# Abstracts

## An Hypothesis on Neurosomatic Disorders

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During the past 11 years I have personally examined more than 3 000 patients with pain and/or fatigue as their main symptoms. Since long I have suspected that there is/ought to be a common denominator to disorders such as: Fibromyalgia S.(Syndrome), Chronic Fatigue S., Posttraumatic Stress S., Multiple Chemical Sensitivity S., Temporomandibular Pain S., Chronic Pain S., Gulf War S., Silicon Implantate S., Irritable Bowel S. etc. Also disorders that psychiatrists categorize as Somatoform Diseases most probably have the same kind of explanation.

**Symptome Profiles – Certain Diagnoses (Crude comparisons)**

| | FMS | CFS | Pain syndrome | El.sens | MCS | Somatisation syndrome |
|---|---|---|---|---|---|---|
| **Pain** | + | (+) | + | - | - | (+) |
| **Fatigue** | + | + | + | + | (+) | + |
| **Neurocognitive s.** | + | + | (+) | + | (+) | + |
| **Vegetatative s.** | + | + | (+) | (+) | (+) | + |
| **Inf.; recurrent** | (+) | (+) | - | (+) | (+) | (+) |
| **Mucous membr. s.** | (+) | (+) | - | (+) | + | (+)? |
| **Psych. stress sens.** | + | + | (+) | + | (+) | + |
| **Irritability** | + | + | + | + ? | (+) | + |
| **Soc. isol.** | - | - | - | (+)? | - | + |
| **Sleep disturb.** | + | + | + | (+) | - | + |

In my *Model on Neurosomatic Disorders*, see below, predisposing factors to FMS are summarized, as well as known trigger events and its most prevalent symptoms. – But the intricate, hitherto unanswered question is: *What* has occurred that could cause all the symptoms?

To most scientists involved with these disorders it is by now obvious that the majority of them are neither psychological nor muscular in their origin. Instead, as many patients have been saying for long, it is "all in my head". During the past decade several studies have demonstrated disturbances in neuro- and endocrine functions, and dysfunctions in the immunological system have also been implicated. – *But what is the underlaying cause?*

An hypothesis on dysfunctions of the *astroglia cell membrane* gives a possible explanation to the often long-term disturbances seen at the mentioned syndromes. – If this theory is proven valid new paths will open both in respect of attitudes to these disorders and in the search for effective treatment.

Astrocytes are the most common cell forms in the brain. Three-dimensionally in a starlike fashion they surround and support the neurons and their connections (synapses). Astrocytes are not just a form of connective tissue but have – according to latter years scientific knowledge – important regulatory and nutrional functions and have receptors for neurotransmitters, neuropeptides and other neuroactive substances. Glutamate, ATP and GABA are examples of messengers in astrocyte-neuronal communications which now are in focus due to the discovery that calcium-waves within astrocyte networks constitute a long-range signaling system within the brain. – This may explain why disturbances in brain function can spread from one focal area to even remote functional systems within the brain.

**References** Antanitus D.S. in Neuroscientist 4: 154–9,1998
Bennett R: Emerging Concepts in the Neurobiology of Chronic Pain … Mayo Clin Proc 1999; 74:385–398.
Hansson E el al: Astrocyte and glutamate … Neurochemistry International 37 (2000) 317–29
Watkins LR, Maier SF: Implications of immune-to-brain communications. PNAS, 96; 7710–3, 1999.

# Demographics of the electrically sensitive at Environmental Health Center, Dallas

**WILLIAM J REA**, M.D., President, Environmental Health Center, Dallas, USA

Demographics are compared between the present groups of electrically sensitive patients and the original group. There appears to be a broader spectrum of etiologies with many patients being exposed to pesticides, computers, cell phones and cell phone towers.

Additionally, new data has evolved in that many patients in addition to being generally chemically sensitive are sensitive to metals. Most have vitamin, mineral and amino acid deficiency.

# Characteristics of EHS in Sweden

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During the period 1980–1998, 350 patients with electrical sensitivity were registered at the Department of Occupational and Environmental Medicine and Dermatology, Norrland University Hospital, Umeå. It was possible to reach 344 of these patients. After going through the medical records it was possible, based on clinical experience, to divide the patients into two groups, those with electrical sensitivity (ES) and those with screen dermatitis (SS).

Multi-symptomatic patients that perceived worsening of symptoms from exposure to a multitude of electric sources were labelled ES. Patients with facial skin symptoms that were aggravated by exposure to VDTs, TVs and flourescent light were labelled SS. A questionnaire was sent out, the response was 73%. The questionnaire contained questions on civil status, present health, care, treatment and other measures that were utilised, the consequences of the problem, precipitating factors, current employment situation, and questions concerning feelings, self-image, and coping ability.

Of the 50 patients with electrical sensitivity who responded, 38 per cent were men and 62 per cent women. Of the 200 patients with screen sensitivity, 22 per cent were men and 78 per cent women. It was found from the medical records review that skin symptoms like hotness, a pricking sensation in the face, nervous system symptoms like dizziness and difficulty concentrating, and general feelings of illness like fatigue and headache were significantly more common in the electrical sensitivity group. As expected, nearly all screen-sensitive patients reported that their problems were triggered near a screen. Only slightly more than half the electrical sensitivity patients reported a screen as the cause of their problems. Such factors as flourescent lights, TVs and other items were more often mentioned as the cause of their problems.

The study also showed that more women than men turned to caregivers, including complementary forms of medical care. More than every third patient with electrical sensitivity was no longer gainfully employed as a consequence of the problem, while the corresponding figure for screen-sensitive patients was less than one out of five patients. In general, both groups reported a higher frequency of symptoms and greater difficulty compared with a general population. More than one third of the patients with electrical sensitivity reported at the time of the follow-up that they still had the problems, which is more than twice the proportion reported for the screen-sensitive group. Concerning self-image, women with electrical sensitivity differed from the other patient groups and from a control group in that they demonstrated a more positive and a less negative self-image than the other patient groups and the control group. On the whole, women with electrical sensitivity also had more resources for coping.

In summary, patients with electrical sensitivity have extensive, severe medical and psychosocial problems compared with screen sensitivity. Both groups need early and consistent management. Many patients suffering from problems related to screen dermatitis have a good prognosis. Our investigation shows that all these patients, particularly those with electrical sensitivity, need support from health care services and industrial health services, as well as from other authorities

involved with rehabilitation. The doctor in charge of the patient,
especially in the case of patients with electrical sensitivity, should reserve time for regular consultations over an extended period of time following the debut of symptoms.

# A summary of 5 years research on Electrical Hypersensitivity at the Nath. Inst. for Working Life in Umeå.

**EUGENE LYSKOV**, M.D., Ph.D., assoc. prof. NIWL and
**MONICA SANDSTRÖM**, Ph.D., Researcher NIWL, Umeå Sweden

Dr Eugene Lyskov and Dr Monica Sandström make a summary of their research on electrical hypersensitive people (EHS) with focus on central and autonomous nervous system function and reactions to different physical and mental stimuli. They have during the last 5 years performed a number of studies on EHS that indicate a disbalance of the autonomous nervous system regulation and a hyperresponsitivity to different stimuli.

The focus of the talk will be on the following three papers:

### Neurophysiological effects of flickering light in patients with perceived electrical hypersensitivity.

M. Sandström, E. Lyskov, A. Berglund, S. Medevedev, K. Hansson Mild:JOEM. 1997, 39:15-22.

An increasing number of people in Sweden are claiming that they are hypersensitive to electricity. These patients suffer from skin as well as neurological symptoms when they are near computers, fluorescent tubes or other electrical appliances. Provocation studies with electromagnetic fields, emitted from these appliances, have with only one exception, all been negative, indicating that there are other factors in the environment that can effect the autonomic or/and central nervous system, resulting in the symptoms reported. Flickering light is one such factor and was therefore chosen as an exposure parameter in this study. Ten patients and the same number of healthy controls were exposed to amplitude modulated light. The sensitivity of the brain to this type of visual stimulation was tested by means of objective electrophysiological methods such as electroretinography and visual evoked potential. A higher
amplitude of brain cortical responses at all frequencies of the stimulation was found when comparing patients with control subjects, whereas no differences in retinal responses were revealed.

### Neurophysiological study of patients with perceived "electrical hyper-sensitivity"

E. Lyskov, M. Sandström, K. Hansson Mild. In press 2001, Int J of Psychophysiology.

The aim of the present study was to investigate baseline neurophysiological characteristics of the central and autonomous regulation and their reactivity to different tests in a group of persons with so-called "Electrical Hypersensitivity", which is often considered as a form of psychosomatic disorders. Twenty patients with combinations of neuroasthenic symptoms (general fatigue, weakness, dizziness, headache) and facial skin (itching, tingling, redness) have been investigated. An equal number of symptom-free persons served as a control group. The examination comprised self-reported measures, testing of visual functions, measurements of blood pressure, heart rate and its variability, electrodermal activity, respiration, EEG and visual evoked potentials (VEP).

Several variables were found to differ between the patient and the control groups. The mean value of heart rate in rest condition was higher in the patient group compare to the controls (mean value of inter beat intervals were 0.80 s and 0.90 s, respectively). Heart rate variability and heart rate response to standing test were decreased in the patient group compared to the controls.

Patients had faster onset, higher amplitudes, and left-right hand asymmetry of the sympathetic skin responses. They had a higher critical fusion frequency (43 Hz vs. 40 Hz), and a trend to increased amplitude of steady-state VEPs at stimulation frequencies 30–70 Hz.

The data indicated that the observed group of patients had a trend to hyper sympathotone, hyperresponsiveness to sensor stimulation and heightened arousal.

### Provocation study of persons with perceived electrical hypersensitivity and controls using magnetic field exposure and recording of electrophysiological characteristics

E. Lyskov, M. Sandström, K. Hansson Mild. In press, 2001, Bioelectromagnetics.

The aim of the present study was to investigate possible neurophysiological effects of intermittent 15 sec on/off cycle, 60 Hz, 10 T, magnetic field exposure on patients with perceived "Electromagnetic Hyper Sensitivity" (EHS) and control subjects during rest and during performance of a mental arithmetic task. Twenty participants (15 female, 5 male, 31–60 years old, mean 45.8 0.7 years) were invited from the group of EHS patients. Twenty volunteers (15 female, 5 male, 31–59 years old, mean 45.0 0.7 years) served as a control group. The test protocol consisted of a set of examinations (EEG, visual evoked potentials, and electrodermal activity, ECG, blood pressure) conducted in rest conditions and during mental task. The total duration of the test was 40 minutes, divided in to four 10 minute-periods; two rest periods and two periods of mathematical performance. Magnetic field and sham exposures were presented randomly during these periods, resulting in four different conditions: Field-Rest, Sham-Rest, Field-Mat, Sham-Mat, respectively.

The data obtained during the different conditions of the examination showed significant main effects of Group case factor (EHS vs. control subjects) on heart rate ($F_{1,80} = 20.6$; $P<0.01$, heart rate spectrum ratio ($F_{1,80} = 9.5$; $P = 0.02$) and electrodermal activity ($F_{1,76} = 4.2$; $P = 0.04$), whereas EEG characteristics did not differ between groups. The Condition factor (mathematical task vs. relaxed) showed main effects for heart rate ($F_{1,80} = 14.8$; $P<0.01$), heart rate spectrum ratio ($F_{1,80} = 7.8$; $P = 0.06$), electrodermal activity ($F_{1,76} = 56.8$; $P<0.01$), and alpha and theta spectral bands of EEG. Magnetic fields exposure did not affect autonomous system or electroencephalographic variables of either group.

Data obtained in the present study do not indicate that EHS patients or control are affected by low-level 60 Hz magnetic field exposure. However, persons reporting EHS differed from the control subjects in baseline values of investigated physiological characteristics. Perhaps EHS patients have a rather distinctive physiological predisposition to sensitivity to physical and psychosocial environmental stressors.

# Can it be explained why some persons have concentration and memory difficulties after working with VDT?

**LARS RÖNNBÄCK**, Ph.D., M.D., Prof. Inst. of Clinical Neuroscience,
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It is well established that people can suffer from mental fatigue with decreased capacities for attention, concentration and learning when exposed to electromagnetic fields. Similar symptoms are found in some people with amalgam fillings. In fact, the symptoms are very common at different forms of affection of the nervous system. Thus, people who have suffered from a stroke, a brain trauma, an infection or inflammation in the brain report the same symptoms during the rehabilitation period. As such symptoms are highly disabling it is of utmost importance to find out probable mechanisms underlying their appearance. We present an hypothesis on the underlying mechanisms at the cellular level for this mental fatigue.

Conventional theories of information processing in the brain are based on the observed electrical activity of neurons, punctuated by brief chemical messages at synapses. Although this conventional wisdom is true, it does no longer seem to be the whole truth. A majority of the cell number and a prominent part of the brain volume consists of glial cells and new research suggests that this majority is not as silent as was previously believed. Recently, a massive amount of data from various laboratories including our own have demonstrated that the glial cells are able to communicate with each other, and with neurons in in vitro model systems. Furthermore, we and others have shown that this communication is dynamically regulated by neurotransmitters such as 5HT, noradrenaline, especiellay a1-receptor agonists, glutamate, and neuropeptides such as endothelins, and also growth hormone (GH) and insulin growth factor-1 (IGF1). Intercellular $Ca^{2+}$ wave signaling within the astroglial network is mediated via gap junction structures consisting of the protein connexin-43. Data are accumulating both at our laboratory and at other laboratories that a functionally intact astroglial network is necessary for supporting glutamatergic neurotransmission. The astroglial network supports glutamate neurotransmission by removing glutamate and $K^+$ from the extracellular space after the transmitter has been released from the pre-synaptic terminal and interactions with the postsynaptic membrane have occurred.

In pathological brain processes as well as during long-term intense neuronal activity there is a production of substances and altered conditions that have diverse effects in the CNS. Examples of such substances/conditions are free radicals, arachidonic acid, disturbed energy metabolism (with lowering of ATP levels), lactic acid, acidosis, endothelins, cytokines and leukotrienes (such as TNFa, interferon-g, interleukin-1b, leukotriene B4, b-amyloid peptides, NO and peroxynitrite, and hemosiderin in cases of bleeding. These substances/conditions have been tested on astroglial cell cultures and have been found to affect astroglial functions. For instance, they have been observed to decrease the glutamate uptake capacity, depolarize the astroglial membrane potential and/or close the gap junctions. Intense neuronal activity in the patient (due to performance of cognitive tasks for a long duration) may result in an overproduction of such substances that would affect astroglial processes. Hence, a resulting loss of astroglial glutamate uptake capacity and $K^+$ buffering of the extracellular space can lead to a slight increase in levels of glutamate and $K^+$ in the neuronal space and result in a decreased signal-to-noise ratio for glutamate transmission, i.e. a less precise or distinct transmission signal. A less distinct intake and processing of information will lead to difficulties for the brain to recognize if the incoming information is “new or old“. The result might be that the brain does not recognize already known information efficiently, and thus the “filter“ function will diminish with a resultant risk for “over-stimulation“ of the brain. Furhtermore, increased glutamate and $K^+$ concentrations in the extracellular space can contribute to an increased neuronal excitability that can spread to the frontal cortex (neuronally-mediated or mediated via a depolarisation of the astroglial network and a secondary alteration of the extracellular milieu towards a neuronal depolarisation). It is known from experimental investigations that there is a feed-back loop from the left basal frontal cortex with an inhibitory influence on the locus coeruleus in the brain stem. Interactions with the locus coeruleus

and the raphe nuclei are also well established with a resultant decrease in noradrenaline and 5-HT levels in the cerebral cortex following an increased excitability in the basal frontal cortex. Here, there is a possible explanation for the lack of attention, that may be important for problems associated with concentration. In addition, this might also explain the appearance of mental depression, often seen after a pathological brain affection, organic or psychologic. Awareness of this decreased mental capacity may result in the development of anxiety and stress in the patient. Glucocorticoids have been shown to further decrease astroglial glutamate uptake capacity, leading to a further propagation of the negative events at the cellular level described above. If the "vicious cycle" persists, then a probable rebuilding of neural structures can take place, and the symptoms may become chronic.

## Electrosensitivity – the cutaneous experience

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A new category of patients has recently been described in the literature, namely those that claim to suffer from subjective and objective skin- and mucosa-related symptoms, such as itch, smarting, pain, heat sensation, redness, papules, pustles, etc., after exposure to mobile telephones, visual display terminals (VDTs) as well as other electromagnetic devices, both at their work and in their home. Many patients also have symptoms from internal organs, such as the heart and the brain, including headache, nausea, dizziness, and problems with their short-term memory as well as with their concentration capability. Clinical dermatologists often describe these patients as suffering from either some kind of earlier acknowledged skin disease, e.g. seborrhoic keratosis or rosacea, or from so-called 'techno-stress', a term first used in Japan for work-related stress. Also Pavlovian-type conditioning has been attributed to this group of patients. So far, however, no scientific studies give support to such conclusions.

In addition, it may be mentioned that recent epidemiological studies point to a correlation between long-term exposures from magnetic fields and cancer. Of special interest here are the most recent reports about left- or right-sided brain tumours and the correlation to the older analogue NMT system. Also the studies on blood-brain barrier permeability as well as on the growth of induced lymphoma tumours, and changes of mast cells in cell culture, definitely point to true biological effects. Furthermore, in very well controlled and blind-coded studies significant alterations have also been seen in blood pressure, heart rate and the pattern of human EEG. And, and this is very important, these changes have been recorded using irradiation levels (m W/kg~W/kg) below, or even far below, the so-called SAR value of 2 W/kg that is recommended in many countries!

Very little is known about the exact cause of the above-mentioned symptoms and, thus, generally very little help or treatment can be offered today. In the meantime, prudence avoidance measures are certainly very well worth to document and use!

The aim of our previous as well as on-going studies is to investigate possible changes, in the cellular and neuronal systems of the human skin, after provocations with low- and/or high-frequency electric and/or magnetic VDT- or mobile phone-related fields. As controls, age- and sex-matched persons working with VDTs or mobile phones (however, without any subjective or clinical symptoms) have served. Immunohistochemistry using antisera to the previously characterized marker substances of interest in this specific patient category is utilized. Among these markers, PGP 9.5, 8-100, y-M8H, PNMT, CGRP, VIP, NPY, PHI and ChAT, may be mentioned.

Initially, we have done the following:

**a)** Investigated the presence of intraepidermal nerve fibers in normal human skin from healthy volunteers using the new marker PGP 9.5. The intraepidermal nerve fibers are found as close as 20–40 Jlm from the surface, which makes it highly possible that weak electromagnetic fields may affect them. They have also been further characterized using conventional electron microscopy as well as ultrastructural immunocytochemistry.

**b)** Performed a 'pilot'-study to elucidate possible changes in cellular (immunologic, connective tissue, etc.) markers, as well as in sensory and autonomic nerve fibers. From the preliminary data, it seems plausible to conclude that the patient population differs from both healthy controls as well as from rosacea patients, however, further control experiments needs to be carried out.

**c)** Studied, in collaboration with the Karolinska Hospital (prof. K. Hall, Dept. Endocrinol. & dr. V. Björnhagen, Dept. Plast. Surg.), in an open-field situation, the effect of EMFs from an ordinary TV set on the cellular/neuronal populations of the skin of sampled patients. From these studies, it is evident that certain profound effects in the dermis and epidermis take place, however, since the material still is small further investigations are needed.

**d)** Investigated the presence of mast cells in skin from patients using histamine-based immunohistochemistry. From these studies, it seems as the patients have a higher number of mast cells in their affected areas, however, again, the material needs to be further extended.

**e)** Found a person responding correctly to a mobile phone-based provocation 9 times out of 9 provocations ($p<2/1000$), both in the 'acute' phase as weIl as in the 'chronic' phase ($p<1/1000$). In addition, we have also studied further single persons having a better than coincidence hit rate.

In summary, it is already obvious that low- and high-frequency electromagnetic fields have biological effects, and also in humans. Several other background milieu factors, such as airborne chemical substances, e.g. flame retardants, may in addition be highly important. In view of the recent epidemiological studies pointing to a correlation between long-term exposures from magnetic fields and cancer, our data ought to be further analyzed. The implications of this will be further discussed during the presentation. (Supported by the Swedish Cancer and Allergy Foundation (Cancer- och Allergifonden), the Swedish Work Environment Fund (Rådet för Arbetslivsforskning), and funds from the Karolinska Institute.– For correct references to the above-mentioned studies, see the enclosed article "A theoretical model based upon mast cells and histamine to explain the recently proclaimed sensitivity to electric and/or magnetic fields in humans" in Med. Hypoth. 54, 663-671, 2000, by S. Gangi & O. Johansson.)

# Proof of Interaction between low frequency magnetic fields and cell membranes

**JACOB EBERHARDT**, Ph.D., Inst. for Radiophysiology, Univ. Hospital, Lund, Sweden.

**Objective** There is no accepted theoretic model that can explain how an extremely low frequency electromagnetic magnetic field gives a biological effect. It is assumed that the metabolism of calcium is affected by magnetic fields in the cell, but the site of interaction is unknown. The objectives of this study are (a) to test the hypothesis that the interaction takes place in the membrane of living cells and (b) to test a mo del suggested by Blackman, the Ion Parametric Resonance Model (IRP)

**Method** Our experimental system consists of highly purified isolated plasma membrane vesicles and the flow of calcium ions across this membrane is followed. The plasma membranes are obtained from spinach using aqueous polymer two-phase partitioning. By subsequent treatment with Brij 58, the plasma membrane vesicles oriented with the cytoplasmic surface facing the surrounding medium. Prior to exposure, the vesicles are loaded with $Ca^{2+}$ with the help of the primary $Ca^{2+}$pump ($Ca^{2+}$-ATP-ase, exposing its active site to the medium). The efflux of $Ca^{2+}$ through the plasma membrane is studied at 32 °C using 45Ca as a radioactive tracer. A static magnetic field of 37 mT and parallel to this field a time varying magnetic field with frequencies between 7 and 72 Hz and different amplitudes were used.

**Results**

1. Resonances were found at 7, 21, 24 Hz and 31 Hz.
2. The resonances at 21 and 31 Hz were found to be narrow with a width of about 2 Hz whereas the resonace at 24 Hz is broad and consists probably of two peaks
3. When the amplitude of the dynamic magnetic field, Bac, was varied (fixed value for Bdc) for the frequency of 24 Hz the ratio of mean efflux of calcium over the membrane follows the Bessel functions of the IPR model well. A multiple linear regression including the Bessel functions J1, J2 and J3 (index numbers n = 1, 2, and 3, respectively of the model) as independent variables revealed that only J1 contributed significantly to the fit to the data points ($R = 0.84$; $p = 0.003$).
4. A study of the amplitude dependence performed at 7 Hz, revealed that only the Bessel function J2, corresponding to a subharmonic resonance, contributed significantly to the fit throught the data points.
5. For a fixed frequency (25 Hz) the amplitude of the static magnetic field was varied while keeping Bac/Bdc konstant. Comparing the results for the Calcium efflux with the results under (1) and (2) above revealed that the resonance frequencies shifted linearly proportional to the amplitude of Bdc.

**Discussion** It was shown that dynamic magnetic fields interact directly with components of the cell membrane, altering the efflux of calcium through channels in the membrane of “inside-out“ vesicles. This means that in “right side-out“ membranes the influx of calcium would be altered.

This study constitutes an independent test of the IPR model. The following predictions of the model could be confirmed:

- Resonances occur at frequencies predicted by the model for the biologically active ions: $K^{+}$ (n = 2) (7 Hz), $Mn^{2+}$ (n = 1) (21 Hz), $^{45}Ca^{2+}$ (n = 1) (25 Hz), $^{40}Ca^{2+}$ (n = 1) (28 Hz) and $Mn^{3+}$ (n = 1) (31 Hz).
- Both fundamental resonances (n = 1) and resonances at half the fundamental frequency (n = 2) can occur.
- The presence of a static magnetic field is a prerequisite for the occurrence of a Calcium efflux modifications caused by a time-varying magnetic field.

- The resonance frequency for a given resonance is linearly proportional to the magnitude of the static magnetic field.
- The biological effect studied in this work depends on the magnitude of the dynamic magnetic field and an amplitude window is observed in agreement with the prediction of the IPR-model.

This work was supported by grants from the Swedish Medical Research Council, the Swedish Radiation Protection Board and the elforsk- and Gunnar Nilsson foundations.

## Static magnetic fields causes variations in creatinine and calcium in urine and blood.

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**Finn Schmidt** & **Tone Mannsåke**r, Sörfjordens Health Centre, 5751 Odda, Norway.

Experiments have been performed with 35 males exposed to a controlled static magnetic field of 9.6 mT with a ripple of 0.2–0.6%. The participants were exposed twice for 40 minutes during an interval of 7 days. During one of the exposures, a uniform magnetic field 'penetrated' the torso. the other experiment was blank. The participants did not learn when the field was on.

Analysis of urine and blood samples collected before and afte each experiment reveal a significant increase in serum and urine creatinine after exposure to magnetic fields. Variation in calcium is negligible.

These experiments indicate significant biological effects resulting from exposure to static magnetic fields. possible health hazards from these results are difficult to infer since the strength of the applied field is some 100 times stronger than human environmental fields. On the reasonable assumption that magnetic field induced biological effects may depend on the exposure dose, prolonged exposure to weaker fields may induce comparable physiological effects. Secondly, environmental magnetic fields are not static, but exist in a large frequency domain. We believe, however, that the ripple of the applied field mimics some of the human environmental fields.

Possible implications for HG-release during exposure to industrial magnetic fields will be presented and discussed.

## Double-blind study on effects of 50 Hz EMF on sleep quality and physiological parameters in people suffering from EHS.

**CHRISTOPHER MUELLER**, Dr. Sc. Swiss Fed Inst. of Tech (ETH), Zürich, Switzerland

**Outline** Electric and magnetic fields develop in connection with i.e. the production, transmission and use of electric current. Exposure limits were set in order to protect the general population against acute biological effects of electric and magnetic fields. Beside these well documented acute effects, long term health effects are believed to occur even at field strenghts below the legal limits. Although scientifically sound findings of such effects exist only at substantially higher field strengths than the average values measured in Swiss homes, a variety of health problems are attributed to weak electric and magnetic fields. "Hypersensitivity to Electricity" (EHS) is a key word in this respect, which is brought up again and again in media reports or in anecdotal accounts on adverse health effects of electric and magnetic fields. People suffering from electrical hypersensitivity report multifaceted symtoms, as soon as they get close to sources of electric and magnetic fields. Symptoms such as sleep disturbances, tiredness during the day, headache, tingling sensation and skin rashes are among the most frequently reported.

Project nemesis examined the effect of weak 50 Hz fields on humans, who judged themselves as "hypersensitive to electricity". In a double-blind experiment, 53 test subjects were exposed to different field situations during 20 to 25 days. At the same time, subjective and physiological parameters were measured. The subjective parameters were measured using a diary. The

physiological parameters such as movements, breathing frequency and heartbeat frequency were measured without touching the subjects. For this purpose, a measurement device had to be developed (Dormograph). In a laboratory experiment with 63 subjectively hypersensitive subjects, the hypothesis was tested whether it is possible to consciously perceive weak electric and magnetic fields (electrosensitivity).

- Soundness of sleep and emotional state in the morning were changed by the provocation with electric and magnetic fields.
- The group of subjects as a whole could detect the exposure patterns.
- No significant results were found in the investigation of the reported sleep quality and the well-being during the day.
- The hypothesis concerning the influence of weak electric and magnetic fields on movements, respiration and heartbeat could not be confirmed.
- The analysis of the position of the center of gravity relative to the position of the magnetic field coil showed more significant results than could be explained by chance result.
- In the laboratory experiment, the hypothesis on electrosensitivity was confirmed. However, the electrosensitivity seems not to be connected with the perceived degree of EHS.
- The results of the explorative investigations point to a connection between the electric and magnetic field exposure and particular subjective and physiological parameters on the one hand and modifications of the duration and distribution of sleep stages on the other hand. The duration of sleep stages 3 and 4 was shortened, sleep seemed to get more superficial during exposure.

The synthesis of the complete set of results from Project nemesis makes clear that hypersensitivity to electricity cannot be reduced to a simple causal relationship between electric and magnetic fields and the biological effects observed. The character of the reaction under electric and magnetic field exposure depends upon the point in time of the provocation and the current condition of the subjects exposed. The electrosensitivity and hypersensitivity to electricity are two different manifestations of either an effect of electric and magnetic fields on predisposed people or the symptom of a disturbance in well-being that is characterized by a multitude of physical, biological, psychological and psychosocial factors. (October 2000)

## Does EMF interfere with cortisol-production and stress-load on our brains?

**CHRISTINA ELIASCH**, M.D., Head Medical Officer, Social Insurance
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Already many years ago David de Wied, the Netherlands, did report several differently sized ACTH molecules – the ones shorter than normal (<39) – having behavioral effects. Normally ACTH and other important melanopeptides like a and g MSH, a-endorfin etc. are derived from POMC (pro-opiomelanocortine) through limited proteolysis by proprotein convertases.

If the proteolytic process goes on which it tends to do when pH is lowered – the result is more short fragments ACTH1–16, 4–10, 4–16, 11–19 etc. (An extended proteolysis does probably also affect other POMC derived products.) The short fragments have no effect on cortisolproduction or pigment but several different neurogenic effects; avoidance and social behavior, yawning, stretching, learning etc[1].

Eva Lindström and Elisabeth Barbier have both reported EMF effects on cellular calcium[2]. It has been shown on melanotropic cells that pH goes down when intracellular calcium activity is raised[3].

Hence, EMF-exposition might result in less cortisolproduction and more brain disturbance. Would it be wise to look at the relative proportions of normal and short ACTH in EMF-sensitive patients? There are many reports on low cortisolproduction as well as excessive tiredness and cognitive difficulties also in Chronic Fatigue Syndrome and Fibromyalgia and possibly Chemical Sensitivity.

1 David de Wied: Melanotropins as Neuropeptides, Ny.Y. Academy of Sciences vol 680 – The Melanotropic peptides and Fleur Strand et al: Melanopeptides a growth factors, same volume.
2 Lindström et al: Intracellular Calcium Oscillations Induced in a T-cell Line by weak 50 Hz Magnetic Field, in Journal of Cellular Physiology 156:395–398 (1993), and Barbier E. et al: Stimulation of $Ca^{2+}$, influx in rat pituitary cells under exposure to a 50 Hz magnetic field. Bioelectromagnetics 17:303–317, 1996.
3 Simultaneous Kinetic Imaging of Intracellular Calcium and pH in single Melanotropes – N.Y. Academy of Sciences vol 680: The Melanotropic peptides.

## Treatment of EHS and case reports.

**WILLIAM J REA**, M.D., President. Environmental Health Center, Dallas, USA

Treatment has become more difficult because of the rapid proliferation of electronics making avoidance almost impossible. Certainly getting the chemical, food and mold problems under control helps decrease the problem. Vitamin and mineral supplementation helps. Creating faradic cages aids in grounding and decreasing the electrical sensitivity. Energy manipulation helps.

## Rehabilitation of EHS-patients; the experience of Elrum.

**MARTIN ANDERSSON**, Working-Environment Consultant, AMA-konsult, Skellefteå, Sweden.

Elrum is a unique rehabilitation centre – the only one of its kind in Sweden. Its purpose is to look into the occupational conditions of people who are hypersensitive to electricity and suggest solutions for rehabilitating them.

A total of 67 people have taken part in the studies at the rehabilitation centre during the three year period of 1998–2000.

The great majority of those who have taken part in this project at the rehabilitation centre have resided for long periods of time in environments that can be called damaging and that they have experienced as troublesome. Examples of this are living in a house that has mould, handling chemicals, being exposed to smoke/welding smoke, exhaust fumes, etc.

Whilst partaking in this project at the rehabilitation centre, people who are hypersensitive to electricity have the opportunity of living in an electrically sanitized environment, working with computer equipment that meets the strictest demands for a good working environment and that has been installed in a way that further eliminates the existence of electromagnetic fields. As Arbetslivstjänster does not have its own competent technical staff, it relies on external expertise at the Luleå University of Technology, Sunda kontoret and previously Liberel.

An electrically sanitized environment constitutes the basis for Arbetslivstjänsters studies, as we cannot exclude electrical environments as a factor that gives rise to hypersensitivity to electricity.

Our experience in dealing with people who are hypersensitive to electricity is that intensive electrical environments cause their ailments. Other factors, such as exhaust fumes, chemicals, moulds, etc., probably contribute to the symptoms. Often (but not always), hypersensitivity to electricity gets started after a period of great psychological stress.

## Experience from ten years work with electrosensitive patients.

**ULRIKA ÅBERG**, M.D., Spec. child & youth psychiatry, Skövde, Sweden.

During my work with amalgam and electrosensitive patients I have met around 1 200 patients and 300–400 of these patients have electrosensitivity as their main problem. Approximately 50% of my patients become stronger and feel better with injections of vitamin B12 – mercury disturbs the transport of vitamin B12 from the blood to the CNS liquor. Electrosensitive patients who are also sensitive to light, or have been, may have good use of PABA, Para-amino-benzoic-acid. During the last year I have understood the importance of hidden infections and hidden metals in the teeth and the jaws for the health in general for patients of these categories. That these infections are teated and these metals taken away may be necessary for these individuals to recover.

# Contributions of laboratory medicine in cases of metal overload.

**ULF LINDH**, Ass. prof., Centre for Metal Biology in Uppsala, Department of Oncology, Radiology and Clinical Immunology, Uppsala univ., Rudbeck laboratory, Sweden.

Cases of metal overload have historically been found in occupational exposure and in catastrophes such as that in Iraq 1971 caused by the agricultural use of methyl and other alkyl mercury compounds and that in Japan caused by discharge of mercury polluted effluents in Minamata bay (1953–1960) severely contaminating fish. In the case of mercury as well as the non-metal arsenic medicinal uses have been widespread. Not much attention has been paid to exposure of the general public but for environmental exposures such as the microbial conversion to methyl mercury in the bottom sediment of lakes and subsequent uptake in fish. Again, mercury is incriminated and there are other examples that have attracted some attention like emission from crematories.

In spite of at least three amalgam wars, most authorities over the world deny the possibility of health effects occasioned by metal exposure from decaying dental amalgams. The message seem unanimously to be that there are no scientific evidence that such exposures can cause any health effects whatsoever. This, again, in spite of several literature reports about serious health problems ever since the late 19th century.

This presentation focuses on what laboratory medicine can provide in the realm of diagnostic and treatment success in amalgam-associated ill-health. Current evidence-based medicine is vitally dependent on results of laboratory tests to confirm diagnoses and suggest adequate treatment as well as monitoring the results of therapies used. Together with the suspicion that metals may be involved in electro sensitivity these facts motivate the present argumentation.

Whenever amalgam is focused as a possible cause of ill-health it is but natural to try to monitor metals emitted from this material in the body. Biological media available for such monitoring are blood in the first place and urine as well as faeces in the second place. Other possibilities are practicable only in certain circumstances. Early experiences with blood plasma showed that significant differences in mercury concentration existed between patient and control groups. However, there usually is a high degree of overlap in concentrations negatively affecting the usefulness in the diagnostic procedure.

Novel approaches using blood fractions as valuable diagnostic information will be covered by discussing nuclear microscopy of single, isolated blood cells. Nuclear microscopy of erythrocytes and neutrophil granulocytes from patients and controls was proven to be of decisive value even for individual patients and not only at the group level. Conspicuous differences in granulocyte manganese constitute highlights of this laboratory procedure. However, nuclear microscopy is not widely available, is time-consuming and expensive. These facts necessitated development of simpler and less expensive procedures.

Results of a study comprising about 500 patients with amalgam-associated ill-health will be discussed. Current findings include the value of blood plasma as well as packed erythrocytes before and after exchange of amalgam to metal-free alternatives as a monitor of decreasing exposure. Additionally, results of nuclear microscopy will be compared with plasma metal measurements applying multivariate statistical analysis indicating promising possibilities of practical clinical value.

# Does removal of dental metals help the electrically sensitive?

**KARIN ÖCKERT**, D.D.S. Specialist of Periodontology, Göteborg, Sweden.

With the description of two clinical cases it is assumed that electrosensitivity sometimes might have its cause in the mouth and it is shown that it was possible to make these patients recover by removal of metals and/or infected teeth.

In evaluating the improvement of electrosensitivity after amalgamremoval of 42 electrically sensitive patients it is shown that 40% are totally recovered, 24% are improved, 26% are unchanged and 10% are worse.

# Allergotoxic side-effects of dental alloys in dermatological patients.

**JOHN G. IONESCU**, Ph.D., Research Dir. Spezialklinik, Neukirchen, Germany,
Prof. of Clinical Biochemistry, Capital Univ., Washington D.C.

Corrosion, phase transformation and abrasion of metallic dental restaurations as well as the saliva pR value, temperature, microbial plaque and food composition are usually responsible for the release of single components of the dental alloys in situ.

In such cases recorded galvanic currents of remarkable potential and intensity (>200 mV and >2000 nA, respectively) between different metallic restaurations may also explain the frequent electrohypersensitivity symptoms of the carriers. The same dental alloys are significantly disturbing the magnetic resonance imaging during computer tomography investigations.

Spreading and storage of single metal components leading to local or distal body symptoms can be avoided by pre-therapeutical corrosion, mobilisation and biocompatibility tests including skin and lymphocyte sensitization or in vitro cytotoxic investigations. This allows the appropriate material choice and the avoidance of associated allergotoxic side-effects as usually registered in our dermatological patients.

In our experience the right identification of the heavy metal burden in atopic eczema, chronic acne and psoriasis patients, followed by an appropriate elimination with chelating agents as DMPS, DMSA or EDTA under antioxidant protection may lead to a significant improvement of the clinical symptoms in these cases.

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# Analogies between photoallergy and disorders described by patients in electromagnetic fields.

**PER HEDEMALM**, M.Sc. Eng. Phys., senior consultant, Orango AB

Several people have described disorders related to the use of electronic products, such as dermatitis, pruritus, and several different types of nervous system effects. The objective of the current study is to point out the commonalities between photoallergy and disorders commonly ascribed to the use of electronic products.

Photoallergy is created by exposing a person to a chemical (a "photoallergen"), and then to UV-light. Common sources of UV-light in our society are sunlight, fluorescent tubes, and visual display units.

In many cases, photoallergy may clear within week or months, if the exposure to chemicals and UV light is limited.

The sensitivity to UV light is often extended into the visual spectra. It has not been investigated whether the sensitivity may also be extended through the IR and microwave spectra.

In severe cases, the photoallergy may become permanent, and the diagnose is then "permanent light sensitivity", and the person afflicted is termed a "permanent light reactor".

Permanent Light Sensitivity (PLS) is a severely disabling disorder, often confining the person afflicted to a single room or a specially designed hospital environment for life.

Many, if not most cases of photoallergy, go undetected and undiagnosed, because the person afflicted, consciously or subconsciously, will take protective measures. However, if protective measures cannot be taken for any reason, the risk of PLS of course increases.

Common sources of photoallergens are vehicle exhausts, plant extracts, coal tar, perfumes, cleaning agents, and hygienic products. Bisphenol A, a common chemical in plastics in general, and also in electronic products, is a known photoallergen in man. Brominated bisphenol A and other bisphenols, are likely to have similar or even more marked photoallergic effects.

Normally, phenolic substances should be confined to the plastic, but highly improper or negligent manufacturing methods may release photoallergic phenols into surrounding air.

Polyaromatics, such as anthracene and phenanthrene, that are found in vehicle exhausts, are also known to be powerful photoallergens. The fuel standards in Sweden changed dramatically around 1990, when completely new fuels were introduced. The new fuels were not screened for possible photoallergic effects. Photoallergens are usually fluorescent in UVlight, though not all chemicals that are flouorescent are photoallergens. A UV lamp or UV spectroscopy can therefore be used as a simple method to screen for possible photoallergens in chemical preparations or the environment.

# Curriculum vitae

## Martin Andersson

Martin Andersson has been working as a workplace environment consultant for 20 years. From 1980 to 1982 he was working with the environment at the Nuclear Powerplant at Forsmark with radioactive radiation and after that at the Boliden Rönnskärsverken with different kinds of pollutions. From 1987 he has been working as a full time consultant with the question of Hypersensitivity for Electricity in Sweden. He has made technical solutions for persons working at the Stockholm Stock Market which registered skin problems in connection with work with computers. More than 600 work-places were rebuilt with a new type of furniture that were shielded for electric fields, and it seems that this solved some of the environmental problems at the Stock Market. From 1996 he has served as a technical consultant for Arbetslivstjänster at their rehabilitation centre for Electrical Hypersensivite people – elrum – in Skellefteå.

## Marion Crasson

Marion Crasson is research fellow at the Faculty of Medicine, Psychoneuroendocrinology Unit, University of Liège, Belgium. She is coordinator of the Belgian BioElectricMagnetic Group (BBEMG) and scientific coordinator of the BBEMG web site:www.ulg.ac.be/bbemg, She also practices clinical psychology, for her PhD in Psychology the thitle of her thesis was "Contribution to the study of psychological, psychophysiological and neuroendocrine effects of 50-Hz magnetic field exposure and of the problems related to the interindividual variability". Marion Crasson has made various presentations at international conferences and published articles on this subject. She is a member of, a.o., Bioelectromagnetics Society, USA, European Bioelectromagnetics Assoc., Société Psychophysiologie Cognitive, France. Since 1997 she is correspondent to the Union radio-scientific Internationale.

## Igor Ya Belyaev

Igor Ya Belyaev, Ph.D., Sc.D., is Research Scientist at the Department of Genetic and Cellular Toxicology, Stockholm University. He is on leave from his position as Head Research Scientist at Department of Biophysics, Radiation Physics and Ecology, Moscow Engineering Physics Institute, Russia.

Igor Belayaev has an engineering degree in dosimetry and Radiation Physics and is specialized in Radiation biophysics and Genetics. He is the author of invention of the method of anomalous viscosity time dependence (AVTD) and has received various international scientific awards. He is on the editorial board of the international journal "Electro- and Magnetobiology" and a reviewer for several international scientific journals and has published a great number of articles in such journals. His research experience includes cellculture techniques for bacterial and eukaryotic cells, cytogenetic techniques; methods for extraction and analyses of chromatin nucleic acids, proteins, techniques for analysis of gene expression; dosimetry and metrology for inoising radiation and electromagnetic fields.

## Per Dalén

Per Dalén, M.D., Ph.D., is a retired psychiatric consultant and associate professor of psychiatry. Ph.D. thesis 1974 on season of birth in mental disorders, papers on neglected problems in psychiatric genetics and epidemiology. Actively interested in the dental amalgam problem since ten years. This problem is one of the prime examples of how medicine tends to ignore controverisal causal hypotheses and may instead accept scientifically poor psychological explanations in sensitive areas – EHS is another example.

## Jacob Eberhardt

Jacob Eberhardt has an academic background in nuclear physics and environmental medicine. The last ten years he has been specializing in medical radiation physics at the Department of Radiation Physics at the University Hospital of Lund. He developed a special interest in the biological effects and possible health risks of non-ionizing radiation. Together with Bertil Persson and Leif Salford he carried out studies of the influence of pulse modulated RF radiation on brain tumor development and opening of the blood-brain barrier in the rat. Nowadays, his special interest focuses however on studies of reaction mechanisms between low frequency magnetic fields and simplified biological systems.

## Christina Eliasch

Christina Eliasch is Head Medical Officer at the Social Insurance Office of Stockholm county. She was Assistant Prof at the Department of Histology, Karolinska Institute 1959–1961.

She is a specialist in Rehabilitation Medicine, Occupational Medicine and Insurance Medicine and she has participated, as expert in Insurance Medicine, in the Investigations of Electrosensitivity initiated by the National Board of Health and Welfare 1994, and the Swedish Council for Working Life Research 1999–2000.

## Kjell Hansson Mild

Dr Kjell Hansson Mild is Professor at the Swedish National Institute for Working Life and at the Örebro University, where he is doing research on the bioeffects of electromagnetic fields. He has been working with bioeffects of electromagnetic fields since 1976. In the last 5 years the research has been mainly associated with mobile phone use. He has a background in physics and theoretical physics, and presented his thesis in 1974 on problems on cell membrane permeability and the state of water in the cytoplasm. He has published over 200 articles and 170 conference abstracts. He was the first person from Europe to serve on the Board of the Bioelectromagnetics Society and was President from 1995 to 1996. He has also served as associate editor for the journal Bioelectromagnetics during the years 1988 to 1996. He is presently the chairman of the Commission K, of the Svenska Nationalkommittéen för Radiovetenskap, SNRV.

## Per Hedemalm

Per Hedemalm earned a masters degree in engineering physics from Lund Institute of Technology in 1986. Per worked in hardware and systems design in the Ericsson group between 1986 and 1990. From 1990 through 1997 he was active in “design for environment“ of electronic products at the Swedish Institute of Engineering Production (IVF). In 1994–95 he was the project leader of a survey of hazardous substances in electric and electronic products, which was published by the Nordic Council of Ministers. From 1998 he has been active in Orango AB, mainly on various projects minimizing the toxicity of materials and substances in electronic and chemical products.

## Gerd Holmboe

Gerd Holmboe has a BA in biology (photobiology) at Umeå University. In 1979 she became Medical Doctor and has since become a specialist in internal medicin and geriatric cardiology as well as occupational medicine. Gerd Holmboe is medical adviser to FEB, the Swedish Association for the Electrosensitive, in the region of Gävleborg.

## John G Ionescu

Graduated in biochemistry and immunology at the University of Bucharest 1976. 1983 he accomplished his PhD in medical biochemistry at the University of Saarbrucken, Germany and directed until 1985 the research programme of a dermatological clinic in Aschaffaenburg. Main research areas: atopic dieczema, psoriasis, arthritis and the MCS-syndrome. In 1986 John G. Ionescu founded the Special clinic Neukirchen for the treatment of allergic and degenerative deseases according to the principles of the nutritional and environmental medicine. The clinic is fully integrated in the official hospital system and treatment covered by all German and Austrian health insurances.

The original diagnostic and therapeutic approaches of his cortisone-, cytostatic- and radiation-free concept have been reported in more than 100 scientific publications in Europe and USA. His current research involves biological redox systems and free radical reactions in skin, environmental and cancer patients. He is an active member of the European Academy for allergology and Clinical Immunology, of the Bristish Society for Allergy and Environmental Medicine, the American Academy of Environmental Medicine and the Intl Oxidative Medicine Association. Since 1988 John G. Ionescu is Professor for Clinical Biochemistry at the Capital University of Integrative Medicine, Washington D.C.

## Olle Johansson

Olle Johansson, Ph.D., is head of the Experimental Dermatology Unit, Department of Neuroscience at the Karolinska Institute. He wrote his Ph.D. thesis on “Peptide Neurons in the Central and Peripheral Nervous System. Light and Electron Microscopic Studies“. He was appointed assistant professor in neurobiology in 1986 and associate professor in neuroscience in 1991, both at the Karolinska Institute. He was for several years active in the organization of sessions at “The European Conference on Brain Research“ and he is a member of i.a. the European Society for Dermatological Research (ESDR), International Brain Research Organization (IBRO), International Society for Stereology (ISS) and the New York Academy of Sciences. Olle Johansson is the author of more than 450 scientific papers and abstracts and a member of the referee board in several journals.

## Ulf Lindh

Ulf Lindh is Assistant Professor in physical biology at the Science Faculty, and Associate Professor in trace element biology, Uppsala University. He has been declared competent to hold a professorship in radio ecology at the Swedish University of Agricultural Sciences and a professorship in physical biology at the Uppsala University. He is the director of Centre for Metal Biology in Uppsala. Ulf Lindh has several international assignments e.g. as member of “International Advisory Committee for the International Conferences on Nuclear Mocroprobe Technology and Applications“, appointed expert by IAEA for “Applications of accelerator-based nuclear analysis“ and he is a member of “Association of Official Analytical Chemists“, “American Association for the Advancement of Science“ and the “New York Academy of Sciences“.

## Eugene Lyskov

Eugene Lyskov has a PhD in Medicine and Clinical Physiology at the Institute for Experimental Medicine, St Petersburg where he has been a researcher and associate professor till 1990. He has specialized in Clinical Neurophysioology and in 1996 he presented a Doctor's thesis in Medicine at the Institute of Higher Nervous Activity and neurophysiology in Moscow. he has been a guest researcher at the University of Kuopio, Finland and for several years at the National Institute for Working Life, Umeå where he is presently Senior Researcher at the Center for Musculo-Skeleton Research. Since 1995 Eugene Lyskov is also Head of Laboratory at the Institute of Human Brain, St Petersburg.

## Reidar Lövlie

Reidar Lövlie is Professor at the Institute for Solid Earth Physics at the University in Bergen, Norway. He had his PhD in Paleomagnetism in 1972 and has done field work, taught, done research on this subject and related areas in various countries. In 1998 he was made Honorary Pofessor at the Taiyuan University of Technology, China.

He has published more than 80 papers in international peer reviewed journals as well as a great number of scientific reports.

Reidar Lövlie is presently the Vice-chairman of the Inst of solid Earth Physics and chairman of the Geophysical Institute at the University in Bergen. His professional affiliations are a.o. the European Geophysical Society and the American Association for the Advancement of Science.

His research interests include magnetization processes in igneous and sedimentary rocks, design and development of measurement instruments and empirical experiments to assess physiological effects of magnetic fields on the human body.

## Mats-Olof Mattsson

Mats-Olof Mattsson, Ph.D., Associate professor, is a researcher and teacher of Biology at the Department of Natural Sciences, Örebro University, Sweden.

## Christopher Mueller

Christopher Mueller has studied environmental sciences at the ETH Zurich where he presented his diploma thesis at the Institute for Hygiene and Applied Physiology and in 2000 the doctorate thesis "Project nemesis: Non-ionizing elecric and magnetic fields and electrical hypersensitivity in Switzerland".

## Bo Nilsson

Ph.D., M.D., Clinical Chemist at Uddevalla hospital, Uddevalla, Sweden.

## Robert Olin

Robert Olin, M.D., Ph.D., Stockholm, Sweden, is Professor emeritus in Preventive Medicine. During his active years he has worked as a clinician and scientist dealing with issues within Preventive Medicine, Occupational Medicine, Internal Medicine and Epidemiology. For the last 11 years he has been focused on finding explanations to long-term pain and fatigue. On these he has published books and scientific papers, mostly in Swedish. As retired he still – albeit on a part-time basis – receive patients for clinical evaluation and treatments.

## William J Rea

William Rea, M.D., F.A.A.E.M.; Dr. Rea is the founder and director of a highly specialized Dallas-based medical facility, the Environmental Health Center. He is also a practicing thoracic and cardiovascular surgeon. Author of the medical textbook Chemical Sensitivity, Vols., I & IV and he has published more than 100 research papers on related topics. Dr. Rea was named to the world's first professorial chair of environmental medicine at the University of Surrey in Guilford, England. He serves on the board of directors of both the American Academy of Environmental Medicine and the American Environmental Health Foundation. He previously served on the Science Advisory Board for the U. S. Environmental Protection Agency.

## Lars Rönnbäck

Lars Rönnbäck, M.D., has a Ph.D. in histology and is a specialist in Neurology. He has been associate professor and assistant senior physician in neurology at Sahlgrenska University Hospital, Göteborg, and is since 1993 Professor of Neurology at the Medical Faculty, Göteborg. His research activities focuses on development, plasticity and function of the central nervous system. He has done cell physiological studies dealing with the role of astroglia in exitation control in the brain and the role of astroglia in states of opiate intoxication and for the development of epilepsia. During the last years studies have been performed on astroglial-astroglial and astroglial-neuronal Ca2+ signaling. The experimental work now focuses on the role of astroglia in the glutameate transmission with the over all aim to cast light on an hypothesis formulated by Rönnbäck et al, on cellular mechanisms underlying our most usual organic psychosyndrome with decreased capacity for concentration and learning. Lars Rönnbäck is a member of many national and international societies. He acts as a referee in several international journals in neurology, neurobiology and neurochemistry and is often engaged as a referee in international applications for grants for research.

## Monica Sandström

Dr Monica Sandström is a researcher in occupational hygiene, Group for Non-Ionizing Radiation, Department of Technical Hygiene, The National Institute for Working Life, Umeå, Sweden. Since the early 80:ies she has been working in the area of Bioelectromagnetics and published about 50 papers and 70 conference abstracts. She started her work in this area of research with EM field effects on cellular and embryonic level at the Zoophysiological Department at the University of Umeå. During the last 15 years Dr Sandström's work has been focused on direct as well as indirect health effects of EM-fields mainly in the office environment, both at the Occupational Dermatological Department and at the National Institute for Working Life. The title of her thesis "Office work and physical factors – health aspects of EM-field and light" include epidemiological studies of subjective symptoms among VDT workers, a line of research that she has continued but in the RF range. She got in contact with electrical hypersensititvity during her time at the Dermatological Department and has during the last 10 years performed a number of studies mainly with focus on neuro- and physiological responses to different stimuli.

## Berndt Stenberg

Associate professor, dermatologist at University Hospital in Umeå, Sweden. Main research areas are "Indoor environment and health" and "Environmental syndromes".

## Jacques Van Der Straeten

M.D. He has done epidemiological research, as a member of the Environment Cell of the Preventive Medecine Institute (IMP) of the Belgian Société Scientifique de Médecine Générale (SSMG) and theoretical research, as scientific co-worker of the EMIC laboratorium of Prof. André

Vander Vorst (Hyperfréquences, Applied Sciences, Université Catholique de Louvain, Belgium). He is a general practitioner and has a beginning experience of consultative activity for people who complain about “electrosensitivity“ or related problems.

## Peter Wilhelmsson

Peter Wilhelmsson, B.A., M.A., N.D., N.M. His education includes Naturopathic Studies, 1979–1983 at the European College of Natural Medicine, Wetslar, Germany, practitioner training at the Institute of Functional Medicine, Gig Harbour, USA, training and accreditation by A4M as Anti-ageing Practitioner, Chicago, USA. Peter Wilhelmsson is the author of nine books on health issues for the general public. He has had speaking engagements in various countries and is a member of Institute of Functional Medicine, and American Academy of Anti-ageing medicine. He is president of Naturläkarförbundet (The Swedish Ass. of Naturopathic Medicine) and board member of Näringsmedicinska Terapeutförbundet (The Swedish Ass. of Nutritional Medicine). Peter Wilhelmsson is co-founder and co-rector of the Nordic Nutritional and Herbal School, founder and architect of IFM Health Systems – a series of functional medicine clinics – founder and CEO of Alpha Plus, nutritional products distributor to practioners, and President of Scandlab, functional medicine laboratory in Stockholm, Sweden.

## Matti Wirmaneva

An engineer in electronics he has also finished preclinical medical studies at Karto University, Estonia, and done research in micro nutrients and heavy metals. He is presently the chairman of the Association for the Electrohypersensitive in Finland.

## Ulrika Åberg

Medical doctor since 1973, Ulrika Åberg specialized in child- and youth psychiatry and worked in a clinic for this patient group till 1987. Since 1992 she works with patients sensitive to dental amalgam and electromagnetic fields.

## Per-Arne Öckerman

M.D., Ph.D. was appointed Professor and Head Physician at the Department of Clinical Biochemistry, University Hospital, Lund, Sweden 1969. Emeritus in 1998. He has done research in the following areas: Inborn errors of metabolism – Glycogen storage diseases, mannosidosis, which he was first to describe. Carbohydrate biochemistry – Techniques for assay of complex carbohydrates. Nutrition – Vegetarian diets, fasting, trace elements, dietary supplements. Others: Techniques for assay of free radicals. Antioxidant treatment. Publications on this and on chronic fatigue syndrome. He has been a member of scientific committees in a number of international societies in biochemistry and laboratory medicine.

Per-Arne Öckerman has experience of patients with electrical hypersensitivity since 1982 and has an out-patient clinic using analysis of free radicals, antioxidant treatmanet, chelation therapy, etc. Much of his time is devoted to defend patients against those lacking acceptance of electrical hypersensitivity, chronic fatigue syndrome and amalgam disease.

## Karin Öckert

Karin Öckert has practised dentistry since 1964. While practising at her dental office she has had a position at the University of Gothenburg, School of Dentistry, teaching periodontics and prosthodontics until 1984, when she became a specialist in periodontics. The last 12 years she has been devoting her time more and more to patients injured from dental materials and infections. In collaboration with researchers at the Sahlgrenska hospital she has done a study on fibromyalgia

patients treated with detoxification and amalgamremoval. This concept of treatment was a great success for most of the patients. She has written articles about dental intolerance reactions and the danger of rootfilled teeth for systemic health.