnetics*, 9, 195-205, 1988.
48. BARKER A.T., FOULDS I.S. Human skin battery potentials, they variation with site, age and sex, *Clin. Phys. P.*, 4(11), 101-2, 1983.
49. NORDENSTROM B.E.W. Biologically closed electrical circuits: clinical, experimental and theoretical evidence for an additional circulatory system, *Nordic Medical*, Stockholm, 1983.
50. POHL H. Natural oscillating fields of cells, in: *Coherent excitations in biological system*, FROHLICH H. and KREMER F. Eds., Springer-Verlag, Heidelberg, 199-210, 1983.
51. SMITH C.W. et al., The emission of low intensity electromagnetic radiation from multiple allergy patients and other biological systems, in: *Proc. 1° Intl. Symp. on photon Emission from Biological Systems*, Wroclaw, Poland, January 24-24, Jezowska-Trzebiatowska et al. eds., 110-26, 1986.

52. WAGENEDER F.M., GERMANN R.H. Electro therapeutic Sleep and Electro anaesthesia, VERLAG R.M., Graz, 1978.
53. REID K. H. Mechanism of action of dental electro-anaesthesia, *Nature*, 247, 150-1, 1974.
54. BARR M. et. al., Photo dynamic therapy for inoperable cesophageal, gastric and cholorectal cancers, Abstracts issue Intern. Confer. on PDT and Medical Laser Applications, *Lasers in Medical Sciences* N° 39., London 19-21 July 1988.
55. CHECCHUCCI A. Patologia da esposizione a campi elettromagnetici: un'ipotesi di inquadramento nosografico. In: *Interaction of Radiation with Matter*, pp. 265-291, Ed. Scuola Normale Superiore, Pisa, 1987.
56. CHIABRERA. M. Grattorola, G.C. Parodi, Stimolazione ellettromagnetica dell'osteogenezi in: F. Bistolfi, ed., *Campi magnetici in medicina*, Minerva Medica, 1986.
57. DUBOURG G., COURTY G., PRIORE' A., PAUTRIZIEL R. Stimulation des défences de l'organisme par association d'un rayonnement electromagnétique pulsé et d'un champ magnétique: tentative d'application au traitement du cancer chez l'homme, *International Symposium on Wave Therapeutics*, pp. 198-208, Versailles 19-20 maggio 1979, Ed. Z.W. Wolkowski, 1979.
58. HAIMOVICI N., LANGUASCO G.B. Campi magnetici pulsati a bassa frequenza e debole intensità nel trattamento delle affezioni e arteriose degli arti in ortopedia a traumatologia, In: BISTOLFI F. *Campi magnetici in medicina*, pp. 459-469, Ed. Minerva Medica, 1986.
59. SZENT GYORGYI A. Bio electronics and cancer: electronic desaturation of proteins in normal and canceous tissues, *Come in*, 310, 109-113.
60. BASSETT C.A.L. Medical benefits of electric and magnetic fields. *Electricity and magnetism in biology and medicine*. San Francisco Press Inc., USA, 1992.
61. BASSETT C.A.L. Fundamental and practical aspects of therapeutic use of pulsed electromagnetic fields, *CRC Crit. Rev. Biomed. Eng.*, 17, 451-259, 1989.
62. BASSETT C.A.L., CARPENTER D.O. Therapeutic use of electric and magneic fields in otrhopaedics, In: CARPENTER D.O. ed., *Biologic effects of electric and magnetic fields*, Academic Press, NY, In press.
63. BASSETT C.A.L. Physical and biological principles affecting weak ELF electromagnetic bio responses, in: C.T. Brighton and S.R. Pollach Eds., *Electromagnetics in biology and medicine*, pp. 1-13, San Francisco Press, 1991.
64. BRIGHTON C.T., PFEFFER G.B., POLLACK S.R. In vivo growth plate stimulation in capacitively coupled electric fields. *J. Orthop. Res.*, 1-42, 1983.
65. CANE V., BOT P., SOANA S. Effect of pulsed magnetic fields on bone appositional growth rate during the repair of transcorticals holes. *Electricity and magnetism in biology and medicine*, San Francisco Press, Inc. USA, 1992.
66. CANE V., BOTTI P., FARNETI D., SOANA S. Histomorphometric study of low frequency pulsing electromagnetic fields on bone repair of transcortical holes. *Trans. BRAGS*, 9, 19, 1989.
67. CANE V., BOTTI P., FARNETI D., SOANA S. Electromagnetic stimulation of bone repair. A histomorphometric study, *J. Orthop. Res.*, 9, 908-917, 1991.
68. BECKER., C.A. BASSETT., BACHMAN C.H. Bio electric factors controlling bone structure, in: *Bone bio dynamics*. FROST H. ed., Little Brown and Co., Boston, 1964.
69. MIR L.M., ORLOWSKI S., BELEHRADEK J., PODDEVIN JR B., PRON S., DOMENGE C., BELEHRADEK M., LUBOINSKI B., PAOLETTI C. Electro chemio therapy: A new anti tumour treatment using electric pulses. *Institute Gustave Roussy, Villejuif, France*. *Electricity and magnetism in biology and medicine*. San Francisco Press, Inc., USA, 1992.
70. PILLA A.A. State of the art in electromagnetic therapeutics. *Electricity and magnetism in biology and medicine*. San Francisco. Press, Inc., USA, 1992.
71. PILLA A.A., FIGUEIREDO M., NASSER P.R., KAUFMAN J., SIFFERT R.S. Broadband EMF acceleration of bone repair in a rabbit model is independent of magnetic component. *Electricity and Magnetism in biology and medicine*. San Francisco Press, Inc., USA, 1992.
72. PLIQUETT F. PLIQUETT. Pulse impedance measurements. Their applications in medicine and research. *Electricity and Magnetism in biology and medicine*. San Francisco Press, Inc., USA, 1992.

73. RYABY J.T., MAGEE F.P., MEINSTEIN A. The effect of combined AC/DC magnetic fields on resting articular cartilage metabolism. *Electricity and magnetism in biology and medicine*. San Francisco Press, Inc., USA, 1992.
74. SISKEN B.F., WALKER J. Nerve regeneration, implication for clinical applications of electrical stimulation. *Electricity and Magnetism in biology and medicine*. San Francisco Press, Inc, USA, 1992.
75. WALLECZEK J., MILLER P., ADEY W.R. Simultaneous dual-sample fluorimetric detection of real-time effects of ELF electromagnetic fields on cytosolic free calcium and divalentcation flux in human leukemic T-cells(Jurkat). *Electricity and Magnetism in biology and medicine*. San Francisco Press, Inc., USA, 1992.
76. BISTOLFI F. *Campi magnetici in medicina*, p. 363, Ed. Minerva Medica, 1983.
77. FREEMAN N. Biological and clinical effects of low frequency electric and magnetic fields, *Australas. Phys. & Engl. Sci. Med.*, 3. 182-192, 1980.
78. HAIMOVICI N. Quattro anni di esperienza con terapia con campi magnetici pulsanti a bassa frequenza in ortopedia e traumatologia, *Atti del II Congresso Int. Magnetomedicina*, Roma 1980.
79. BISTOLFI F. *Campi magnetici in medicina*, p. 364, Ed. Minerva Medica, 1983.
80. GIUBBOTTI A. Effetto dei campi magnetici pulsanti sulla flogosi dei seni paranasali, *Atti del II Congr. Int. di Magnetomedicina*, Roma, 1980.
81. BISTOLFI F. *Campi magnetici in medicina*, pp. 365, Ed. Minerva Medica, 1983.
82. ROSSANO C. La magnetoterapia ad impulsi nel dolore erpetico e post-erpetico, *Clinica Europea*, XXII, 6, novembre-dicembre, 1983.
83. MUSTACCHI G. Trattamento di sindromi dolorose neoplastiche con magnetoterapia ronefor, *Atti VI Cong. Naz. dell'Ass. It per lo studio del dolore*, Trieste, maggio 1982.
84. NEUMANN E. Membrane electroporation: toward a molecular mechanism, *Univ. Of Bielefeld, Germany. Electricity and magnetism in biology and medicine*. San Francisco Press, Inc, USA, 1992.
85. MOUNEIMNE Y. Electroinsertion of proteins into membranes: a novel approach to the study of membrane receptors, *Harvard Univ. Usa. Electricity and magnetism in biology and medicine*. San Francisco Press, Inc., USA, 1992
86. BISTOLFI F. Radiazioni non ionizzanti, ordine, disordine e biostrutture, pp. 209-246, *Minerva Medica*, Torino, 1989.
87. BISTOLFI F. *Campi magnetici in medicina*, pp. 384, Ed. Minerva Medica, 1983.
88. MICLAVCIC D., REBERSEK S., SERSA G., NOVAKOVIC S. Nonthermal anti tumour effect of electrical direct current on murine fibrosarcoma SA-1 tumour model, in: *Electromagnetics in Biology and Medicine*, C.T. Brightho GRUNDLER W., KAISER F. *Mechanics of Electromagnetic Interaction with Cellular Systems*, *Naturwissenschaften*, 79, 551- 559, 1992.n and S.R. Pollack eds, San Francisco Press Inc, San Francisco, Ca-USA, 1991
89. ADEY W.R. Whispering Between Cells: Electromagnetic Fields and Regulatory Mechanism in tissue, *Frontier Perspectives*, Vol. 3, N°2, Fall, 1993.
90. GRUNDLER W., KAISER F. *Mechanics of Electromagnetic Interaction with Cellular Systems*, *Naturwissenschaften*, 79, 551- 559, 1992.
91. JOSEPHSON B.D. *PHYS. IETT.*, 1, 251, 1962.
92. BOX G.E.P., HUNTER W.G., HUNTER J.S. *Statistics for experiments*, New York, 1978.
93. FLETCHER R. *Practical methods of optimisation*, John Wiley & Sons, New York, 1987.
94. ADEY W. Ross. *Electromagnetics in biology and medicine* in: *Modern Radio Science* edited by Hiroshi matsumoto, pp. 231-249, 1993.
95. TSONG T.Y. Deciphering the language of cells, *Trends in Biochemical Sciences*, Vol. 14, pp. 89-92, 1989.
96. SIENKIEWICZ Z.J., CRIDLAND N.A., KOWALCZUK C.I. and SAUNDERS R.D. Biological effects of electromagnetic fields and radiation in: *The Rewiew of Radio Science 1990-1992*, edited by M. Ross Stone, pp. 737-770, 1993.
97. TENFORDE T.S. Cellular and molecular pathways of extremely low frequency electromagnetic field interactions with living systems in: *Electricity and Magnetism in Biology and Medicine*, edited by Martin Blank, pp. 1-8, 1993.
98. HAND J.W. and CADOSSO R. Therapeutic applications of electromagnetic field in: *The rewiew of Radio Science 1990-1992*, edited by W.Ross Stone, pp. 779-796, 1993.

99. PILLA A.A.. State of the art in electromagnetic therapeutics in: *Electricity and Magnetism in Biology and Medicine*, Edited by Martin Blank, pp. 17-22, 1993.
100. HILLE B. Ionic channels of excitable membranes, Sinour Associates Inc., Massachusetts, 1984.
101. CLEARY S.T. Biophysical mechanisms of interaction in: *The review of Radio Science 1990-1992*, edited by W.Ross Stone, pp. 717-735, 1993.
102. PILLA A.A., NASSER P.R., KAUFMA J.J. Gup junction impedance, tissue dielectrics and thermal noise limits for electromagnetic field bioeffects., *Bioelectrochemistry Lab., Department of Orthopaedics, Mount Sinai School of Medicine, New York.*, In: *Bioelectrochemistry and Bioenergetics*, 35, pp. 63-69, 1994.
103. TENFORDE T.S. Health effects of low-frequency electric and magnetic fields, *Environ. Sci.*
104. TRAIKOV L.L., KUZMANOVA M.A., IVANOV S.P. and MARCOV M.S. Effect of static magnetic field on lectin binding to erythrocyte membrane, *Bioelectrochemistry and Bioenergetics*, Vol. 35, pp. 49-52, 1994.
105. CIESLAR G., SIERON A., TURCZYNSKI B., ADAMEK M. and JASKOLSKI F. The influence of extremely low-frequency variable magnetic fields on rheologic and dielectric properties of blood and the water-electrolyte balance in experimental animals, *Bioelectrochemistry and Bioenergetics*, Vol.35, pp. 29-32, 1994.
106. LIU D.S., ASTUMIAN R.D., TSONG T.Y. Activation of Na⁺ and K⁺ Pumping Modes of (Na,K) ATPase by an Oscillating Electric Field., Printed in USA. *The Journal of Biological Chemistry.*, Vol. 265, N°13, Issue of May 5, pp. 7260-7267, 1990.
107. SERSA G. (a), CEMAZAR M.(a), MICLAVCIC D. (b), MIR M. Lluís. (c)., *Electrochemoterapy: variable anti-tumour effect on different tumour models.*, (a) Institute of Oncology, Dep.of Tumour Biology, Ljubljana, Slovenia.,(b) Univ. of Ljubljana, Faculty of Electrical and Computer Engineering, Ljubljana, Slonenia., (c) Department of Antitumour Pharmacology, Institut Gustave-Roussy,, Villejuif, France. *Bioelectrochemistry and Bioenergetics* 35, pp. 23-27, 1994.
108. MIR M.L., ORLOWSKI S., BELEHRADEK Jr. J., PODDEVIN B., PRON G., DOMENGE C., BELEHRADEK M., LUBOINSKI B., PAOLETT C. Electrochemotherapy: A new antitumour treatment using electric pulses, Institut Gustave-Roussy, Villejuif, France. In: Martin Blank, Ed., *Electricity and Magnetism in Biology and Medicine*, San Francisco Press, Inc.,pp. 119-121, 1993.
109. DEL GIUDICE E., DOGLIA S., MILANI M., SMITH C.W. and VITIELLO G. Magnetic flux quantization and Josephson behavior in living systems, *Physica Scripta*, Vol. 40, pp. 786-791, 1989.
110. GORDON PETERS. Cell cycle stifled by inhibitions, *News and Views, Nature.*, Vol. 371,pp. 204-260., 15 September 1994.
111. ADEY W.R. Electromagnetic fields, cell membrane amplification and cancer promotion, *Extremely Low Frequency Electromagnetic Fields: The question of cancer*, Wilson, B. W. Stevens, R.G., and Anderson, L.E., eds, Columbus, Ohio, Battelle Press, 211-250, 1990.,(b)*
112. BENTAL R.H.C. Low-level pulsed radiofrequency fields and the treatment of soft-tissue injuries, *Bioelectrochem. Bioenergetics*, 16, 531-548, 1986.
113. BLANK M. "Na,K-ATPase function in alternating electric fields", *FASEB J.*, 6, pp. 2434-2438, 1992.
114. BLANK M., SOO L. "Ion activation of the Na,K-ATPase in alternating currents". *Bioelectroche. Bioenerget.*, 24, pp. 51-61, 1990.
115. ALBERTINI A., NOERA G., PIERANGELI A., ZUCCHINI P., CADOSSO R. Effects of low-frequency pulsed electromagnetic fields on experimental myocardial infarcts in rats., in C.T. Brington and S.R. Pollack. Eds. *Electromagnetics in Medicine and Biology*, San Francisco Press, pp. 187--190, 1991.
116. BRINGTON C.T. Advanced clinical applications of electromagnetic field effects bone and cartilage, in C.T. Brington and S.R. Pollack., Eds. *Electromagnetics in Medicine and Biology*, San Francisco, San Francisco Press, pp. 293-308, 1991.
117. PILLA A.A., NASSER P.R., KAUFMAN J.J., in ALLEN M.J., CLEARY.F., SOWERS A.E., SHILLADY D.D. Eds, *Charge and Field Effects in Biosystems*, 3, Boston: Birkhauser, pp. 231-241, 1992.
118. TRAIKOV L.L., (a) CUZMANOVA M.A.,(a) IVANOV S.P., (a) MARCOV M.S.,(b) Effects of static magnetic fields on lectin binding to erythrocyte membrane, (a) Department of Biophysics and Radiobiology, Sofia Univ. Bulgaria.,(b) *Bioelectrochemistry Lab. Mount Sinai Medical Center, New York, USA.* In: *Bioelectrochemistry and Bioenergetics*, 35, pp. 49-52, 1994.

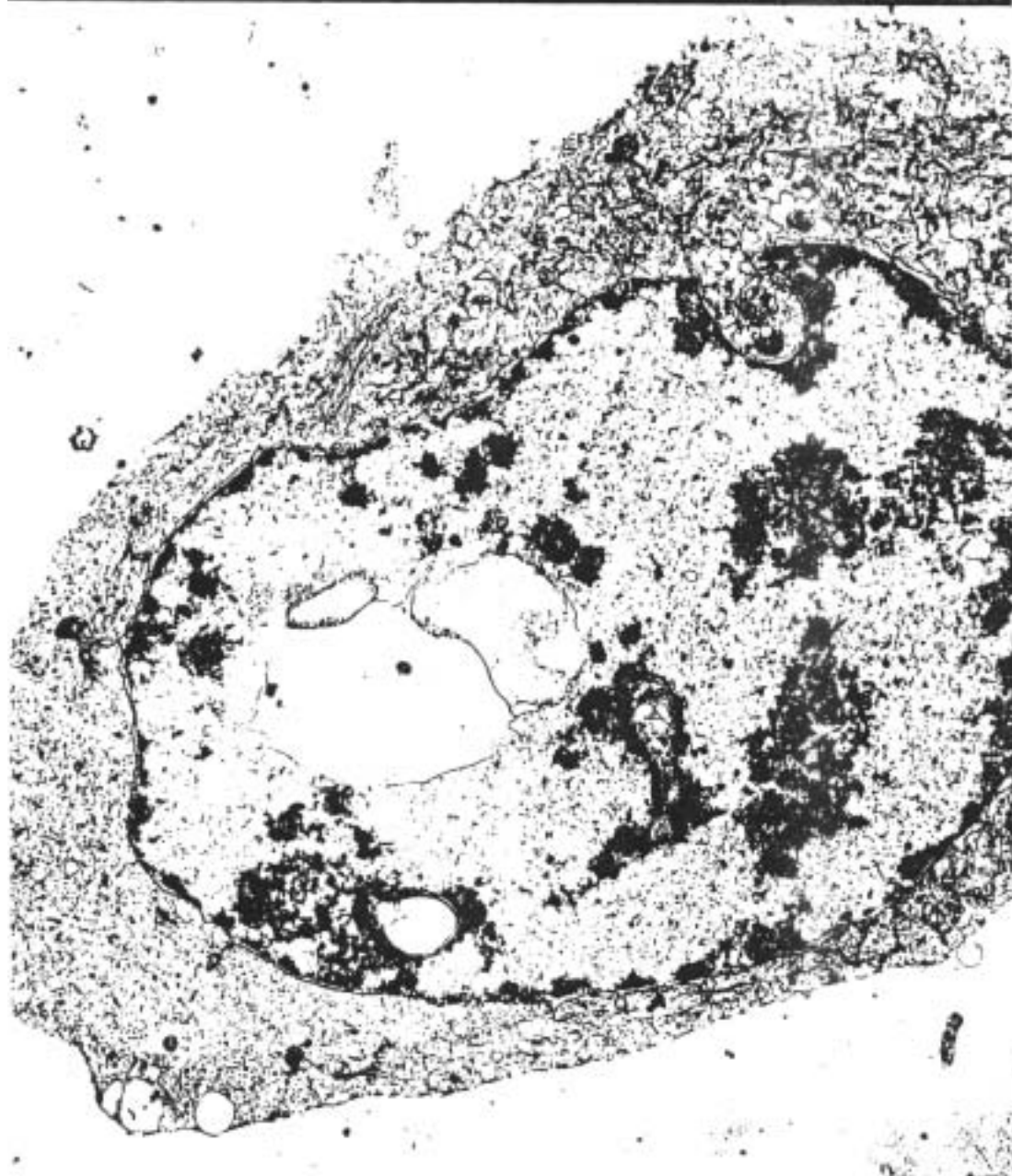
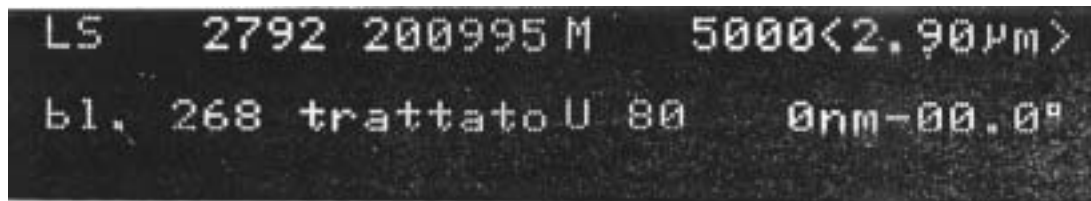
119. LEW V.L., BEAUGE L. In membrane Transport in Biology (Giebisch G., TOSTESON D.G., USSING H.H. Eds.), pp. 81-115, Springer-Verlag, Berlin-Heidelberg, 1979.
120. BELEHRADEK Jr.J., ORLOWSKI S., PODDEVIN B., PAOLETTI C., MIR L.M. Electrochemotherapy of spontaneous mammary tumours in mice, *Eur. J. Cancer* 27: 73-76, 1991.
121. DEL GIUDICE E., DOGLIA S., MILANI M., VITIELLO G. *Nucl. Phys.* 251B (FS13), 375 (1985), *Nucl. Phys.* 275B, (FS17), 185 (1986); Frohlich H., (Ed), Structures, correlations and electromagnetic interactions in Living matter: theory and applications. In: *Biological Coherence and Responce to External Stimuli*, p.49, Springer (1988).
122. De LATEUR B.J., LEHMANN J.F., STONEBRIDGE J.B., WARREN C.G., GUY A.W. Muscle heating in human subjects with 915 Mhz. Microwave contact applicator. *Arch. Phys.Med.* 51, 147, 1970.
123. MCAFEE R. D. Analeptic effect of microwave irradiation on experimental animals. *IEEE Trans, Microwave theory techniques.* Vol. MTT 19, 251, 1971.
124. NADASDI M. Inhibition of experimental arthritis by athermic pulsating short waves in rats. *Orthopedics* 2, 1960.
125. ATALAY Muzaffer.: Clinical results of the treatment of cancer with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". Seminary, 1979.
126. GUNER Z., KAYABALI I.: Experimental research work on Electrotherapeutic sleep and Electroanesthesia. Surgical team: KAYABALI I., GORGUN S., TUGCU K., DUMAN H., NUMANOGLU H., 1970.
127. GORGUN S. and Coll.: Experimental research work on cell membrane and the control of the cell mitosis with the modulated EM energy, according to the "Method of GORGUN". *Sea Biology Lab.*, 1972-1973.
128. GORGUN S., OZCELIK F.: Control of the cancer cell mitosis with the modulated EM energy, according to the "Method of GORGUN ", on white mice. *Institute for Biophysics and Nuclear Medicine*, 1974.
129. GORGUN S., OZCELIK F.: experimental research work on regeneration of the medulla spinalis with the modulated EM energy, according to the "Method of GORGUN", after experimental injury on animals. 1974.
130. GORGUN S., OZCELIK F., GURMAN I.: Demostration on the cancer cell culture (for control of the cell mitosis) with the modulated EM energy, according to the "Method of GORGUN". *Faculty of science, Nuclear research centre.* 1975.
131. GORGUN S.: Study on the effects of the modulated EM energy on the infected tissue, according to the "Method of GORGUN". 1976.
132. GORGUN S., BANKO E.: Experimental invitro work on, control of the cancer cell mitosis with the effect of modulated EM energy, according to the "Method of GORGUN". *Nationale Cancer Institute, Research Division*, 1979.
133. GORGUN S. BANKO E.: Control of cancer cell membrane functions with the modulated EM energy, according to the "Method of GORGUN". *Staff Conference. National Cancer Institute, Research Division.* 1979.
134. GORGUN S.: Treatment of cancer with the modulated EM energy, according to the "Method of GORGUN". on the terminal cancer patients. *Pub. Scientific Research Center.* 1980.
135. GORGUN S. De RENZO A.: Clinical applications of symptomatic cancer treatment with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". 1985.
136. GORGUN S. De RENZO A.: Clinical applications of symptomatic cancer treatment with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". *Staff Conf., Dec.* 1985.
137. GORGUN S. De RENZO A.: Clinical applications of the treatment of cancer with the modulated EM energy, according to the "Method of GORGUN", on the terminal cancer patients. 1988-1991.
138. GORGUN S. De RENZO A.: Clinical applications of the treatment of cancer with the modulated EM energy, according to the "Method of GORGUN", on the terminal cancer patients. *International Seminary, Patologia specifica delle ELF.* 1991.
139. GORGUN S. De RENZO A.: Possibilità di trattamento del cancro con energia elettromagnetica. *Libera Università Trapani, Anno X - N.29 Novembre 1991.* (Clinical applications of the treatment of

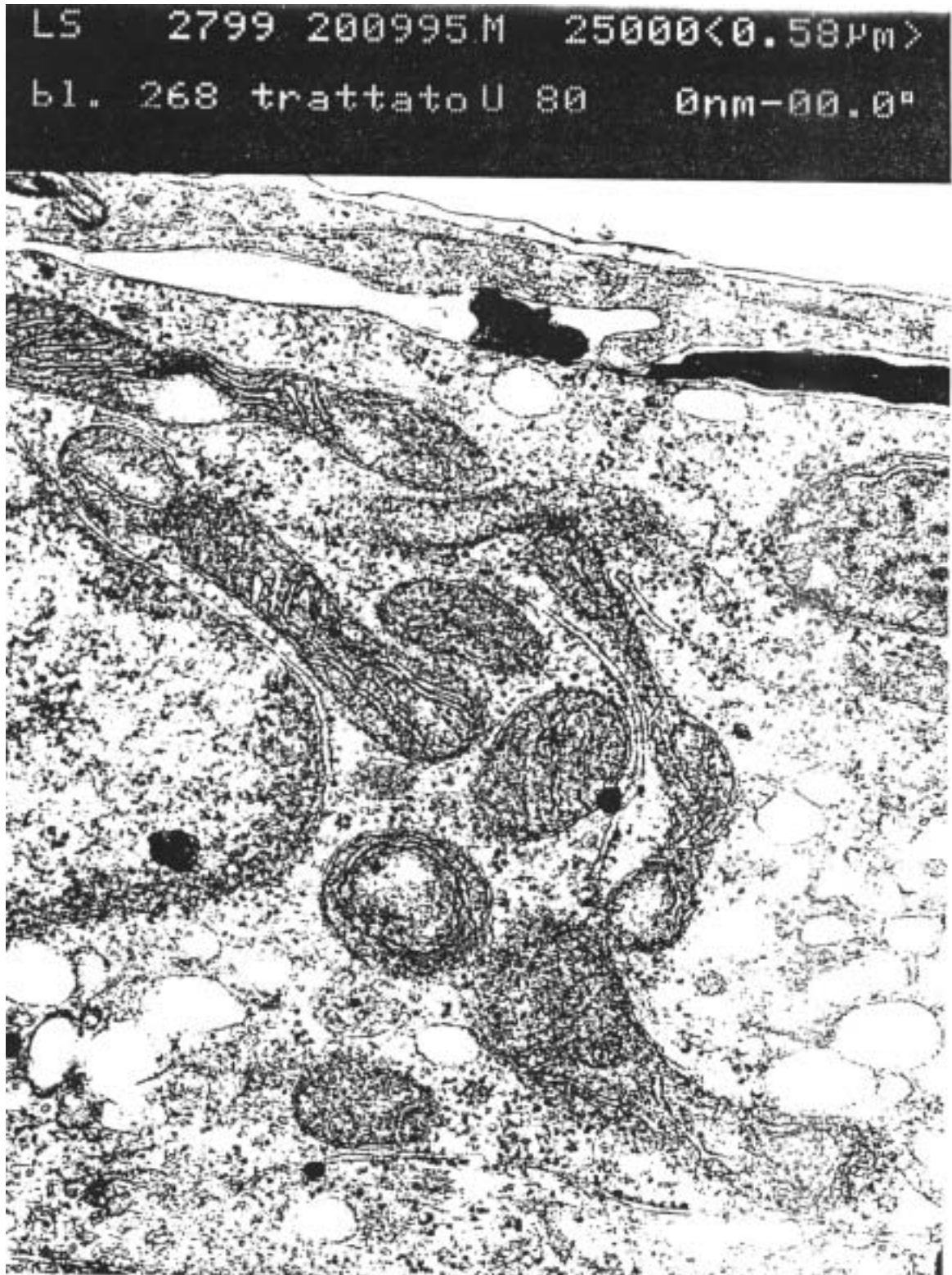
- cancer with the modulated EM energy, according to the "Method of GORGUN", on the terminal cancer patients).
140. GOODMAN R. and HENDERSON A.S: Transcriptions and translations in cells exposed to extremely low frequency electromagnetic fields, *Bioelectrochem. Bioenerget.* 25: 335-355, 1991.
 141. ITO H., BASSETT C.A.,L.: Effect of weak pulsing electromagnetic fields on neural regeneration in the rat, *clinical orthop. and related research* 181:283-290, 1983.
 142. KADIOGLU Y.: Clinical applications and results of the treatment of cancer with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". *Seminary*, 1979.
 143. KANJE M., RUSOVAN A., SISKEN B.F., LUNDBORG G.; Pretreatment of rats with pulsed electromagnetic fields enhance regeneration of the rat sciatic nerve. *Bioelectromagnetics* (in press).
 144. KAYABALI I.: Personal Communications for the control of cancer cell membrane functions, in vitro, with the effect of modulated EM energy, according to the "Method of GORGUN". 1970-1973.
 145. KAYABALI I.: Personal Communications for the control of cancer cell membrane functions, in vitro in vivo with the effect of modulated EM energy, according to the "Method of GORGUN". 1974-1975.
 146. KAYABALI I.; Personal Communications for the clinical results of the treatment of cancer with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". 1979.
 147. KERNS J.M., FAKHOURI A.J., WEINRIB H.P., FREEMAN J.A.: Electrical stimulation of the nerve regeneration in the rat. *Neuroscience* 40:93-107, 1991.
 148. ORGEL M.G., O'BRIEN W.J., MURRAY H. M., Pulsing electromagnetic field therapy in nerve regeneration. An experimental study in the cat, *Plast. reconstr. surg.* 73:173-183, 1984.
 149. OSBORN K. D., TRIPPEL S. B., MANKIN H. J.: Growth factor stimulation of adult articular cartilage. *J. Orthop. Res.* 7:35, 1989.
 150. PILLA A.A., FIGUEIREDO M., NASSER P.R., KAUFMAN J. J., SIFFERT R.S.,: Broadband EMF acceleration of bone repair in a rabbit model is independent of magnetic component. *Electricity and magnetism in biology and medicine.* San Francisco Press, Inc. 1992. U.S.A.
 151. PLIQUETT U., PLIQUET F.: Pulse impedance measurements. Their application in medicine and research. *Electricity and magnetism in biology and medicine.* San Francisco Press, Inc. 1992. U.S.A.
 152. RYABY J.T., MAGE F.P., WEINSTEIN A.M.: The effect of combined AC/DC magnetic fields on resting articular cartilage metabolism. *Electricity and magnetism in biology and medicine.* San Francisco Press, Inc. 1992. U.S.A.
 153. RUSOVAN A., KANJE M.: Stimulation of regeneration of the rat sciatic nerve by 50 Hz. sinusoidal magnetic fields. *Exp. neurol.* 112:312-316, 1991.
 154. SAMARAS G.M., MURAFF L.R., ANDERSON G.E.: Prolongation of life during high intensity microwave exposures. *IEEE trans Vol. MTT* 19, 245, 1971.
 155. SIEERA R. C., HALTER S., TANNER J.A.: Effect of an electromagnetic field on the process of wound healing. Dept. of anatomy, Queen University, Third int. Symposium, Varna, Vol. 33, 10, 1967.
 156. SINAV M.: Clinical results of the treatment of cancer with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". *Seminary*, 1979.
 157. SISKEN B.F., WALKER J.: Nerve regeneration, implications for clinical applications of electrical stimulation. *Electricity and magnetism in biology and medicine.* San Francisco Press, Inc. 1992. U.S.A.
 158. SISKEN B.F.:Electric and pulsed electromagnetic field effect on nerve tissue regeneration, in C.T. Brighton and S.R. Pollack, Eds., *Electromagnetics in medicine and biology*, San Francisco Press, 1991, 259-274.
 159. SISKEN B.F., KANJE M., LUNDBORG G., HERBST E., KURTZ W.: Stimulation of rat sciatic nerve regeneration with pulsed electromagnetic fields. *Brain. res.* 485:309-316, 1989.
 160. TEMUCIN T.: Clinical applications and results of the treatment of cancer with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". *Seminary*, 1979.
 161. WHEELER P. C., WHEELER M.C.: Electromagnetic wound healing; Further clinical and basic considerations. Dept. of Phys. Medicine and rehabilitation, University of Missouri Medical center. Third int. Symposium, Varna. Vol. 33, 10, 1967.

162. WORDEN R., HERRIK J., WAKIM, KRUSEN F.: The heating effects of microwaves with and without ischaemia. Arch. Phys. Med. 29, 751, 1948.
163. YALCIN S.: Clinical applications and results of the treatment of cancer with modulated EM energy, on the terminal cancer patients, according to the "Method of GORGUN". Seminary, 1979.
164. ZIENOWICZ R.J., THOMAS B. A., KURTZ W.H., ORGEL M.G.: A multivariate approach to the treatment of peripheral nerve transection injury. The role of electromagnetic field therapy. Plast. reconstr. surg. 87:122-129, 1991.
165. ZIMMER R.P., ECKER H.A., POPOVIC V.P.: Selective electromagnetic heating of tumours in animals in deep hypothermia. IEEE trans. on microwave theory techniques, Vol. MTT 19, 238, 1971.

For further information: Phone: 0090-532-2025007. (For phone call, with local Turkey times between 12-22 hours).

2.6 THE ELECTRON MICROSCOPY PHOTOS







Dr. S. Seçkiner GÖRGÜN (winner of the price of Physics) in the Ceremony of the price of Physics, 2001.

Equipment of electromagnetic field and its different models is the physiotherapy equipment and therefore in clinic these physiotherapy equipment's (Equipment of electromagnetic field) uses also for the rehabilitation's of the different pathologies and the patients. For example, this physiotherapy equipment used for pain treatment (Cancer patients), Osteoporosisext. without any side effects. These physiotherapy equipment applications are not the absolutely invasive applications.

For to obtain appointment, **Phone: 0090-532-2025007**. Every day with local time between 13 to 22 hours.

Per informazione **Tel: 0090-532-2025007**. Tutti i giorni dal 13 all 22 con ore locale.