Forschungsgemeinschaft Funk e.V.

NEWS letter

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Editorial

The 22nd annual meeting of the Bioelectromagnetics Society (BEMS) was held in June 2000 in Munich. The many premeetings and side events such as meetings and seminars of COST 244bis, EBEA, IEEE SCC28, COMAR, EMF Forschungsverbund (Research Association) Prof. Brinkmann and of the U.S. Air Force Research Laboratory taking place around the annual meeting were a great success.

The articles in this issue of the newsletter published by the Forschungsgemeinschaft Funk e.V., FGF (Research Association for Radio Applications), revolve around the events in Munich, naturally putting the main emphasis on detailed coverage of the BEMS. Further information as usual is available at www.fgf.de/, forum of topics.

Happiness must be earned, as they say; so, many helpers were involved and a lot of work had to be done in order to make sure that the meeting and the social events in the evening went off smoothly. Very important too were the many small favours done to us, as a part of the overall encouragement and support we received from others.

The reward for all the work was the praise and surely heartfelt appreciation we gained from the participants of BEMS and the surrounding events. This appreciation is for all those involved in planning and organising BEMS 2000.

Therefore, in the name of the Research Association for Radio Applications, of the Bioelectromagnetics Society and – as I am very pleased to do – in my own name I would like to express our thanks to all our helpers particularly from the Bavarian State Ministry for State Development and Environmental Affairs, from the Federal Office for Radiation Protection, the Federal Ministry for Economy and Technology, from the Forum Mobilkommunikation, the Siemens AG, the Technical University of Munich, the Volkswagen AG and many, many others.

Regrettably, money always plays a big, big part in organising such an event. The Research Association for Radio Applications was very lucky to gain the support of generous sponsors. Very many thanks to the Siemens AG, the Motorola GmbH, the Bavarian State Ministry for State Development and Environmental Affairs, DeTeMobil Deutsche Telekom MobilNet GmbH, to the Deutsche Telekom AG and the Forum Mobilkommunikation.

Last but not least many thanks to the permanent staff of the FGF and the specifically hired helpers who with their engagement all did contribute to making BEMS 2000 such a huge success.

Gerd Friedrich

Forschungsgemeinschaft Funk

Contents

22nd annual
of the Bioele

by Frank Gollnick

The program of this year's meeting held in the quarters of the Technical University, Munich, in English was divided into 18 lecture sessions, each with several contributions focusing on the following 14 topics:

- Genotoxicity
- Theory, models & mechanisms
- Mobile phones in radio communications
- Cells & tissues
- Dosimetry
- Medical devices
- Exposure assessment
- Clinical applications: Epilepsy
- Electromedicine
- Nervous system & sensory physiology
- Human studies
- Animal studies
- Epidemiology & public policy
- RF Effects on cells & molecules

Besides, there were three main lecture events, two of which were divided into several contributions. In three poster sessions 220 contributions were presented by participating authors. As in precedent years, though, in the lecture sessions American contributors were strongly overrepresentated. Besides, certain working groups presented several contributions during one session, thus hardly helping to achieve the initial aim to discuss matters from all possible scientific angles. Interesting new insights often were hidden in poster presentations receiving less attention because of the abundance of material. But there were also contributions clearly distinguished by form and/or their scanty contents from the otherwise high scientific standard of the meeting. Because of the great number of contributions and the fact that no outstanding new insights into the effects of electromagnetic fields (EMF) on living organisms and their biological substance was reported, in the following we will concentrate on what might be seen as the highlights of the meeting from a scientific point of view.

Genotoxicity

The investigations - partly pilot studies - presented in the lectures on genotoxicity (damaging of genetic material or disorders of connected mechanisms) with one exception referred to the impact of low

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frequency fields resulting from power supply or railway lines.

Positive findings exclusively resulted from relatively strong exposures of cell cultures (Yaguchi et al., Fujimori et al., both Japan) in the range of 50-100 mT or from environments of occupationally exposed persons (Nordenson et al., Sweden; Mashevich et al., Israel). The results are yet to be confirmed statistically.

In a study on human lymphocytes (white blood cells, immune cells) under a frequency and amplitude modulated 1.8 GHz exposure no statistically significant genotoxic effects could be measured (d'Ambrosio et al., Italy).

In this context poster presentations showed only in one single case (of five) an increased mutation rate in a cell culture of genetically altered human malign glioma cells (MO54), again caused by a relatively strong ELF field (60 Hz, 5 mT; Ding et al., China & Japan).

In another cell culture of mouse the transformations (cancerigenous alterations) caused by x-rays even were suppressed or reduced by a six-week exposure to an ELF-MF (5-400 mT; Fujimori et al., Japan & China). A 15 min unpulsed 1.748 GHz field exposure (SAR value, i.e. Specific Absorption Rate: 2 mW/g) applied in a further study showed no genotoxic effect on isolated human lymphocytes (see above; d'Ambrosio et al., Italy).

Theory, models and interaction mechanisms

During the discussion of theory, models and interaction mechanisms regarding potential field impacts on biological systems besides concrete knowledge there were also presented highly hypothetical contributions, again mainly concerning the area of low frequency fields.

In this context Blank & Soo (USA) introduced new studies on the 'moving charge interaction (MCI) model' which claims an interaction between electromagnetic fields and electrons moving within molecule chains. During in vitro studies the scientists claim to have observed an acceleration (10%) of an oscillating redox reaction at an exposure to magnetic fields (60 Hz, 10 µT (!)). According to the scientists, this result quantitatively corresponds to the alteration (increase) of observed enzyme (i.e. catalyzed by certain albumen) reactions under exposure to EMF. Based upon these observations Blank & Soo presented the possible impact of electromagnetic fields on DNA and/or the introduction of DNA transcription processes (reading of genetic information). This contribution led to animated discussions among the audience.

Subsequently, Walleczek & Carson (USA) presented the results of an in vitro study aimed to confirm the significance of the 'radical pair mechanism' as a possible mechanism of the impact of magnetic fields on biological systems. At an exposure to direct magnetic fields (1-100 mT) also used in magnetic field therapy, a significant alteration of the oscillation activity of the peroxidase/oxidase/enzyme system has been observed. This could indeed be interpreted as a confirmation of the scientists' assumption that complex enzyme systems show a highly sensitive reaction to alterations of the magnetic field.

Weaver & Vaughan (USA) suggested a new theoretical approach that may provide higher reliabiliy in demonstrating the actual occurrence of weak field effects during in vitro and in vivo experiments by means of an improved differentiation of interferences during evaluation (differentiated observation of the signal-to-noise ratio).

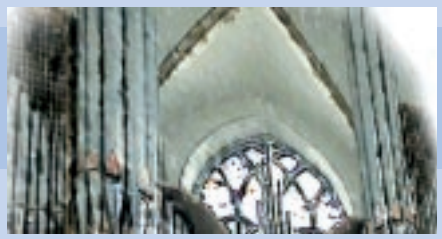
Based upon an in vitro study Pernodet et al. (USA) suggested that the extracellular albumen fibronectin necessary for cell adhesion with its matrix formation and adhesion behaviour may be the target of possible damaging field effects. Yet, appropriate experiments regarding induced surface charges under exposure are still to be developed.

Polk (USA) presented interesting calculations concerning effects of direct and ELF fields as well as temperature effects of high frequency fields in the molecular level of DNA. In his view, sudden

Agenda

of the 22nd annual meeting of the Bioelectromagnetics Society

main events	side events
Friday 06-09	
IEEE SCC28 Meeting	
Saturday 06-10	
IEEE SCC28 Meeting	
COST 244bis Workshop	COST reception at the Hofbräuhaus
COMAR Meeting	
Sunday 06-11	
US Air Force Workshop	COST Premountaineering Tour
EBEA Council Meeting	
Monday 06-12	
BEMS lectures	reception at the Deutsches Museum hangar Oberschleißheim
Tuesday 06-13	
BEMS lectures	reception of the mayor in the Altes Rathaus
Wednesday 06-14	
BEMS lectures	
Colloquium honoring Prof. Brinkmann	guided tour of the Residenzmuseum
Thursday 06-15	
BEMS lectures	organ recital at the cathedral „Unserer lieben Frau“ with Prof. Franz Lehrndorfer
Friday 06-16	
BEMS lectures	
panel discussion	
press conference	



temperature rises in the DNA molecule caused by quite high field strengths could lead to alterations of the molecular structure and to string breaks, as were observed, though less often, by Lai & Singh (1995) at a SAR value of 1.2 W/kg.

Vistnes & Gjötterud (Norway) assessed the photon density of visible light compared to 50 Hz and/or 60 Hz fields of power lines. They concluded that the common view of ELF fields of high voltage lines as photons (as in light quanta) can lead to massive errors regarding the assessment of their possible impact. Assessments of 50 Hz and/or 60 Hz electric and magnetic fields therefore should only be made on the basis of classical electrodynamic fields.

Liboff (USA) did not find any physical evidence in theoretical approaches concerning the impact of devices for permanent magnet therapy on cells and tissue which might explain an actual effectivity. The assessed physical powers at the site of obscure effects in all cases were much too weak.

Out of eight poster presentations on this topic one particular contribution that dealt with a theoretical model on the impact of high frequency fields is worth mentioning: Bruna et al. (Italy) introduced a new approach that could provide an explanation of the impact of weak HF fields on living cells through the influence on ion binding in its specific membrane channels as well as the influence on channel behaviour itself. As a model system served calcium-activated calium channels responsible for neuronal excitation, particularly considering the binding behaviour of calcium ions at the regulatory albumen calmodulin. In conclusion, the meeting did not bring forth fundamentally new aspects of possible interaction mechanisms.

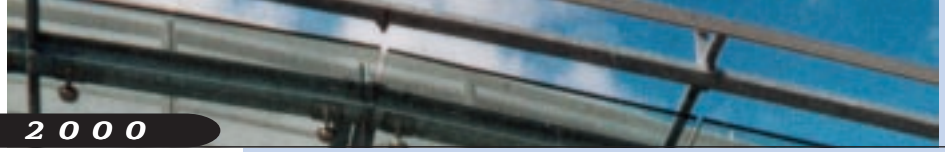
Mobile phone devices and telecommunications

Sessions and poster presentations on mobile phone devices and telecommunications focused on various topics, the center of attention being the area of dosimetry. Kubacki et al. (Poland) and Conover et al. (USA) concluded from their investigations that the protection of workers in radio transmission and radar stations could be further improved if the actual dose of the exposure in the HF field could be determined more precisely by refined methods (in-detail monitoring of intensity and temporal summarisation as well as measuring of induced body currents, particularly in the vicinity of metal structures).

Neubauer (Austria) and Cooper et al. (Germany) presented freeland and/or laboratory measurements concerning security distances to antennas of mobile radio base stations (GSM 900 and DCS 1800 standards). All measurements made in the vicinity of base stations lay far below ICNIRP guidelines limit values of 1998 (maximum measured value: 3.3% of limit value); only eight out of 202 measurement values lay above 1 mW/m². The German measurements were made at a human whole body phantom filled with liquid in front of a typical D net base station antenna (Urban 120). After calculations of the SAR value the resulting data were compared to ICNIRP limit values for different environments (see below). Accordingly, limit values are only exceeded when a person approaches the antenna of the mentioned type up to a distance of 6 cm, 50 cm or 65 cm (exposure at workplace, general population at part or whole body exposure).

Animal experiments of Anane et al. (France) on experimentally neurodegenerated (brain damaged) rats exposed in narrow tubes (GSM 900, 1-4 W/kg local SAR value at the head, for 21 days, 2 h per day) did not show any significant field effect concerning the course of the artificially induced illness (encephalomyelitis) in exposed versus non-exposed animals. The experimentally induced encephalomyelitis is a model for autoimmune reactions in the brain due to multiple sclerosis.

A much discussed contribution of Goodman & Blank (USA) showed that in a standard cancer cell culture („HeLa“ cells) stress proteins are induced by low frequency fields (pulsed frequencies of mobile radio stations; down to 0.8 µT !) at initial energies lying 14 tenth powers below the cases where the energy is induced by heating. As the currently valid limit values all are based upon resilience limits of biological systems through heating, the authors demand a comprehensive review of existing security standards in the area of mobile radio. However, the high



actuality of the topic claimed by the two authors seems doubtful: The results obtained from the used cancer cell culture can not automatically be applied to health relevant aspects in humans. The pulsed frequencies of mobile radio applied in nearly „homeopathic“ energy doses in experiments obviously were simulated rather quickly with a Helmholtz spindle. Until now no other investigation did find effects resulting from such low field strenghts. For a more thorough assessment of the study we have to wait for the printed version soon to be published in the „Journal of Cellular Biochemistry“ (Jin, Blank & Goodman). The very low field strenghts applied in the experiments led to critical observations regarding the results in the plenum.

Dale et al. (France) did measurements and calculations at homogeneous and inhomogeneous head models (phantoms). They found that the average SAR value depends rather from differences in the conductivity of the tissue simulating liquid than from various dielectric properties. Besides, it is important to ensure that the model's ears show the appropriate tissue qualities - a problem dealt with in more detail in the poster presentation of Kanda et al. (USA). They conclude that it is not important concerning the SAR value whether the auditory canal is filled with air or liquid. Increased SAR values can be found at the edge, the seams and the folds of the auricle and the auditory canal.

A contribution of Kainz et al. (Austria) came to the result that GSM 900 or GSM 1800 signals did not interfere tested implantable neurological pulse generators. Such brain pacemakers are mainly used in the treatment of Parkinson patients in order to send aimed pulses to certain brain regions. The measurements were made at models of the human body.

Opening Address for
of the Bioe

by undersecretary Christa Stewens

On behalf of the Bavarian Ministry for Regional Development and Environmental Affairs I would like to welcome all of you to the twenty-second annual meeting of the Bioelectromagnetics Society.

I am pleased to see that so many international experts decided to attend this congress at the Technical University of Munich. The abstract book shows an impressive number of more than 300 contributors among them quite a few from Germany and also from bavarian research facilities and universities.

We are all witnesses to the evolution of an industrialized society into the information age. Around us more and more new technologies are spreading.

Many of these more or less depend on the use of electricity or electromagnetic fields. The latest developments and gadgets are currently on display at the World Exposition in Hannover.

The gadgets of yesterday are now the companions of daily life: Our kitchen is full of electrical appliances. Mobile phones are no longer a symbol of status for the happy few but widely used even by schoolchildren. Surfing the internet has become a modern pastime.

With the increasing use of electricity and electromagnetic fields the concerns about possible risks have also been growing. During the last 20 years the influence of non-ionizing radiation on men, animals and the environment is discussed widely. The fast spreading of the mobile telephones and base stations in many countries now leads to a new surge of controversies. In the public such debates often are very emotional.

But scientists also do not always agree on what is to be deduced from their results. This again leads to even more controversies in the public debate.

Certainly it is not always possible to give simple answers. However the public and we politicians would prefer a simple „yes“ or „no“ when asking questions to a scientist. In the public debate the statement: „More research is needed“ more often than not is misinterpreted as an evasive answer. How can we ever feel safe when more research is needed?

We have to learn to look at a more complex picture without running away and being frightened because there is no easy answer.

This also implies that one has to trust in those who interpret the picture for us. And trust is something which seems to get lost continually. In public hearings or in letters I receive I often witness this loss of trust: for example very often I hear or read the opinion that there are only two types of scientists: the so-called critical scientists

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on the one hand and the scientists whose opinions may be bought on the other.

I believe that this is quite wrong. Being a good scientist necessarily implies doing quality research work and being very critical. Of course, research is expensive and has to be paid for. However maintaining a good reputation in the scientific community is only possible if one is dedicated to the work and not to the grant giving side. Therefore scientific societies are very important institutions. They are a platform for presenting and for refereeing scientific work.

The Bioelectromagnetics Society is a highly renowned scientific organization whose members are involved in research on interaction mechanisms of non-ionizing radiation. The annual meeting and of course the monthly journal of the BEMS are not only important to present and exchange new results and experiences, they also serve to ascertain that the quality of research work is maintained. Only results of high quality can be used as a basis for public health recommendations. But I want to illustrate that this is not enough:

In Germany we do have an ordinance regulating the exposure of the public due to electromagnetic fields. This ordinance follows the recommendations of the World Health Organisation and the International Commisison on Non-Ionizing Radiation Protection. Both organisations use scientific results as their basis for recommendations.

However at the moment several public groups argue, and do so quite loudly, that the regulations don't give enough protection. Obviously their risk perception is different.

So here comes the difficult part: How can we reassure a publics, not trusting in science, probabilities and the scientific process of forming opinions? A public believing that most science is paid for by industry and therefore not trustworthy. A public also assuming that politicians give high priority to technical development and therefore disregard health problems?

Obviously, communication among scientists, governments, industry and the public has not been effective and therefore leads to these problems. I can only see a solution when we all together, scientists, politicians and industry engage in the public debate. Trust and credibility have to be regained and maintained.

In a democratic society everyone has the right to know what is going on. Information campaigns are necessary to help the public better understand what may be affecting them. Also cooperative models with commitments of State and Industry are helpful to reach goals beyond existing regulations. One of these models is used in Bavaria with quite some success, it is called „Environmental Pact".

A dialogue has to be established so that both sides learn more about the reasons why public perceptions of risks are so different, why there is a loss of trust. This is a major task for all of us.

In order to underline this conclusion, I would like to draw your attention to the last day of this meeting, to next Friday afternoon. Then there will actually be such a dialogue with the public: Some of you scientists agreed to summarize the results and trends presented at this meeting in simple words for the public, a German translation will be available and later on a panel discussion will take place. This is an opportunity I am really looking forward to.

Until then I want to wish all of you a week of successful presentations, fruitful discussions and many ideas to take home to your labs.

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credibility

Poster presentations on the topic „Mobile radio devices and telecommunications" introduced quite a few studies showing how the calculation or computerised „modelling" of low frequency fields' energy actually absorbed by body tissue (SAR value) may be further improved. Body shape as well as the position of the transmission devices and other conditions of basic tests were considered. In addition, new developments and methods regarding exposure setups were presented. For example, Schüler et al. (Germany, Switzerland) made a suggestion for a general test signal improving simulation of actual mobile phoning in experiments. Contrary to present use, different transmission elements of mobile phones and base stations were examined under exposure to a mixture of pulsed frequencies. The test signal has already been applied by investigators in Germany (see below).

In a study on rats (exposed in narrow tubes) Lagroye et al. (France) at 900 MHz (1-4 W/kg local SAR value at the head, 2 h exposure) did not find any DNA damages in the brain tissue of the exposed animals. The tissue was examined with the same technology already used by Lai & Singh (1995, 1996) who at similar experiments applying pulsed microwaves (2450 MHz) did find a damaging effect.

Preliminary results of a Finnish working group (Heikkinen et al.) showed no effect of one-year exposure of mice to mobile radio frequencies on the development of artificially induced tumors. A 902.4 MHz GSM signal (217 Hz pulsed) and a 849 MHz signal of the DAMPS standard (50 Hz pulsed) were applied at an exposure of 1.5 hours per day and 5 days per week. The examined skin tumors were induced by UV radiation in normal mice and in mice with a certain metabolism deficiency.

Krafczyk et al. (Germany) did not find any alterations of the electric brain activity (waking EEG and so-called 'visually evoked potentials', VEP, produced during the test through stimulation of the eyes with light) in 39 healthy study subjects during the use of commercial mobile phones. The tested objects were a mobile car phone (8 W), a D net mobile phone (2 W) and a E net mobile phone (1 W transmission power).

The brain can be a main target for the damaging activity of so-called 'free radicals' (particularly aggressive oxidative bindings in cells), since the brain cell membranes are abounding with polyunsaturated fatty acids. A part of the fields emitted by mobile phones 'hit' the brain substance. Therefore, Anane et al. (France) examined the impact of an exposure to mobile radio (GSM 900, 1-4 W/kg local SAR value in the head, applied for 7 days, 2 h per day) in 40 rats held in narrow tubes. The oxidation index (extent of oxygen bonding, i.e. oxidative damaging) of the fats from the rats' brain substance, was evaluated. There were no differences shown between exposed and non-exposed animals.

A poster of Veyret & Wiart (France) presented the French research program COMOBIO, an association of 15 research groups cooperating in eight research projects. The intention is to fill knowledge gaps which are not/or not sufficiently considered by other current large-scale projects as the EMF Project of WHO and the 5th European Framework Program. COMOBIO combines dosimetric studies and studies on humans (particularly the effects on hearing) with animal studies, all with the exception of cancer diseases. Final results will be available in 2002.

An independent replication study of Utteridge et al. (Australia) following the cancer study of Repacholi et al. that met with a lot of attention in 1997 because of its positive findings was presented focusing on improved methods. 1540 mice of the same type and from the same supplier as in Repacholi et al. were examined at four different exposure levels (instead of one). Further, for the benefit of an improved assessment of the interacting field the animals were not exposed in cages but each individually in tubes. The result will be available at the end of 2001.

Cells and tissue

At the start of the sessions on 'Cells and tissues' an American research group (Henderson et al.) presented their results concerning the impact of EMF on signaling pathways within the cell. Accordingly, 60 Hz magnetic fields (100 µT, applied up to 24 h) can have a similar influence on the growth behaviour (cell maturing process, so-called 'differentiation') of leukemia cells (cell culture HL-60) as the known tumor promoter TPA (tetradecanoyl phorbol acetate). Parts of the TPA signaling pathway are already known. The investigation was aimed to demonstrate at which sites the signaling pathway, influenced by the magnetic field, agrees with and/or differs from the TPA channel. It was shown that the magnetic fields activate a certain metabolism channel. Thus, the authors are convinced that there are complementing effects of magnetic field and TPA. Based upon their results, they do not exclude that the two different stimuli have an influence on different metabolism channels, but in the end cause the same effect. Thus, signal transduction channels in cells again are a possible focus of field effects.

In the same cell stem Sontag (Germany) observed the impact of 'interferential currents' on the chemically stimulated release of the neurotransmitter cAMP

within the cells. There cAMP has a crucial transmission function. 'Interferential currents' emerge through an overlapping of two alternating currents of slight frequency differences. 4 kHz currents with frequency differences from 0-50 Hz (power density: 8.5-2500 µA/cm², exposure: 5-15 min) are used. The interferential current led to an additional increase of the cAMP release, though only as a window effect at average chemical stimulation (maximum effect at 250 µA/cm² for 10 min). Other window effects were observed at interferential frequencies of 15 Hz and 32 Hz. The decomposing metabolism channel of the neurotransmitter was not influenced. The study confirmed earlier evidence for 'window effects' with maximum response at an impact on signaling pathways in cells by weak fields. In another lecture of Gottwald et al. (Germany) from the same research group such effects at the molecular level using material from cardiac cells, however, could not be confirmed.

Macrophages (white blood cells, important immune cells) of the mouse were examined by Simkó et al. (Germany) regarding the phagocytosis rate (absorption of smallest latex particles as a model for the destruction of bacteria) and the internal production of 'free radicals' (see above). The impact of a 50 Hz magnetic field (0.5-1.5 mT; 45 min-4 h) was tested. The phagocytosis rate was dose relationally increased by the field impact (as in a immune response), whereas the development of free radicals showed as good as no influence. The increase of the phagocytosis rate at a magnetic flux density of 1 mT was equivalent to the impact of 1 nmol/l TPA (see above) which activates a certain metabolism signaling pathway via the enzyme protein kinase C. The simultaneous appliance of magnetic field and TPA did not lead to a further increase of the effect. Thus, the authors excluded a field impact on protein kinase C.

Sisken et al. (USA) identified effects of a static magnetic field (22.5-90 mT, 1 h/day for two days) on the outgrowth of in laboratory cultivated nerve cells isolated from chick embryos. The growth was significantly increased at 45 mT and 90 mT, though only in combination with 10 ng/ml NGF (Nerve Growth Factor, a substance necessary for the normal growth of such nerve cells). The addition of NGF alone without the magnetic field led to a relatively small growth.

During an examination of mimosa Nimtz et al. (Germany) identified alterations by needle electrodes of the so-called action potential of the plants (AP, internal electrical excitation for stimulus conduction) when treated with electromagnetic fields of a mobile radio frequency (1.87 GHz, 217 Hz frequency modulated, 10 mW/cm²) in the non-thermal field strength range. At the known touch response of mimosa leaves the relatively slow stimulus conduction (1 cm/s) - similar to and based upon in principle analogous processes in animals and humans - may be shown by means of an electrical record. 300 measurements in 27 plants at field exposure resulted in a small (5%) decrease of the action potential at the beginning of its formation, not at conduction. Because of the very small effect and the obviously inaccurately applied measurement method the drawn conclusions were fiercely criticized by experts in the plenum.

Khizhnyak et al. (Russia, USA) could prove skin alterations in anestethized genetically altered mice (BALB/C) following an exposure of 5x5 mm skin areas to mm-waves (42.25 GHz, 40 mW/cm², 15 min exposure). These alterations ranged from vasodilatation and infiltration by immune cells to changes within skin cells or even cellular death. The strongest alterations within the cells occurred in the vicinity of the sweat glands, though they very nearly receded after 48 hours. The applied radiation strength was equivalent to power peaks that can occur during application of microwave therapy devices. According to the authors, it is possible that the observed effects can also trigger whole body responses.

The ability of human immune cells (white blood cells, here T-lymphocytes and

general population	**epidemiological studies** search for effects of high frequency electromagnetic fields based upon a great number of subjects
Individual	**animal studies** Does a controlled use of a certain factor (f.e. an electromagnetic field) trigger a measurable response in the body?
cells and tissues	**cellbiological studies** Can electromagnetic fields have an impact on cell behaviour?
moleculs	**biochemical and bio-molecular studies** Can biochemical responses or molecular structures be influenced by electromagnetic fields?

monocytes) to contribute to a immune response under the influence of radar was examined by Stankiewicz et al. (Poland) (1300 MHz, not pulsed or 330 Hz pulsed, 10 W/m², 1 h exposure). The cells were isolated from freshly extracted blood. The average SAR value was 2 W/kg. The evaluation of a series of various immune tests following radiation generally showed an increased response activity of the cells being stronger in the pulse modulated field than at exposure to the unpulsed field.

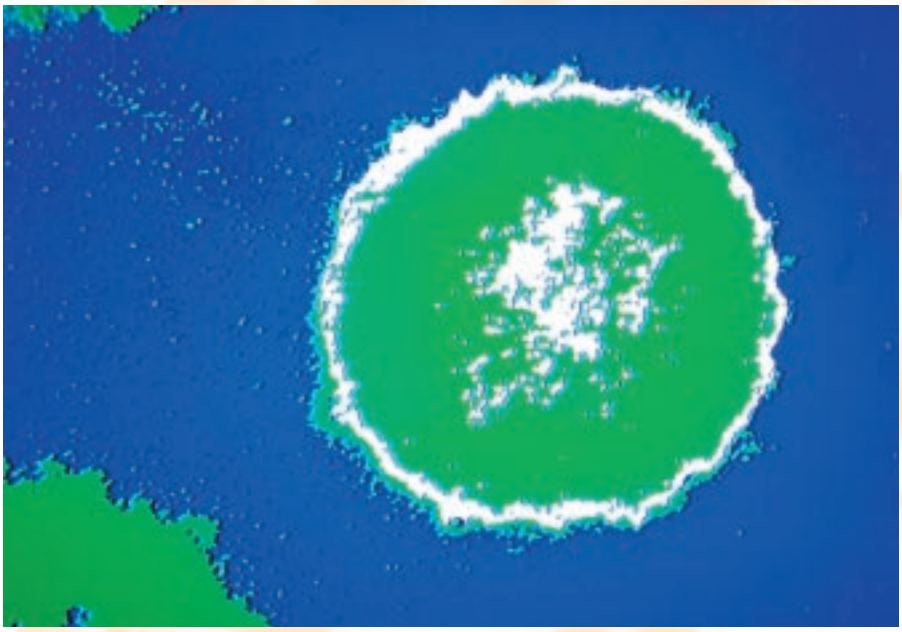
Three other studies (Fitzsimmons & Dillman, USA; Nerucci et al., USA, Germany; Supronowicz et al., USA) searched for the biological fundaments of improved bone fracture healing through magnetic field therapy devices. In cell cultures of bone and cartilage cells exposed to low frequency fields produced by corresponding therapy devices an increased formation rate of differentiated (i.e. fully developed) bone cells was measured. The second study provided evidence of an increased production of proteoglycans which are important for the stability and the mechanical properties of the joint cartilage. The third research group mentioned above also reported a significantly increased depositing of calcium (the basic stabilizing substance of the bones) in the cell intervals.

In the following, we will refer only to a small selection out of over 50 poster presentations on the topic 'Cells and tissues': Concerning assumptions that there is an increased brain tumor risk near high voltage powerlines Sekijima et al. (Japan) examined whether the expression of certain genes (actual reading/use of available genetic information) in brain cells is altered by a 60 Hz magnetic field (500 µT, 0.5-3 h exposed). Since no alterations caused by the field are identifiable, a possible promotion of brain tumors at this - intentionally selected - lower, highly sensitive level of potential stimulus responses can be excluded.

Gollnick et al. (Germany) found no hint of an altered calcium metabolism at exposure to mobile radio fields in pinealocytes (cells from the pineal gland which produce melatonin) taken from hamsters and in retinoblastoma cells (culture of cells of the human retina). Calcium signals (i.e. short concentration peaks) cause many different reactions in cells which - excited at the wrong time - possibly may lead to damaging consequences. Both weak and strong fields (900 MHz with SAR values of 0.08 and 24 W/kg; 1.8 GHz with SAR values of 0.08 and 24 w/kg) were pulsed with a frequency mixture simulating the conditions of mobile phoning more realistically than ever (see above, Schüller et al.). Measurements were taken before, during and after a 9 min exposure.

Weak field effects on the calcium metabolism that show only with the application of a certain statistical test method were demonstrated by Schubert & Glaser, Habel et al. and Haberland & Glaser (all Germany) in different human cell cultures (bone cells, white blood cells) at carrier frequencies in the kHz range or up to 150 MHz (frequency modulated and unmodulated). Various limitations of the reliability of results were discussed. In the range up to 200 kHz strong electric field components (100 V/m) were the centre of attention.

In two contributions Lerchl et al. (Germany) demonstrated effects of a pulsed police radio frequency (383 MHz, TETRA standard) planned for the future as well as a mobile radio frequency (900 MHz spectrum: mobile radio similar frequency mixture, see above) on young conifers and on corn seedlings. In one of three conifer types an increased growth during field exposure and disadvantageous alterations in the distribution of two leaf dyes (clorophyll a and b; leads to reduced light use) were reported. The corn seeedlings grow faster at both tested frequencies. Temperature effects are thought to be



unlikely by the authors, though the ground temperature during field exposure increased by 1-2 C°. Until now, leaf temperature has not been measured.

Winters et al. (Germany) found an increased permeability in a petri dish model of the so-called blood/brain barrier after being exposed to fields of the mobile phone E net (1.8 GHz, 217 Hz pulsed) over a period of 4 days (average SAR value: 0.3 W/kg). However, the barrier function of the used model anyway weakened in due time to a certain extent; the permeability was only relatively increased by the field. Further, the size of the sample (i.e. the statistical relevance) was very small. The blood/brain barrier provides a particularly stable 'wall lining' of the blood vessels in the human brain preventing damaging materials in blood from penetrating into the brain cells.

A genetically changed bacteria culture of salmonellae exposed to a 2.45 GHz field (8 mW/cm²) was examined by Perrin et al. (France). The field was applied for 17 hours during growth phase and/or for 1.5 hours during the following treatment of the culture with a mutagen (substance causing genetic alterations). The aim was to examine whether the mutation rate caused by the mutagen increases through the impact of the high frequency field. However, no statistically significant increase was identified.

The effect of a new high frequency signal used by the military ('pulsed ultrawide band signal', UWB) on cell cultures of human connective tissue cells (fibroblasts) and cultures of cells of the eye lens (corneal cells) of the rabbit was examined by Hambrook et al. (England). Through different tests (for example measurings of the membrane heat shock protein HSP 70) carried out one and two days after a three-hour UWB exposure (5.4 kV/m peak field strength; 2.17 kHz pulsation) the viability of the cells was explored. The result showed that the radition has no influence on cell density and other parameters in both cell types.

In examining lymphocytes (see above) from the blood of healthy study subjects exposed to a sinusoidal 8 Hz magnetic field (21 µT) Belyaev et al. (Sweden, Russia) measured statistically weak effects regarding two of three examined cell properties, mainly the internal organisation (morphology) of the cells, and, to a smaller extent, DNA fragmentation. For positive control gamma radiation and heat were used.

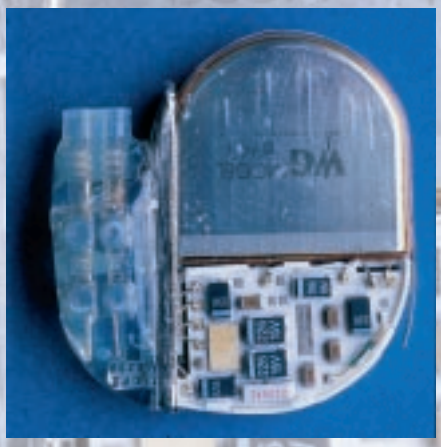
The possibility to stimulate the activity of lymphocytes (see above) in rats exposed to a 50 Hz magnetic field (100 µT) for two weeks before extracting a blood sample was examined by Gollnick et al. (Germany) comparing an exposed group with a control group. Response rate and strength of the cellular calcium metabolism after being activated through induction of the mitogenic stimulus Concanavalin A (a substance that stimulates cell division) were observed. In general, a calcium signal in cells initiates the cell division process. The strength of response in both groups statistically showed no significant difference. However, approximately twice as many cells in the group of exposed animals (16,9%) did not react to the mitogenic stimulus compared with 7,7% of the cells in non-exposed animals. This could be interpreted as a certain weakening of the immune system by field exposure, though the small number of examined animals did not fully support this conclusion.

Cultivated human brain tumor cells (neuroblastoma, LAN-5) also showed a response to a 50 Hz magnetic field (2 mT, exposed for 5 days; Pozzi et al., Italy): The cell division rate decreased by 30%; further, an increased cell maturing ('differentiation') and an increased growth of cell runners were observed preceded by significant alterations of the internal organisation (morphology) of the cells.

Regarding damaging effects on prenatal development Guan et al. (Switzerland, Germany) examined cultures of non-developed embryonic cells exposed to a field of 1.71 GHz (217 Hz pulsed, SAR value: 2 W/kg, 22 or 40 h exposure in the rhythm 5 min 'on', 30 min 'off'). Assumed effects on a number of observed parameters such as cell maturing behaviour, duration of cell division cycles und genetic expression (see above) of important indicator genes were not confirmed.

Dosimetry / Exposure assessment

The topic 'dosimetry' was the focus of a session complemented by two lecture series on 'Exposure assessment'. Two contributions referred to the dosimetry of static magnetic fields (Engström et al., USA; Muehsam & Pilla, USA) connecting their effects with following phenomena: the activating of action potentials (see above), alterations of cell size, epilepsy and pain treatment. As field effects often do not occur at maximum field strength or field gradient sites, the first contribution dealt with a theoretical model forwarding a more precise determination of field site characteristics. This method is also claimed to be a reliable tool to assess magnetic field gradients based upon measurement data or numeric models regarding data with high interference factor. The second research team mentioned above presented a theoretical interaction model which allows to draw conclusions on bioeffects caused by static magnetic fields that occur in connection with ion ligand bindings



(ligands = electrically charged binding sites for ions). A saturation effect is claimed to occur in clinical applications at increasing field strength and prolonged treatment.

Ardoino et al. (Italy) presented a TEM cell for in vitro and in vivo exposure at 900 MHz enabling scientists to control temperature and CO_2 and meeting a number of conditions under which different living organisms can be examined at a highly homogeneous field distribution. At in vivo experiments the cell for example allows a simultaneous exposure of four mice under identical field conditions. The rest of the contributions dealt with new refined or updated calculations and computer models on thermal effects, SAR values, dielectric properties of tissues and permeability/ conductivity of the body tissue in respect to certain waveforms.

During the two sessions on 'Exposure assessment' new exposure chambers were introduced, too: A waveguide chamber designed for simultaneous exposure of 25 severely restrained mice at 900 MHz (Puranen et al., Finland), a horn chamber with a parallel plate system providing a simultaneous and uniform (±3 dB) exposure of non-restrained rodents in 18 standard cages at 1.6 GHz (Wilson et al., USA) as well as a horizontal radial waveguide with cages for the exposure of various non-restrained rodents (for example 48 rats simultaneously) at the boundaries of the setup at frequencies around 900 MHz (in rats 13% field variation inside the cages; Bitz et al., Germany). Further, two contributions introduced new measurements of field strain of strongly exposed workers in electric plants (Bracken et al., Bowman et al., both USA).

A highly interesting thesis of Fews et al. (England; Int. J. Rad. Biol. 75, 1523-1531, 1999) which is already available in print was amplified by adding more detailed data in the corresponding lecture. According to this thesis, electrically charged particles of harmful substances in the air below high voltage lines are responsible for as yet doubtful and unsolved hints of increased cancer rates in children living in the vicinity of such lines. As we know, cancer in children may be caused by air pollution from traffic. This means that fields emitted by high voltage lines over 100 kV (around 100 V/m) would not - as is often suggested, but not fully confirmed - have a direct influence on humans, but instead through the charging (and thus concentration) of pollutants in the air. This effect would only be observed downwind (not upwind) in areas up to 200-500 m from the lines. Since until now only electrical measurements concerning air charging are available, the mentioned conclusions are still hypothetical.

Based upon their measurements in the USA, Kavet et al. (USA) suggested that contact currents (for example via metal cases of grounded appliances or water fittings) in the domestic environment may provide a lacking link of the chain of proof for a connection between the influence of powerlines and child leukemia.

In a theoretical study Kotnik & Miklavcic (Slovenia, France) demonstrated that in experiments with cell cultures exposed to the MHz and GHz range the power loss of the fields in the cell membrane can surmount the value measured in surrounding culture fluid by a hundred times. This means that in spite of the lacking evidence of heating of the whole system we can not exclude effects in the microscopic dimensions of cell membranes. However, these calculations lack conviction in so far as the layered molecular structure of the membranes was not taken into consideration.

A noteworthy contribution (Hamnerius & Uddmar, Sweden) dealt with measurements of high frequency fields (30-2000 MHz in 8 technically used bands from TV to mobile radio) at 26 sites in Sweden. The highest measured power flux density was 3 mW/m² in urban areas (mainly 900 MHz mobile radio). The average value for all measurement sites (urban and rural areas) amounted to 0.5 mW/m², for the city to 0.8 mW/m², for rural areas to 0.0016 mW/m² and inside buildings (average value urban and rural areas) to 0.0055 mW/m². In comparison, in 1978 an average value of 0.05 mW/m² was measured in 50 US cities, i.e. a value 16 times smaller for cities than in the current study. The emissions mainly (47% in all areas, 61% in cities) came from 900 MHz mobile radio base stations, with the exception of rural areas (48% TV stations). The highest measured power flux density at all still lay a thousand times below recommended limit values.

The over 30 poster presentations on this topic contained measurement data concerning the exposure of the general population and of workers to low frequency and high frequency fields. Van der Plas et al., for example, presented a survey on relevant sources of low frequency and high frequency emissions in the Netherlands comparing exposure strengths with valid limit values.

A survey from Korea (Kim & Cho) compared measurements of 60 Hz magnetic

fields for 55 occupationally exposed persons and for 50 not occupationally exposed persons. The result shows that persons in the occupational environment are exposed to higher magnetic field strengths. Field strengths in households lay between 0.03 and 0.17 µT, the average value of outdoor areas (without occupational exposure) lay below 0.1 µT.

Schüz et al. (Germany) presented the results of the residential measurements promoted by the German Ministry for the Environment as a part of an ongoing demographic studies on child leukemia in connection with low frequency field exposure (50 Hz electricity system power and 16 2/3 Hz railway system power). 1841 (out of 1900) evaluated 24-hour measurements (50 Hz) made in the rooms of affected children and of a control group showed an average value of more than 0,2 µT only in 1.5% of the cases. 50% of the residences had an average value below 0.03 µT, 95% of the households lay below 0.12 µT. The highest measured 24-hours average value was 0.73 µT. At night the values did not lie significantly below daytime emissions. There was a certain tendency to higher values in houses with more inhabitants and in streets with much traffic. Compared to the United States and Canada German values were significantly lower. The connection of these data with the case-control study on child leukemia is currently made (see below). Here, only the relatively small number of cases with an average household value of 0.2 µT were taken into consideration. This treshold value was established before the start of the study.

Two contributions from Finland (Kantell et al., Kotiniitty et al.) presented results and methods for measuring electric and magnetic field strengths in various environments (households, outdoor and working areas). In no area valid limit values were exceeded. Extreme industrial working areas (for example in the vicinity of arc furnaces), however, were not considered.

Further, following posters were presented: measurements of induced currents from whole body exposure of different polarisation, suggestions for new appliances designed for experimental exposure or for exposure measurements, new calibration methods for such appliances as well as measurements of the impact of high frequency fields on cardiac pacemakers. In this context a study of Geisbusch et al. (Germany) should be mentioned exploring disturbing effects on cardiac pacemakers (assuming a worst case scenario) through coupling of high frequency fields (in the range of 50 MHz-500 MHz) with the pacemaker's electrode. The electrode can operate like an antenna in respect to disturbing fields. Results were obtained via field measurements at models and elaborate computations. Distant field conditions showed distinct resonant phenomena (i.e. a possible interference depending on the distance/power of the transmitter) in the frequency range around 80 MHz (range of radio and TV transmission frequencies). Under near field conditions the interference was less distinct. No electrode type was identified posing a particular hazard. As the contributions on dosimetry often were highly abstract, we will not discuss them in detail. Poster presentations on improved calculation or testing methods aimed to obtain exact data on the impact of fields of various frequencies on biological material prevailed. Next to mobile radio frequencies security systems (kHz/MHz range, Chadwick, England), static magnetic fields (Pilla, USA), radar frequencies (Kubacki et al., Poland) and low frequency fields (Gobba et al., Italy) played an important role.

Gajsek et al.(USA) dealt in detail with dielectricity constants of different tissues needed for the calculation of SAR values. Klar et al. (Germany) developed a new very fast SAR testing system to obtain data on high frequency fields inside homogeneous body models in connection with security limit values.

Nervous system & sensory physiology

Here, at first an impact of pulsed low frequent magnetic fields on the human vestibular system was reported (Prato & Thomas, Canada). In corresponding tests with 31 study subjects the standing balance with eyes open and with eyes closed under varying light conditions at a site with and without magnetic field (200 µT) was examined. With eyes open there was no effect. With eyes closed the standing balance at field exposure deteriorated, though only under poor light conditions. Strong light conditions even improved the standing balance compared with the control situation. The offered explanations of this phenomenon, though, seemed highly hypothetical.

Szmigielski et al. (Poland) compared 38 exposed workers in radio/transmission stations (10-50 MHz) with the same number of non-exposed workers (average age: 45 years). Compared were 24-hours electro-cardiogram (ECG) and blood pressure recordings in connection with individual high frequency recordings during the 12-hours shift. As in an earlier study of the same research group on workers of medium wave radio transmitters (0.7-1.5 MHz), increased rates of ECG irregularities in exposed workers were identified (in 74% versus 41% of the control group). The blood pressure values showed a similar trend. Therefore, the scientists assumed that several years of work at workplaces with a

BEMS 2000 in Munich
Speech of Eike Bär, chairman of the board of the Research Association for Radio Applications

Dear ladies and gentl

welcome to the 22nd annual meeting of the Bioelectromagnetics Society here in Munich. The Research Association for Radio Applications sees this year's meeting as a very special occasion, as we are for the first time co-organisators of this most important event in the area of „electromagnetic fields" taking place in Germany.

In contrast to the Bioelectromagnetics Society, which now exists for some 20 years, the Research Association for Radio Applications is a relatively young institution. The Research Association was founded as a non-profit organisation in 1992 by only 16 members on the initiative of the Federal Minister for Posts and Telecommunications in Bonn. Since then the number of members has steadily increased. Among the now 48 members there are - besides the Federal Ministry - network operators and manufacturers as well as numerous associations, universities and institutions engaged in the area of radio.

In order to enforce and intensify its activities the Research Association cooperated from the start with other scientific and research institutions, among others, of course, the BEMS, of which it is a member. Other partners are, for instance, the World Health Organization (WHO), the European research association „Cooperation in Science and Technology" (COST 244), the „European Bioelectromagnetics Association" (EBEA), the ICNIRP and DKE (DIN/VDE).

The Research Association's work is based upon two fundamental components: research promotion and public relations. Our aim is to foster scientific exploration of the effects of electromagnetic fields on humans and environment and to distribute information on research results to the general public. We wish to contribute to the objectification of the debate on possible health risks of EMF, particularly in Germany, where for the last ten years there is an ongoing emotionally high-charged debate in the public and the media on the so-called „Elektrosmog". This debate is connected with the liberalization and the extension of the mobile phone net in Germany since the early nineties. The public has been confused by a whole lot of unobjective and non-verifiable assertions made by so-called experts. Among other things this questionable debate prompted the various organisations and enterprises to combine efforts in confronting their common task of tackling the issues at hand and thus taking responsibility.

For the Research association taking responsibility means supplying information by commissioning scientists to do research studies and discussing the obtained results at public forums - as we quite often did at BEMS. In regard to the topic's complex nature a forum like the BEMS' annual meeting is of utmost significance. Here, the experts engaged in the various fields of EMF-research may interact, learn about current research, discuss results and develop further research projects.

We should always bear in mind that with the continuous development of mobile radio there also is an increased need for research into the matter, since mobile radio - as is the case with all modern technology - not only offers new chances, but also may pose risks to the public. Only through the combined effort of all those involved it is possible to come to satisfying solutions. Therefore the Research Association for Radio Applications attaches great value to the diversity of its members as well as the international character of the association illustrated by its participation and membership at BEMS.

An additional important aspect - though sometimes easily overlooked by scientists - is the credibility of research results in the public. You, dear experts, of course are well able to correctly assess the value of other colleagues' work. Public perception of research, however, quite often differs a lot from ours, being influenced by views and judgements of those affected as well as self-appointed experts. It is suspected that research results could be manipulated by manufacturers and network operators along the lines of their own particular interest. Quite often they are accused - not only in Germany, I think - to consciously impede thorough research into issues. Therefore it is necessary to convince the general public of the independence of scientific research institutions. This is also

lemen,

in the interest of manufacturers and network operators, as the adoption of a new technology to a great part depends on public acceptance.

Having recognized this, the Research Association for Radio Applications from the start strove for strictly neutral and scientific selection criteria in commissioning research projects. The studies exclusively are carried out by independent research institutions and universities, following the strict guidelines of WHO. However, with this approach we do not only seek to gain public acceptance, but also - or mainly - international scientific acceptance.

In the meantime we all - and especially you, dear ladies and gentlemen - were able to contribute through our work to the fact that the debate in Germany on „Elektrosmog“ lately has become more objective.

In conclusion I would like to thank you, dear participants of BEMS 2000, for all the work you have done so far and surely will do in the next few days here in Munich, discussing in detail the results of your research. Your work will remain hugely important, and I wish you every success in your future efforts. Besides, I wish to express my thanks to the organisers of BEMS and to Munich for giving us the opportunity to meet in this beautiful city. Thank you very much indeed.

corresponding high frequency strain poses an increased risk of cardiac/circulatory disorders. A clinical relevance of the obtained data is still to be verified.

In a time perception response test based upon rewards on rhesus monkeys D'Andrea et al. (USA) did not prove any influence of a 500 MHz field on the head (average SAR value in the brain: 0.6 W/kg, measured at body phantom models). Whole body SAR values were in the range from 1-4 W/kg. During the test the monkeys were tied at the neck.

The perception of so-called „phosphanes“ at exposure to low frequent amplitude modulated (20 Hz) 900 MHz fields was examined by Taki et al. (Japan) in four study subjects (phosphanes: light perception inside the eye, known at exposure to highly effective low frequent fields; threshold value for the perception at 20 Hz: 5 mT at the retina). At 900 MHz near field radiation with very high local SAR values up to 40 W/kg (!) no phosphanes are perceived (exposure duration: 1 min). At lower carrier frequencies (52.2 and 18.4 MHz) no effects were observed either.

Two other contributions of the same working group dealt with the phenomenon of 'microwave hearing' and with the memory of rats under the impact of pulsed high frequency fields (GSM and Japanese PDC standard). 'Microwave hearing' is a phenomenon also known in humans, meaning that high pulse energies of radar impulses through minimal thermoelastic prolongation (mechanical pressure wave) of the brain tissue produce clicking, knocking or hissing noises in the inner ear. An experiment with a 1 W peak transmission power combining numeric computations and studies on restrained rats (at 915 MHz, GSM standard and 2450 MHz, pulse duration 10 µs) showed that the peak SAR value at 915 MHz must lie at 600-1200 W/kg in order to trigger 'microwave hearing' in animals (Watanabe et al., Japan). This would be equivalent to a 90 W operated monopole antenna 2 cm in front of the rat's head. During the discussion following the lecture Veyret (France) confirmed that he, too, was not able to trigger 'microwave hearing' in experiment at peak SAR values of 40 W/kg in guinea pigs.

The experiments of Yamaguchi et al. (Japan) on the memory of rats were carried out in a T-shaped labyrinth with or without exposure to a 1439 MHz field (Japanese mobile radio standard). Restrained groups of six rats (test and control groups) were exposed or sham exposed for an hour (SAR values: brain: 7.4 W/kg, whole body: 1.4 W/kg) at four subsequent days before the experiment. The evaluation was aimed to determine whether the animals provided with food bowls positioned at two ends of the labyrinth remembered the filled one (16 tests per day with each animal). The result was that the field exposure caused no effects on memory.

Again, only a few examples out of the many poster contributions on the topic shall be mentioned: Bornhausen & Scheingraber (Germany) carried out learning tests on rats in so-called 'Skinner boxes'. The applied method differentiated the cognitive abilities of the animals more clearly than normally used methods. 40 developed rats in utero exposed for 20 days to a 900 MHz field (GSM standard, SAR value: 17.5-75 mW/kg) did not learn better or worse than the 40 examined control animals in utero without field exposure.

Nerve channels from frogs were examined under exposure to strong magnetic direct fields (up to 14 T; Ishihama et al., Japan). There was no impact shown on nerve excitation.

Several posters presented results of studies on brain tissue. Testylier et al. (France) found an increased release of acetylcholine (a neurotransmitter in the brain) in the brains of rats at an unmodulated 2.45 GHz and an amplitude modulated (32 Hz) 800 MHz field exposure. Deans et al. as well as Scott & Tattersall (all England), too, found effects on brain tissue of rats during the exploration of excitation of the nerve tissue influenced by an unmodulated or modulated (16 Hz sinusoidal or rectangle modulation) 700 MHz field. Temperature influences over 0.1 C° were excluded.

Thuróczy et al. (Hungary) detected a certain lengthening of the conduction of hearing stimuli to the brain; corresponding reaction tests used high frequency hearing stimuli switched on for 15 min (2 W peak transmission power) when the study subjects held a mobile phone to their ear (without their knowing). The obtained data, also based upon cognitive tests, came from the examination of only 10 study subjects and therefore statistically are not fully secured. Interpretation models regarding the effects assumed a small temperature rise and/or ion transfers in the inner ear.

Studies on humans

The much expected session on 'Studies in humans' was opened by Adair et al. (USA). Based upon earlier studies, physiological measurements were made at three different site temperatures in (only) 7 study subjects partly exposed to high frequency radiation (2.45 GHz unpulsed, SAR values up to 7.7 W/kg) of an antenna. A new aspect was a simultaneous easy body exertion of the study subjects (pedal trainer, 15 min before or during the 45 min exposure phase) in order to achieve a better impression of the role of the metabolism. The measurements were made at different body parts: skin temperature, sweat secretion, blood circulation in the skin and whole body temperature. Reported results were an increase of the three first mentioned parameters through the exertion, but mostly through field exposure. The whole body temperature though showed nearly no effect at all (0.2 C°). The assumption was that body exertion and field exposure at the experiments have an additive instead of a synergetic effect.

Kutrumbos & Barnes (USA) detected an increase or a decrease (!) of the blood oxygen factor in the index finger of study subjects after producing a static magnetic field at this spot (50-500 mT, effects only from 300 mT upwards). Questions regarding the relevance of this finding remained unanswered.

From a double blind sleep study from Switzerland on the phenomenon of electrohypersensitivity reported Müller et al. Electrosensitive persons at home were temporarily exposed to electric and magnetic 50 Hz fields (80-160 V/m, 2-6 µT) during sleep without knowing whether or when the field was switched on. Sleep quality and well-being on the following morning were measured via subjective and objective parameters (diary, interview, psychological tests, physiological parameters). The result was a positive interrelation between field exposure and well-being in the morning. The sleep quality was not impaired.

Out of 15,000 randomly selected adults (19-80 years old) in Sweden (Hillert et al.) 167 persons (1.5%) claimed to be electrosensitive, partly combined with an amalgam incompatibility. The thorough study considered many side influences (asthma, allergies, incompatibilities etc.). Among the identified electrosensitives were more women, better educated persons and immigrants than in the total sample. Statistics confirmed that the 1.5% self-defined electrosensitive persons react stronger to all possible environmental influences or disturbances than the average population (all sorts of incompatibilities, noise, weather, air pollution etc.).

Hietanen & Hämäläinen (Finland) in a provocation study examined 20 study subjects claiming to be electrosensitive in connection with mobile phones. In an environment with low background fields (lonely wooden hut in the woods without power supply) they were exposed to mobile phones (900 or 1800 MHz, GSM/NMT standard) directly at the head. Object of the examination was the ability to sense the (directed by computer) 'on' and 'off' modus of the phones. All subjective feelings during the 30 min single experiments were recorded. All participants experienced the more or less significant subjective impression of being impaired during the tests. Nobody, though, could distinguish clearly between an actual exposure (on modus) and a sham exposure (off modus). During sham exposures even more symptoms were described, mainly by women.

The poster presentations on the topic did not provide ultimate evidence of the phenomenon 'electrosensitivity' gained under objectively controlled conditions either. In this respect both low frequent fields as well as fields of mobile radio were taken into consideration. An impact on sleep quality, this time at an exposure to 900 MHz fields (GSM standard), could not be confirmed (Espa et al., France). The size of samples mostly seemed too small (often well below 20 participants).

Animal studies

Compared to the great number of animal studies actually carried out this topic was given very little time during a short lecture

session. Many of the animal studies of course got their due attention during sessions on other topics as well as during poster presentations. Lerchl et al. (Germany) presented experiments with non-constrained hamsters in cages exposed to a continuous high frequency field for 60 days (cages in the radial waveguide, see above under 'Exposure assessment'). Groups of 120 animals (120 non-exposed control animals) in three experiments were exposed to mobile radio frequencies of 900 MHz, 1800 MHz (pulsed with a frequency mixture, see above) and to a future police radio frequency (383 MHz, TETRA standard) with a calculated SAR value of 80 mW/kg (variations 30%). Results: At 383 MHz and 900 MHz (but not at 1800 MHz) the body weight of the animals in due time showed a statistically relevant increase bigger than that of the control animals. In all experiments the growth rates of testicle tissue showed a significant increase (testicle cells show one of the highest natural division activity in the animal and the human body, similar to unnatural tumor tissue defying any physiological control).

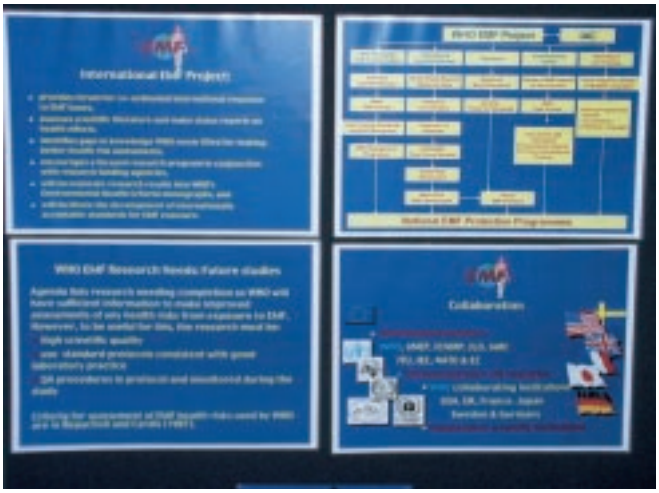
Also noteworthy is a report from Fredericks et al. (USA) who obviously achieved a strengthening of the immune system in the body of 20 examined rabbits (10 exposed, 10 sham exposed) through a device for electrotherapy operated by low frequency pulses (15 Hz). During an operation at the shin the animals were infected with bacteria (staphylococci). After 14 days of magnetic field treatment (or sham treatment; 3 h per day) tissue samples were extracted from the infected bone area and examined for bacteria foci. Whereas all non-treated animals showed bacteria foci, 56% of the exposed animals showed no traces of bacteria colonies at all. The number of examined animals, though, seems too small in order to speak of a scientifically valid finding.

Comparisons of heat conduction from the skin into the body caused by strong millimeter waves (around 100 GHz) led to differences between animals and humans as well as between different animal species (rats, rhesus monkeys; Walters et al., USA). In humans the blood circulation in the skin exposed to weak millimeter waves plays a crucial part. The results again implied that knowledge gained from animals in this respect can not be simply applied to humans.

A leukocyte deficiency (to below 50%) caused experimentally by cyclophosphamide (substance used in chemotherapy in humans) could not be suppressed by a treatment with millimeter waves (42.2 GHz), as already shown in earlier studies (Logani et al., USA). Without the cyclophosphamide treatment a notable increase (> 45%) of the number of leukocytes in the exposed and sham exposed animals restrained in narrow tubes was observed.

Out of the great number of poster presentations on this topic we will only sum up a few positive findings (positive and negative findings all in all were balanced):

Static magnetic fields (0.35 T, 0.5 T as well as ground magnetic field) could have an influence on pressure receptors in the arteries partly leading to healing and partly to unfavorable effects on blood pressure (Gmitrov & Ohkubo; Slovenia, Japan). Study subjects were rabbits and humans.



Static magnet fields (0.3-0.4 T) diminished the velocity of nerve channel conduction in the spinal cord of rats. This may have a pain suppressing effect (Tatsuoka et al., Japan).

Through strong rotating magnetic fields (0.4-0.6 T) the serotonin contents (neurotransmitter in the brain) sank in the brain of mice, at the same time rising in the peripheral blood (Xiaoyang et al., China).

Strong magnetic fields (up to 8 T) had no effect on oxygen bonding to the red blood dye haemoglobine in rats. The decoupling of oxygen from haemoglobine in vitro, though, was affected; this process may therefore possibly occur also in the lungs (Yoshimura et al., Japan).

A 42 GHz distant field (0.15 mW/cm²) had a suppressing effect on some general (non-specific) immune responses (phagocytosis activity, number of leukocytes) in mice (Gapeyev et al., Russia).

A 50 Hz magnetic field (1 mT) diminished the activity of N-acetyltransferase (NAT) in rats. The enzyme (catalytic protein) participates in the nocturnal production of the neurotransmitter melatonin in the pineal gland (Chacón & Massot, France).

The immune system of mice was affected by an exposure to a 50 Hz magnetic field (2 mT). Cells of different lymphatic tissues altered in number and response behaviour. Within 21 days, though, by counter-regulation normal conditions were restored (Frasca et al., Italy).

Demographic studies and social politics

In a cohort study on death occurrences among the employees of a manufacturer of mobile radio products (Motorola) data concerning 200,000 workers from the years 1976-1996 were evaluated (Kelsh et al., USA). The workers were qualitatively

divided into four categories according to the intensity of their occupational exposure to high frequency fields. The main focus lay on death causes, with special attention to brain tumors, lymphatic cancer and leukemia. No case confirmed an increased risk in connection with the occupational high frequency exposure.

A demographic study from Canada (Lavallois et al.) compared 221 women living 150 m or nearer to a 735 kV high voltage line with 195 women living 400 m or farer from the line. The electric/magnetic field strain showed an average difference of the factor 2 or 3. The deposit of the neurotransmitter melatonin in morning urine was measured (as an indicator for the nocturnal melatonin production). The suppression of the nocturnal melatonin production by magnetic fields is relatively well proven by experiments with rodents; for humans, however, such evidence is lacking. A statistically clear reduction of the melatonin deposit could be detected only in a small group of older heavily overweight women with strong field exposure. For more comprehensive interpretations this group was too small.

A lecture of Bernhardt & Matthes (Germany) depicted the tasks of the International Commission for Non-Ionizing Radiation Protection (ICNIRP) explaining on which basis and along which scientific evaluation criteria the commission decides on international recommendations for limit values.

Further interesting results on this complex issue were presented by following posters: In a pre-study of a large demographic study in Belge (Crasson et al.) with 111 persons the determination of the melatonin deposit in urine samples (see above) was combined with the evaluation of questionnaires on psychological well-being, on life organisation (including application of electrical devices) and on health status. Besides, the 50 Hz field strain in residences and electrical consumption were measured. The results showed no connection between different magnetic field strains and the psychological well-being or the functioning of the (melatonin producing) pineal gland.

Thier et al. (Germany) found out through his studies on available literature and researches on biological effects of

electromagnetic fields that an intelligent combination of the information from various data bases would significantly improve the efficiency of access to scientific knowledge. In this respect evaluation techniques and search routines were developed and applied. This aspect is especially important as the search for relevant results on the theme complex in question becomes increasingly complicated because of the great mass of published results as well as the wide range of study objectives and aims.

Schüz et al. (Germany) made risk calculations on child leukemia cases in connection with the demographic study above already mentioned under 'Dosimetry/exposure assessment'. According to statistics, each year 4.7 out of 100,000 children in Germany fall ill with leukemia, i.e. there are about 600 new cases annually. In 1.5% of the measured households magnetic fields above 0.2 µT were found. At this selected threshold value for the inclusion of children in the case-control study (see above) the calculatored risk factor of the general population was 0.7%. Under these conditions theoretically only about 4 new child leukemia cases per year could be explained by an exposure to a stronger magnetic field. However, this assumption is still not confirmed by the evaluation of the overall study. The evaluation will be finished at the end of 2000.

High frequency effects on cells and molecules

This lecture session was very different. There was no general discussion about effects on cells and molecules; instead single effects on the genetic substance and DNA molecules were separately discussed. At first, numbers were presented that underline the everyday character of natural temporary DNA damages: In a human cell each day occur about 16,000 so-called 'depurinations' (separation of a sugar-base-binding in the molecule), during our life each gene is damaged about 1010 times, and in a body cell continuously and simultaneously occur more than 3000 single strand breaks (each DNA molecule consists of two very long connected molecule strands). If these events occur with the mentioned normal frequency, they do not lead to damages of the whole organism. Each cell has effective recovering mechanisms which permanently repair the damages in the molecules (almost to perfection).

As earlier Lagroye et al. (see above under 'Mobile phone devices & telecommunications'), Cedervall & Lange (Sweden, USA) examined the reliability of a verification technique ('Comet Assay') used by Lai & Singh (1995, 1996) to prove a damaging effect on DNA strands applying pulsed high frequency fields (3450 MHz). They found out that the results of the verifying method mostly are interpreted incorrectly by the users, since in most cases an invalid interpolation of the measurements has become general use. A calibration of the evidence at applying ionising or UV radiation is valid only for a specific dose range. Consequently, the velocity of available repair mechanisms (see above) often is assessed incorrectly: This means that there may be made a wrong assessment of DNA strand breaks actually caused by test treatments (particularly at weak field effects).

Also with finding evidence of DNA strand breaks dealt Roti Roti et al. (USA), again with regard to the publications of Lai & Singh (see above). By means of the already mentioned 'Comet Assay' the effects of different field exposures on DNA samples were explored (2.45 MHz, unpulsed and pulsed, SAR values: 0.6-1.9 W/kg; 835.62 MHz access method FDMA as well as 847.74 MHz access method FDMA, SAR values: 0.6-5 W/kg). From their own studies and in comparison to other contributions to the topic the authors concluded that it is highly uncertain whether high frequency fields at all can cause DNA damages.

Vijayalaxmi et al. (USA) reported from experiments to prove DNA damages in freshly isolated human lymphocytes (white blood cells, immune cells). The samples were exposed for two hours to a pulsed 2.45 MHz field at an average SAR value of 2.135 W/kg. Samples for positive controls were treated with ionising radiation. Again, the 'Comet Assay' was the applied measurement method. As a result, there were found no single strand breaks in the DNA molecules as a consequence of high frequency field exposure, neither immediately after the exposure nor four hours later.

As the three lectures of this session referred to the same topic complex, there was a vivacious discussion about results and even more so about the used method for finding evidence during which doubts concerning the results of Lai & Singh (see above) were expressed.

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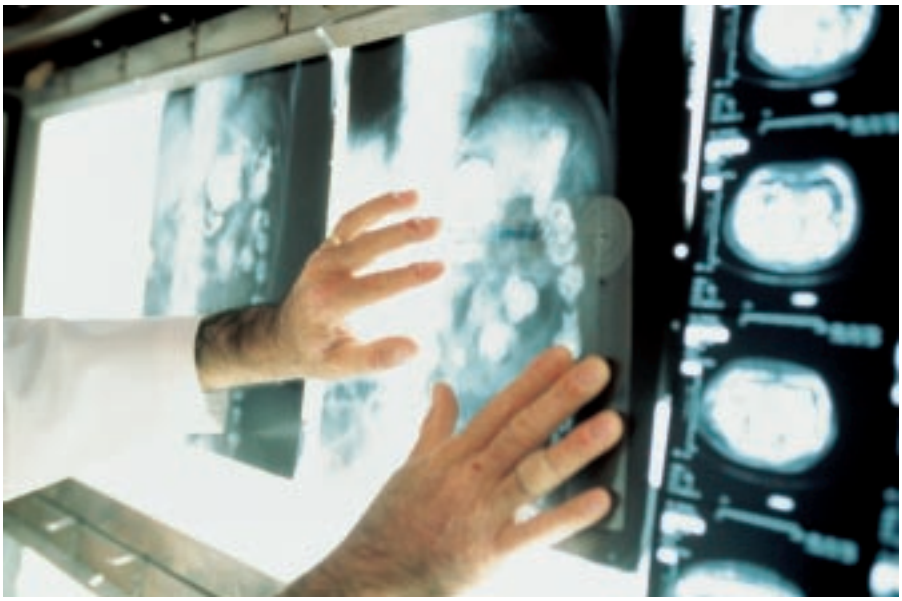
Medical Applications a

by Frank Gollnick

During the meeting of the BEMS in Munich from June 11th to 16th 2000 special sessions dealt with medical applications of electromagnetic fields in the areas „Clinical devices“, „Epilepsy research and therapy“ and „Electrical Medicine“. The focus was not the scientific exploration of possible dangers of electromagnetic waves or magnetic fields, but the medical benefit that may derive from them. Regrettably, some contributions were strongly influenced by commercial interests and therefore of little scientific use.



During the session on clinical devices Wachtel et al. (USA) talked about molecular causes for a finding at Vanderbilt University, USA: Strong magnetic fields in the range from 0,1 to 1 T in a quadrupole setup (four crossing electrodes) are claimed to have a pain-soothing impact on patients. According to Wachtel, there is certain evidence that magnetic fields theoretically may have a strong influence on ion channels in certain human nerves resulting in a partial bloc of the pain stimulus channeling.

The hypothesis that static magnetic fields foster the healing of bone fracture is denied by many scientists. Rogachefsky & Markov (USA) claim to have observed an acceleration of the healing of a certain type of bone fracture of average three weeks in a number of patients. The reason supposedly is to be found in the stimulation of the metabolism of bone stem cells and an increased blood circulation in the fracture environment.

A new improved design for a 915 MHz catheder antenna for the treatment of tissue with heat was presented by Pisa et al. (USA). Such catheders are used - in part today or at least in future - to carry out minimum invasive heat treatments on cancer foci as well as the removal and shaping of critical tissue through heat treatment inside the body.

A study on 50 mice (30 treated, 20 control group) regarding cancer treatment with a direct 120 Hz magnetic field (10-20 mT) showed that the tumor growth rate and recovering of blood capillaries (for the supply of the tumor tissue) could (at 15 mT) be reduced to around 41% (Williams et al., USA). The reason for this phenomenon is still unknown.

nd Devices

A possible disturbing impact of electric fields emitted by power supply on pacemakers - 50 and 60 Hz at field strengths of 1,5 kV/m - was claimed by Sastre et al. (USA, Canada) based upon measurements at human body models and computations.

Morrissey et al. (USA) tested the interference protection of selected medical appliances such as EEG devices, infusion pumps etc. against electromagnetic fields in the range from 800 MHz to 1900 MHz. The study particularly examined the emerging development and installment of new wireless communication systems in clinics where a general ban of mobile communication in future will not be necessary. Instead, the technical characteristics of the new systems must be refined considering the sensitivity of medical devices (lack of radiation shielding).

A special focus in analyzing medical applications this year was the topic „epilepsy research". In four detailed lectures the most important techniques of magnetic detection and therapy were presented.

After an introduction into the topic and the symptoms of epilepsy Fernandez (from the working group C. Elger leading in Germany in this area) explained the procedure of „functional Magnetic Resonance Imaging" (fMRI). This technique allows an precise localisation of the so-called „epileptic focus" in the human brain. Its exact size can be determined; different areas of the focus defining certain symptoms can be distinguished. Such information is of utmost significance regarding the planning and assessment of the efficiency of operations. To this aspect Fernandez referred in detail, too: Only seriously damaged tissue is made visible before operation. The danger to remove valuable healthy tissue thus can be reduced substantially.

Mattson (USA) presented a another method to show not only damaged tissue areas, but above all concentrations of neurotransmitters (connecting the coordinating points in the brain) and the effects of medicine directly in the brain. Besides, this method named „Nuclear Magnetic Resonance Spectroscopy" (NMRS) helps to find the mechanisms which contribute to trigger seizures or which occur simultaneously. The advantage of this method is the possibility to examine the effects of antiepileptic medicines on neurotransmitters. Therefore, it was presented as a method for „non-invasive biopsy" of the brain (i.e. preventing an actual sample taking).

With the „magnet encephalography" (MEG) Stefan (Germany) presented a third method designed for diagnosis of epilepsy. Here, the development of minimal magnetic fields at the brain cells and/or at defined small areas of the brain is measured and made visible in a threedimensional reconstruction. The basis for the reconstruction are the above mentioned NMR recordings. The real measurement is made by „superconducting quantum interferometer devices" (SQUID's), a computerised technique which makes magnetic field detectors through cooling with helium superconductive and thus highly sensitive. This

method as well as the other mentioned methods contribute to a significant decrease of the dangers of surgical treatment of medically incurable epilepsy types.

The session was concluded with a report on recent developments concerning the „transcranial magnetic stimulation" (TMS). This method induces local whirl currents in the brain through well-focused magnetic pulses which produce nerve stimulation. Theodore (USA) explained the procedure which shows significant advantages compared with other therapeutical approaches. Next to the theoretical approach background information on the therapy's efficiency and on experiences made was presented. The method is already in use in the clinical practice.

Another topical focus of the meeting was the use of electromagnetic waves or magnetic fields in disease therapy called „electromedicine". Discussed were methods of magnetic field therapy or results of „electrical hyperthermy" (heating of tissue through electromagnetic waves, for example in cancer treatment).

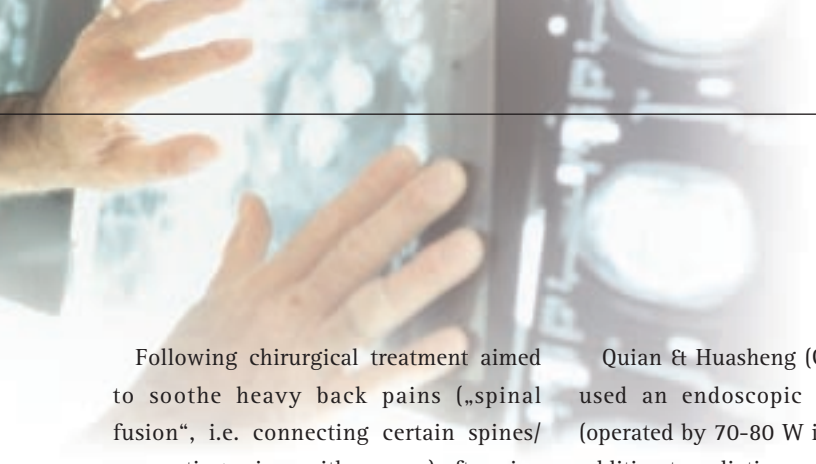
Nindl et al. (USA) addressed the nowadays used UVA or UVB light therapy methods in the treatment of skin diseases such as psoriasis. Since the applied UV radiation, however, is known to be potentially cancerigenous, the possibility to reduce the necessary light dose through additional use of static and/or low frequency fields (20 min 40 µT static and 100 µT 15-100 Hz sinusiodal) was explored. The used model of human lymphocyte cell cultures as well as ceratinocytes (connective tissue cells) from the skin led to the finding that certain frequencies result in an increase of the UVB treatment effects. Thus, an additional use of magnetic fields could reduce the light dose necessary for therapy.

According to Szasz (Hungary), the electro-hyperthermal treatment has important advantages compared with classic heat treatment methods in tumor therapy operating without the use of electromagnetic waves. In classical methods the inevitably emerging so-called „heat shock proteins" (albumen which can recondition the affected cells according to the new situation) may prevent the intended destruction of tumor cells. At electro-hyperthermy the heat develops in the cell intervals. Thus, tumor cells are destroyed from the outside, before they can produce heat protecting proteins. Further, specific tumor protecting characteristics of the immune system are activated.

Five other papers dealt with the therapeutical possibilities of a rather fiercely criticized method using devices that produce magnetic fields in the low frequency range (5-3636 Hz, partly with specific pulse patterns): Thomas et al. (Canada) presented a test protocol for rheuma patients which shall help to objectively measure the efficiency of magnetic field therapies and to improve treatment methods. Patients take part in a standing balance test with eyes open and closed. A test with 20 patients using a time-varying pulsed 60 Hz magnetic field (200 µT) was supposed to lead to a decrease of the measured differences between the exercises with eyes open and closed.

Two further studies are supposed to have proven that pain symptoms or movement restrictions in patients with arthritis or spinal column diseases could be eased through the use of magnetic field therapy devices. The results are based upon the data of 50,000 arthritis patients (Markoll, USA, Germany) and of 100 patients with back problems (Walzl & Thuile, Austria).

Davey et al. (USA) talked about health improvement in patients with incontinence after a six-week treatment with a 3636 Hz magnetic field (pulsed with 5 Hz and after that 50 Hz) in the area of the sphincter. The statistically significant results are based upon subjective reports (diary) of 66 patients.



Following chirurgical treatment aimed to soothe heavy back pains („spinal fusion“, i.e. connecting certain spines/ connecting spines with sacrum) after nine months an obviously improved connection of the bones was observed in a group of patients treated with magnetic fields (30 min per day; Ryaby et al., USA). In a blind study on 201 patients a complete healing of 64% of those treated with the field was observed, in contrast to the 43% of the non-treated patients. The reason was identified by the lecturer as an acceleration of the bone healing through the field.

The poster presentations at the meeting also contributed to the topics of magnetic field therapy, epilepsy research and general clinical applications:

Epilepsy patients which can not be treated with medicine were examined by Hofmann et al. (Germany) regarding brain activity (EEG measurements) in preparation for surgical treatment. At an exposure to external low magnetic field stimuli (around 60 µT) with complex time patterns the so-called „epileptiform activity“ was measured. The mentioned research study provides a basis for stimulating this special brain activity for diagnosis and/or for reducing it out of therapeutical reasons.

Yukawa et al. (Japan) presented another type of bone fracture healing, this time particularly in humans of old age, through a magnetic field therapy with weak 2 Hz sinusoidal fields. Out of 12 examined patients 9 showed a complete healing, a control group (without magnetic field treatment) was not mentioned.

According to Pasche (Suisse), sleep disturbances can efficiently be cured by a therapy device which, operated by very low energy (battery power supply), emits a 27.12 MHz signal (modulation at certain frequencies between 0,5 and 300 Hz). The treatment of states of panic has been tested under the same conditions in a pilot study which also shows a certain success.

Quian & Huasheng (China) successfully used an endoscopic microwave probe (operated by 70-80 W in 10 sec pulses) in addition to radiation and chemical therapy in treating gullet cancer in 300 patients. Survival rates were increased by this side treatment.

Also from China (Quian & Yaping) comes a microwave application which is claimed to be already widely spread in Chinese hospitals: Reportedly, the additional treatment of hepatitis resulted in accelerated healing. For ten days ten minutes per day a microwave probe was externally placed at the patients' liver area. But again, a control group without microwave treatment was not mentioned.

Feiner et al. (Germany) explored safety aspects of magnet resonance recording used for diagnosis. A relevant test parameter was defined to allow predictions which flux density is needed to provide stimulation of external nerve channels. This stimulation can occur during examination through electric fields induced in the patient. The threshold value lies directly below the limit of a damaging cardiac strain.

Finally, Goldman (USA) presented a provisional study on a electrotherapy method with which blood circulation disturbances in the extremities of arteriosclerosis patients can be successfully treated. The method called „galvanic stimulation with pulsed high voltage“ is supposed to improve blood circulation in tissue and to suppress a progress of the disease with the risk of a later amputation.

One has to bear in mind that some of the lectures and/or part of the studies introduced during poster presentations on therapy methods mainly had provisonial character.

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The BEMS in

Otto Petrowicz

Numbers often help us to see things more clearly. In this respect the BEMS meeting in Munich shall be compared to previous meetings in order to illustrate its specific significance.

For the fourth time since the foundation of the BIOELECTROMAGNETICS SOCIETY the annual meeting was held outside the United States:

- 17th annual meeting 1994 in Copenhagen, Denmark
- 19th annual meeting 1996 in Victoria, BC, Canada
- 2nd world congress 1997 in Bologna, Italy
- 22nd annual meeting 2000 in Munich.

Table 1 shows the individual events divided into symposiums/workshops, forum papers, tutorials, lectures and poster presentations since 1994 in Copenhagen up to this year's event in Munich. The tendency of the last two meetings to include less lectures and rather more poster presentations was confirmed.

Nearly unchanged compared to the past annual meetings is the quota of the contributions from individual countries in forum discussions, lecture series and poster presentations. On the one side, this reflects among other things the focus of current and/or completed research programs, but also underlines the „importance" of certain aspects for the individual countries. The following table 2 demonstrates that the greater part of lecture presentations goes to Americans and Canadians. The other countries dominate poster presentations.

An significant aspect for comparison is the current proportion of BEMS members shown in table 3, divided into full members, associated members, students, members after the end of their active occupational life (emeritus members), sponsoring members and founding members. Beside the dinstiction by membership form the table points to categories such as continent and „country group". A further important aspect of this year's meeting was the selection of topics that did not differ substantially from past events. The topics were:

- genotoxity
- theoretical models and mechanisms
- dosimetry
- cells and tissue
- medical devices
- exposure assessment
- electromedicine
- nervous system and sensory apparatus
- studies on humans
- animal experiments
- mobile phones, radio communications
- epidemiology and public relations
- high frequency effects on cells and molecules.

A special topic at the 22nd annual meeting of the BEMS was discussed in the two sessions „Epilepsy: Magnetic diagnosis and therapy" (see illustration).

Side events at the BEMS:

The days prior to the official start of the BEMS' annual meeting traditionally are devoted to workshops, small symposiums and sessions of individual organisations and working groups. This year sessions of the American Engineers' Association IEEE, Standard Coordinating Committee 28 (Non-Ionizing Radiation) took place on two

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subsequent days. The COST 244bis meeting of the European Union and the traditional workshop of the U.S. Air Force Research Laboratory went on for only one day.

American Engineers' Association IEEE (IEEE SCC28)

In the following contents and results of the working group sessions of IEEE SCC28 and its subcommittees will be summarised.

The specialized group sessions on one hand are a continuation of the routinely held special meetings of the IEEE; on the other hand the activity of the IEEE Standard Coordinating Committee is presented to new or potential future members. Correspondingly, the agenda not only announced specialist information, but also information about the IEEE and the activities of the committee. Subject were comprehensive information on the IEEE's structure, its self-defined tasks and the approach to realise them, its involvement in national U.S. regulation procedures and also on international cooperation with other international and national organisations. Please go to the web side http://www.grouper.ieee.org/groups/scc28.

The IEEE Standard Coordinating Committee 28 is divided into 5 subcommittees:

SC 1: Techniques, proceedings and instrumentation

SC 2: Control measures and risk communication

table 1: survey of BEMS 1994-2000

	1994 Copenhagen	1995 Boston	1996 Victoria	1997 Bologna	1998 St. Pete Beach	1999 Long Beach	2000 Munich
small symposiums workshops	2	2	2	28 with 179 lectures	3	3	1
plenum lectures	-		4	12	2 with 9	11	3
tutorials		2			lectures	11	3
lectures	198	122	94	168	86	98	107
posters	201	280	238	304	203	170	227

table 2:

	1998		1999		2000		
	USA/ Canada	others	USA/ Canada	others	USA/ Canada	others	Ger- many*
plenum lectures	9	-	8	3	2 + W	1	-
lectures (sessions)	62	24	57	31	61	46	14
posters	92	111	65	105	45	182	34
total	163	135	130	139	108	229	48

* Germany included in „others" and separately mentioned

table 3:

Members	Total	Europe Israel	USA Canada	Asia Australia New Zealand	Central/ South America Africa	Germany
Full Member	328	85	213	28	2	20
Ass. Member	150	27	98	23	2	5
Student Member	29	11	14	4		1
Emeritus Member	40	5	34	1		1
Sustain. Member	3		3			
Charter Member	31	5	23	2	1	
total	581	133	385	58	5	27

SC 3: Safety limits for the exposure of the general public, 0-3 kHz

SC 4: Safety limits for the exposure of the general public, 3 kHz-300 GHz

SC 5: Electrical detonation devices.

Two contributions of the workshops were noteworthy: a presentation by Dr. Eleanor Adair referring to study subjects exposed to high frequency fields (2.4 GHz). Radiation density was 35/70 mW/cm² with a duration of 45 min from behind the subjects. Body temperature, oxygen supply, perspiration values and environmental values were measured. The results show that the heat development in individual body parts of study subjects differed substantially. Interestingly, temperature measurements in the osophagus (gullet), in the vicinity of the heart showed no rise of the basal temperature caused by exposure.

The second noteworthy contribution was presented during the SC 3 session: The draft revised in the subcommittee for limit value recommendations in the frequency range from 0-3 kHz was presented in detail by J. Patrick Reilly and discussed during the workshop. Generally, recommendations do not differ greatly from to date recommendations (guidelines) of other institutions. However, the draft considered new aspects of the current risk discussion.

In summary, all participants of the IEEE meeting found that the event was highly informative and successfully complemented the BEMS meeting as a whole.

U.S. Air Force Workshop

The U.S. Air Force Research Laboratory (USAF) named also „forum on EMF – safety, standards and research“ was the organisator of the event. The workshops of this U.S. Air Force research group in the last six years were part of the BEMS' annual meetings being held as a premeeting of the BEMS. At the start the workshop's chairman Dr. Michael Murphy gave a brief survey on the activities and the objectives of the U.S. Air Force Research Laboratory.

The program of the workshop focused on four main topics:

The first topic was the current existing standards in need of being harmonised. As a representative of the WHO Dr. Kenneth Foster presented the WHO's activities aimed to harmonise EMF standards. In his speech he described the WHO's international EMF project and referred to current efforts to intensify international cooperation. As cooperating institutions dealing with the EMF topic there are to be mentioned UNEP, ICNIRP, ILO, IEC, IARC, NATO, ITU and the EU. Individual countries such as the United States of America, the UK, Japan, Sweden and Germany also participate in the EMF project. As a basic task the WHO sees the achieving of a consensus on all currently existing national and international standards.

After that Foster presented the international committee for the protection against non-ionizing radiation (ICNIRP) which he characterised with the words „sience, science, science“. The ICNIRP originates from the IRPA (the department „Non-ionizing radiation“ was founded in 1970 in Paris) and is connected very strongly with the WHO, ILO and the EU. (Go to the ICNIRP's web site http://www.icnirp.de). Special emphasis was put on the cooperation with U.S. and European associations regarding the question of harmonising limit values, for example with the IEC, CENELEC, IEEE SCC28, RF and LASER Standards Int. Labor Organisation, WHO, UNEP, IRPA, EU (DG V, XII and XIII) and IEC. The main activity of the ICNIRP are the review and evaluation of recent research results concerning existing limit values recommendations. Besides, the ICNIRP's research activities are aimed to fill obvious gaps of knowledge; the objective is to develop and implement exposure guidelines for occupationally exposed persons as well as for the general population. The respective studies are worldwide renown and often provide a basis for national legal and regulatory action.

In another contribution of the USAF workshop the activities of IEEE SCC28 concerning limit value recommendations

CENELEC	Comité Européen de Normalisation Electrotechnique
ELF	extremely low frequency
EMF	electromagnetic fields
IARC	International Agency for Research on Cancer (UN)
ICNIRP	International Committee of Non-Ionizing Radiation Protection
IEC	International Electrotechnical Commission
IEEE	Institute of Electrical and Electronic Engineers
ILO	International Labour Organisation (UN)
IRPA	Ionizing Radiation Protection Association
ITU	International Telecommunications Union (UN)
NATO	North Atlantic Treaty Organization
UNEP	United Nations Environment Programme (UN)
WHO	World Health Organisation (UN)

for exposure to non-ionizing radiation (NIR) were introduced (see report on IEEE SCC28).

The following two lectures dealt with the basic differences in setting standards between Western countries and countries of the former Eastern bloc. The differences in defining limit values and, correspondingly, in recommendations (guidelines) above all were based on different point of views. The question, why there are different assessments, is answered by pointing to the economic situation, to different interpretations of biological responses and, not last, philosophical reasons.

During the workshop the topic of low and high frequency pulsed fields and their effects on subcellular and cellular levels was addressed. The focus were known cellular effects of ELF-impulses and impulse modulated high frequency fields. The impact threshold at which effects are observed is very high, namely in the range of >500 kV/m, similar to known effects on membrane depolarisation and on signal transduction. Non-thermal effects were addressed too, but only concerning high electrical field strengths which also produce thermal effects.

Another scientifically confirmed effect produced by pulsing (pulsed microwaves) is subjective hearing. Chou, Lin and Seeman gave a survey on already published studies on the topic. The studies going back up to 1956 deal with defining hearing thresholds, signal forms, pulse duration, power, repeat frequency etc. Some of the past studies presented focused not only on the subjective hearing impression, but also on quantification methods (evoked responses etc.). The phenomenon is explained by micro-thermal dilations in the head area producing accoustic signals (thermo-elastic expansion). These effects in

Personal Comment on BEMS 2000

Dr. Dr. O. Petrowics
(university lecturer)

Each year the „rapporteur“ gives his impression regarding the results of the annual meeting of the Bioelectromagnetics Society. My proposal for a ranking would be „deuce“.

On the one hand, this ranking means that the presented results and information provided by new research contributions were more or less equally divided between groups assuming health risks and those who only see a marginal risk or no risk at all. On the other hand, „deuce“ also means that nothing is decided. „Nothing decided“ means that the presented lectures and posters regarding research results as well as the contents of the presentations did not succeed in denouncing current knowledge and totally change risk assessment and discussion.

Regrettably, the quality of the presented studies differed very much. Besides high-ranking studies already published in renown peer-reviewed journals or currently in print the meeting also introduced reports of doubtful scientific contents. Each one of the above mentioned groups will put greater emphasis on results confirming certain tendencies. Therefore, reported effects do not automatically provide valid evidence of or against a certain impact.

Numerous ICNIRP seminars made an attempt to fill gaps of knowledge about effects of electromagnetic fields and to define the future course of research. Many contributions at the BEMS meeting 2000 as well as at previous events had - in my view - entirely different motives. When a laboratory method is established in respect to other problems, i.e. environmental compatibility, there are often made attempts to use the new model also in connection with EMF issues. Whether this approach always makes sense remains questionable.

The scientific confirmation and evaluation of found effects is a difficult process already described in many other reports. Insofar, an event such as the BEMS is an appropriate forum to spread information about current research studies from all over the world. The scientific community meets for discussion, focusing on single facts that seem to be important for an assessment of the issue and particularly for the own work. Thus, such meetings are necessary and very important for progress in this area. In this respect the event in Munich must be judged as a huge success. Future annual meetings will be compared to it.

science are seen as thermal. The temperature rise lies. at <1/1.000.000 degrees.

A further contribution also dealt with the subject of „hearing effects“ making an attempt to approach the phenomenon numerically (MAXWELL approach, Hook law and principles of thermoelastic deformation). The presentation of the results was quite spectacular because of the accompanying film on pressure effects at three head models. Otherwise the results were rather matter-of-fact and offered no surprising insights into the well-known phenomenon.

The third of the four lecture series dealt with the topic „limit values“ beginning with proceedings and criteria needed for initiating scientific procedures aimed to generate limit value recommendations and standards.

The interactive proceedings of scientific studies were depicted as following:

- hypothesis
- experimental study
- reviewed hypothesis
- confirmation of hypothesis
- replication of studies in own laboratories in order to minimize wrong positive results and replication of studies by other independent scientists. A successful replication of the positive results (effects) is necessary, but not sufficient.
- publication in a peer-reviewed journal
- potentially new hypotheses derived from results
- acceptance by science.

Which effects are to date proven and established?

Low frequency

- nerve and muscle stimulation
- shock and burns
- electroporation
- Pearl-Chain-Effekt
- bone healing
- perceiving

High frequency/microwave

- thermal effects
- contact currents
- shock, heat and connective tissue damages.

Dr. Eleanor Adair spoke in detail about the ability of the human organism to emit heat as well as about the mechanisms being part of this process. For the ability to emit heat which in top athletes can build up to 6.5 W/kg the threshold is 0.4 W/kg for the occupationally exposed and 0.08 W/kg for the normal population.

The workshop emphasized the fact that (regarding only thermal effects) in healthy humans one must assume a temperature rise of 1° C at an exposure to 4 W/kg. This is also the basis of standards taking into consideration the factor 10 (occupationally exposed persons) and/or 50 (general population) as currently valid recommendations. Regarding the impact of high frequency energy and the current development of limit value recommendations only thermal effects are considered because of the lack of knowledge about non-thermal effects. Thermal effects are well-confirmed and have been examined for several decades.

The lecture of Dr. M. Blank from the United States was met with fierce critic in the plenum. In his paper on biologically based safety standards for mobile phones he pointed to the different signal forms, frequencies and modulations which play a part in the GSM norm in contrary to other norms. However, he emphasised non-evaluated effects such as ODC (ornithin decarboxyglase), ATP (adenosin triphosphate) and the also non-thermally produced stress proteins which, according to him, are not considered in regulations. Summarising, he demanded that research in this area should be more critical regarding the translation of research results into standards, especially concerning mobile radio. In his view, stress proteins are an ascertained biological answer to GSM-signals demanding attention towards these effects.

A rather more generalised contribution to the topic „Science and precautionary considerations“ was presented by Dr. P. Osepchuk, USA, concerning the influence of the precautionary principle on the EMF risk management. Beginning with the different definitions of international bodies (North Sea Conference 1989, Declaration of Helsinki etc.) of the concept „precaution“ he addressed risk assessment of ionizing radiation where thresholds can not be set (Anmerkung des Autors: „This is ultimately not proven, too.“) Here, in his view, we must follow the ALARA principle. He posed following questions to the audience: „What is the situation concerning non-ionizing radiation? Does the concept of precaution agree with scientific risk assessment?“

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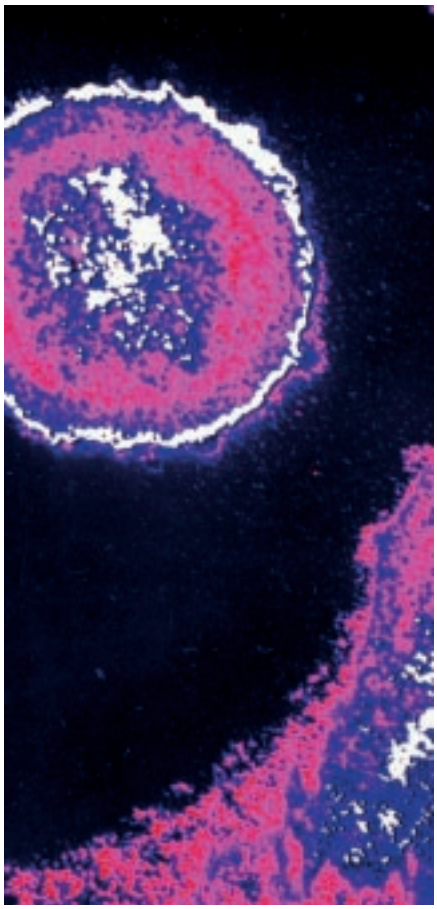
WORKSHOP COST244BIS

Christoph Bächtle

„Biological EMF-Interaction Mechanisms and their Relevance to Exposure Limits“

On July 10th 2000, at the start of the annual meeting of the Bioelectromagnetics Society, the 10th COST 244bis workshop „Biological EMF-Interaction Mechanisms“ took place in Munich. The workshop's aim was to achieve a deeper knowledge of physical and biological interaction mechanisms of electric, magnetic and electromagnetic fields and to discuss in detail possible mechanisms. Potential mechanisms may occur on the molecular level, causing effects which may have an impact on cells, tissue or whole organisms. Corresponding to the different types of interaction the event was divided into the following sessions:



I. Introduction and definitions
II. Primary biophysical and biochemical effects
III. Interaction on subcellular and metabolic level
IV. Interaction in cellular and tissue level
V. Interaction on organs and whole organism

During the first session it was established that there is still no conclusive definition of the term „mechanism“ in regard to biological effects of electric, magnetic and electromagnetic fields. Dr. Ulf Bergqvist presented the various approaches of different scientific disciplines to the problem reaching the conclusion that not least the different research methods are an obstacle for developing a generally valid definition.

Thus, mechanisms in a sense are a „black box“ containing individual observations, theories and insights. However, an increased knowledge of mechanisms might well contribute both to a better planning of future studies and an improved interpretation of results enhancing the credibility of scientific work. In addition, it would be useful in the process of assessing new technologies in their potential biological effects. Mechanisms can be seen as a sequence of events, triggered by physical quantities such as electromagnetic fields. Physical quantities do not accumulate in biological systems, in contrast to resulting alterations. Hence, we need greater knowledge of mechanisms for a better assessment of alterations.

Consequently, Dr. Bergqvist in his introductory paper stressed the importance of knowledge of physical and biological interaction mechanisms for setting appropriate and efficient exposure limits, in particular for selecting adequate exposure parameters and models for extrapolation accounting for multiple source exposure situations and chronic exposure duration. He also addressed the problem of reciprocity of time and amplitude in exposure assessment.

Prof. Dr. Jürgen Bernhardt presented the activities and future plans of the International Commission of Non-Ionizing Radiation Protection (ICNIRP) and explained ICNIRP's approach to EMF protection and future development of guidelines pointing out that our society needs different bodies dealing with different tasks: bodies like ICNIRP which set guidelines based on biological health related effects, governments which are responsible for considering social and economic impacts of limits, and scientific committees for developing product related standards. The guidelines set by ICNIRP, i.e. the limits for the general population and for occupational exposure, as well as basic restrictions and reference levels account for such factors as uncertainty of knowledge, different sensitivities and long term exposure.

Prof. Dr. Guglielmo d'Inzeo talked about theoretical models of interaction of electromagnetic fields and biological systems, such as the potential polarisation of ligand binding and functional alterations in ion channels. The primary site of such interactions, d'Inzeo concluded, might be cell membranes. As an approach to investigating effects he suggested step-by-step studies. Based on quantum mechanics there should be an examination of biophysical response at cell membranes on the level of biochemical processes. Cell biological alterations should be examined as a second step. With the „Integrated Membrane Model“ d'Inzeo presents an appropriate scientific approach for following up on possible interaction of electromagnetic fields and biological components.

In his lecture „Mechanisms of Interactions of RF-Fields with Biological Systems“ Dr. Kenneth Foster referred to effects with known mechanisms: membrane depolarization, electric charges, induced forces and thermal response. The extent of these forms of interaction is minimal because of the high energy turnover. In regard to other observed processes such as the heating of tissue or the electroporation, underlying mechanisms are purely speculative. As for the heating of tissue Foster mentioned a study of the U.S. Air Force registering a skin heating of up to 3 degrees K in a field exposure of 2.45 GHz. Foster suggested increased research activities on interaction mechanisms.

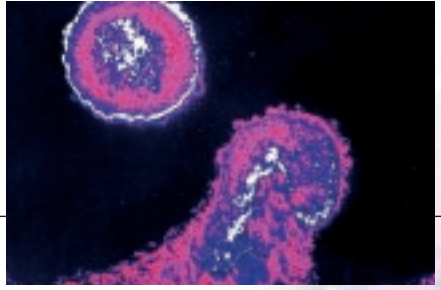
Following this paper Dr. Patrick Reilly talked about the choice of analysis parameters for defining standard limits which should not exclude any but adverse (unpleasant or painful) reactions. He favoured the electric field strength in situ for excitation metric and contrary to ICNIRP the concept of split limits for controlled and uncontrolled environment. Since all alterations at synaptic levels are considered adverse, EMF limits should be derived from the 1% level of the probability distribution of the general population's perception threshold and then reduced by an acceptance factor 3.

The topic of Dr. Rainer Meyer, from the University of Bonn, was the impact of electromagnetic fields on calcium homeostasis. Meyer's studies on cardiac muscle cells confirm the results obtained by Wolke et al. 1996. In other words, GSM signals show no influence on the calcium equilibrium of these cells.

In a short contribution Dr. René De Seze summarised that in his studies on hormones no effects could be found.

Dr. James C. Weaver pointed out that following an exposure there are alterations on the molecular level, though it must be confirmed that an exposure did occur. Molecular alterations must not per se be explained by a preceding exposure. Moreover, it is of importance to distinguish permanent from temporary alterations. In Weaver's opinion physical effects are not permanent, whereas chemical alterations may be irreversible.

Dr. Alexander Lerchl talked about the melatonin hypothesis. Melatonin is among other things known to be an antioxidant which is of importance regarding cancer. There might be a connection between low melatonin values and an increased occurence of tumors. Melatonin production



occurs in circadian rhythm; but low magnetic fields nonetheless could be responsible for alterations in this context, as they influence the pineal gland, where melatonin is produced. In his experiments with Djungarian hamsters, however, Lerchl could not detect effects of 900 MHz and 1800 MHz signals on melatonin production.

Dr. Jan Gimsa talked about mechanisms of energy absorption on the cellular level and described electrokinetic phenomena such as dielectrophoresis, electrorotation or deformation of small particles in the electromagnetic field.

Dr. Jiri Pokorny discussed short term EMF effects of electromagnetic fields on living cells. In his opinion there occur physical processes at the start of interactions of field and cell. Based on questions such as

- do cells emit EMF?
- which cellular structures generate EMF?
- how are such fields to be measured?
- can external fields alter intrinsic cellular EMF?

Pokorny investigated the role of mikrotubuli concerning the intracellular field of yeast saccharomyces cervisiae. His measurings show that yeast cells are surrounded by an electromagnetic field. The development of mikrotubuli (protein structures participating in cell stabilization and intracellular transport processes) is influenced by this field.

Prof. Dr. Alan Preece discussed the connection between electromagnetic fields and individual behaviour. The following areas of behavioural research were examined regarding the impact of electromagnetic fields:

- memory
- sleep
- learning
- avoidance
- driving.

An established effect of electromagnetic fields on ethological processes in humans is, according to Preece, the legthening of the reaction time of drivers after an exposure. In animals exposure resulted in altered perception of objects. Other parameters such as spatial memory remained unaltered.

During the COST 244bis workshop „Biological Interaction Mechanisms“ it was clarified that electromagnetic fields can lead to effects in biological systems on different levels, from molecules to complex organisms. Until now mechanisms on which these effects are based, at present are purely speculative. A survey of individual mechanisms is not available and may even be impossible. Conversations with participants showed that opinions differ widely regarding the question, wether studies on mechanisms make sense or wether a distinction between concepts such as „effect“ and „mechanism“ is of use. Sometimes „effect“ and „mechanism“ are distinguished, sometimes they have the same meaning. Some scientists deny the necessity to distinguish, as they ask, which one came first: Does an exposure lead to a certain effect which in turn has an impact on certain mechanisms? Or are certain mechanisms influenced by exposure leading to corresponding effects? Up to which level mechanisms can or must be explored? Up to the molecular, the nuclear or even the quantum mechanical level? These questions may be the subject of endless discussions, but it remains questionable, wether this approach contributes to solving problems. It is obvious, however, that effects and mechanisms of electric, magnetic or electromagnetic fields at present not only are a scientific, but also a language problem.

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Colloquium honoring

Prof. Dr. Dr. Karl Brinkmann

During this year's annual meeting of the Bioelectromagnetics Society (BEMS) in Munich on June 15th 2000 a colloquium honoring Prof. Dr. Dr. Karl Brinkmann took place. The intention was to acknowledge and to appreciate his life achievements after 28 years of work for the Forschungsverbund (research association) „Electromagnetic compatibility of biological systems".

Karl Brinkmann, born on April 30th 1911, studied electrical engineering at the Technical University of Braunschweig. In 1941 he did his doctorate at the Institute for High-Voltage Engineering in the care of Prof. Marx. In 1952 Karl Brinkmann qualified as a university lecturer at the same university. In the early seventies Karl Brinkmann as general director of the Central Direction of Siemens AG Berlin was commissioned to construct a 380 kV line. In connection with this task he was confronted with the issue of possible health hazards caused by this line.

Based upon his new responsibilities in 1972 Brinkmann initiated the research association „Electromagnetic compatibility of biological systems" aimed to explore biological effects of electric, magnetic and electromagnetic fields. Right from the start Brinkmann directed and coordinated a multi-disciplinary team of scientists coming from more than 20 institutes of different German universities. Thus, Karl Brinkmann is one of the pioneers in Germany in establishing the new research subject of „electromagnetic environmental compatibility".

Now, 28 years later, Karl Brinkmann and the research association can look back on a successful work period. More than 100 publications in national and international scientific journals and the participation in many international symposiums and meetings give evidence of the extraordinary performance of the research association and its director, Prof. Dr. Karl Brinkmann. The numerous scientific results found by the research association were the basis for the development of limit values and security regulations. As electric, magnetic and electromagnetic fields are part of our daily life, Brinkmann's research activities are, now as well as then, of great public relevance.

The encomium was made by Dr. Rudolf Fitzner of the Klinikum Benjamin-Franklin of the Freie Universität Berlin. He spoke about Brinkmann's life achievements and his commitment to the research association „Electromagnetic compatibility of biological systems".

Following the encomium several scientific lectures on the topic of electromagnetic environmental compatibility were presented. Prof. Dr. Dertinger gave a survey of studies on cell cultures regarding effects of magnetic fields and interference currents. Dr. Rainer Meyer of the Physiological Institute at the University of Bonn talked about the impact of low and high frequency fields on calcium homoestasis of different cell types. Dr. Fitzner and Prof. Dr. Tauber reported on growth behaviour of human leukemia cells. The paper of Dr. Joachim Schüz dealt with epidemiological studies on electromagnetic fields and leukemia. Finally, Dipl.-Ing. Grigat talked about measurement techniques of epidemiological studies. Following the lectures Karl Brinkmann addressed the plenum to express his thanks before accepting the congratulations of his colleagues.

Lectures at BEMS 2000

How compatible are electromagnetic fields?

Christoph Bächtle

On June 16th 2000 during the meeting of the Bioelectromagnetics Society (BEMS) in Munich scientists from all over the world talked about different aspects of eletromagnetic compatibility. At the start of the public event Gerd Friedrich, managing director of the FGF (Forschungsgemeinschaft Funk e.V., Research Association for Radio Applications), remarked on aims and contents of the subsequent lectures.

In his opening speech Gerd Friedrich from the Research Association for Radio Applications referred to several aspects of the controversial debate on electromagnetic environmental compatibility in Germany revolving around the popular catchword „electrosmog" putting the main emphasis on conflicting interests of the public. The fact that authorities not only have to protect the general population from health damages but should also provide for a secure und orderly use of radio and energy technology, causes disagreement. There is much tension between supporters and opponents of an increased technical use of electric energy. Producers and operators are met with often not very objectively discussed reservations and misgivings of the population, as Friedrich reported. Therefore, the lectures should be seen as an attempt to look into the recent developments of scientific discussion from the angle of various scientific approaches. Of course, the individual lectures can offer only a rough survey of the different aspects of electromagnetic compatibility. Concluding, Gerd Friedrich pointed out that scientific evidence often is thought insufficient to answer urgent questions of health related relevance, thus leaving people unsatisfied.

Lecturers:

- Dr. Ulf Bergqvist, National Institute for Working Life, Solna, Sweden
- Dr. Gerd Friedrich, Research Association for Radio Applications (Forschungsgemeinschaft Funk e.V., Bonn, Germany)
- Dr. James Lin, University of Illinois, Chicago, United States of America
- Dr. Mary McBride, British Columbia Cancer Agency, Vancouver, Canada
- Dr. Alan Preece, Bristol Oncology Centre, Great Britain

Low frequency EMF and childhood leukemia

British scientist Alan Preece spoke about research projects, among others about the „EMF-Rapid Program" carried out from 1992 to 1999 in the United States.

According to Preece, the wide range of electromagnetic fields requires a sub-classification according to frequency. Electromagnetic fields of frequencies less than 100 Hz are called „extremely low frequency electromagnetic fields", commonly abbreviated as ELF-EMF. To these ELF-EMF belong for example the frequencies of national power supply networks. In Germany this frequency lies at 50 Hz, in North America at 60 Hz. High voltage facilities, i.e. lines or transformers, but also household appliances produce electric, magnetic and electromagnetic fields. In the United States a large-scale study was carried out to investigate possible health hazards due to these fields. In the following Preece particularly referred to the results of this study.

Past years' increased scientific activity has been prompted by an epidemiological study, carried out in 1979 in the United States by Wertheimer and Leeper. The two scientists then reached the conclusion that certain types of tumors, particularly childhood leukemia and chronic lymphacitic leukemia in adults are favoured by electromagnetic fields produced by high voltage power lines. In 1992 the federal government of the United States of America initiated the „EMF-Rapid Program" with a funding of 35 million dollars. The program was aimed to investigate possible adverse health effects of extremly low frequency electromagnetic fields by means of various scientific methods including measurements, studies on interaction mechanisms as well as laboratory and epidemiological studies. The final results of the „EMF-Rapid Program" were summarised in a report for the public and the United States Congress. These results were reviewed and compared to the findings of other studies. Conclusions were published in 1998 by C. Portier and M. Wolfe called „Assessment of Health Effects from Exposure to Powerline Frequency Electric and Magnetic Fields - NIEHS" (NIEHS = National Institute of Environmental Health Sciences).

Based upon the IARC criteria as well as the available literature the scientific evidence was evaluated by a group of experts. The results were again summarised in 1999 by C. Portier and M. Wolfe in the so-called NIEHS Report („NIEHS Report on Health Effects from Exposure to Power-Line Frequency Electric and Magnetic Fields").

One of the results of a further evaluation of the „EMF-Rapid Program" was that „ELF-EMF are potentially cancer-promoting." However, this conclusion derived from epidemiological research until now could not be either confirmed nor disproved by laboratory studies. In addition, the NIEHS Report shows that to date no individual epidemiological study did succeed in establishing a connection between electromagnetic field exposure and childhood leukemia. There seems to be very weak scientific evidence for associating ELF-EMF with health risks. The strongest evidence for possible health hazards is given in the study on high voltage power lines suggesting „sporadic biological effects, including an increased probability of tumors in experimental animals". NIEHS draws the conclusion that ELF-EMF cannot be seen as altogether safe, based upon the though weak scientific evidence that associates exposure with leukemia. In Preeces personal opinion, however, there seems to be no connection between magnetic fields and cancer, as follows from further epidemiological studies.

Electromagnetic hypersensitivity

The lecture of Dr. Ulf Bergqvist from Sweden dealt with the question: „Does Electrosensivity exist?" The term electro-sensitivity refers to symptoms in humans which are supposed to be causally related to environmental power line fields and the use of electrical appliances. Bergqvist preferably uses the term „electromagnetic hypersensitivity". In his view society should fully accept the reports of people affected und provide appropriate support to end or at least ease their suffering. On the other side society has not necessarily to adopt individual explanations of health detriments, but should carry through scientific and individual studies on the issue.

In 1996/97 Bergqvists working group gathered reports from various European countries on electromagnetic hyper-sensitivity containing detailed information on health detriments, on conditions under which they occur as well as evidence to the extent of the problem. Between the individual countries there were differences regarding the importance given to electromagnetic hypersensitivity. In France and Great Britain the topic was scarcely noticed by the public, whereas in Germany and Sweden it met with great interest. But not only the significance attached to the problem distinguished the countries regarding the issue but claimed symptoms and triggers thought responsible for them as well. Over the years several hypothetical explanations of electromagnetic hyper-sensitivity have been discussed. These explanations can be subdivided into two categories: The first category stresses the individual factors of the person affected, while the other emphasizes external factors and influences. Bergqvist, for his part, thinks that explanations should be found in both categories, since the observed health detriments suggest multiple influences.

Considerable effort has been made to distinguish affected people by gender, age, personal factors, other illnesses, from which they suffer, dermatological disorders and the neurological status. Few studies investigated illness history, personality and other factors. According to Bergqvist, the interpretation of results is rather compli-cated, since the cause of health changes cannot be identified clearly. Swedish studies reported that the number of mast cells in blood increases compared to

controls. Bergqvist, however, pointed to the partly small number of study objects. A causally related connection between the alterations and electromagnetic fields therefore is not verified. Studies on the autonomic nervous system show that electrosensitive persons react particularly strongly for example against monitor screen flickering. Other studies demonstrate that affected persons also show an increased response to stimuli such as noise or mental stress.

Therefore, at present we still do not know which person because of which personal or physiological characteristics is at a special risk to develop a case of electromagnetic hypersensitivity, Bergqvist concluded. There is no evidence of a crucial factor causing electromagnetic hypersensitivity. Nonetheless, there is no denying the fact that there are people claiming to be electrosensitive, partly suffering from serious health problems, who need help. The ultimate cause of electromagnetic hypersensitivity remains in the dark. The best strategy to deal with the issue would be an individual approach combined with extensive studies on possible causes and remedies.

Health related effects of radio waves

In his paper Dr. James Lin, member of numerous scientific assocations and commissions in the United States, referred to health related effects of radio waves, i.e. fields of higher frequency than those of power supply (50 Hz, 60 Hz). He talked about scientific knowledge und results concerning the impact of radio waves on tumor initiation and promotion, the genotype (DNA), the visual system, the nervous system as well as human memory.

Childhood cancer and high voltage power lines

A differentiated approach to the issue of a connection between magnetic fields of high voltage power lines and childhood cancer presented the Canadian Mary McBride. Referring to the study of Wertheimer and Leeper (1979) she discussed the term „increased cancer risk“ questioning the validity of evidence and evaluation of certain individual studies. She stressed the particular importance of epidemiological studies. In this respect she pointed to the influence of the experimental strategy with set parameters demonstrating how different studies lead to different results and where there are their limitations.

McBride explained that from 26 studies carried out to this date on the topic „Childhood cancer and high voltage power lines“ in different countries you could draw following conclusion: In countries with a great share of above ground high voltage power lines (for example in the United States and Canada) generating higher magnetic fields; the contrary is true for countries where many cables run underground (Great Britain and other European countries).

A recent study from Great Britain concludes that there is no increased risk of childhood leukemia, acute lymphacitic leukemia, tumors in the CNS and other forms of childhood cancer at exposure to magnetic fields of high voltage power lines.

McBride is convinced that this study is an additional epidemiological proof of the hypothesis that high voltage power lines are no hazard factor concerning the diseases in question.

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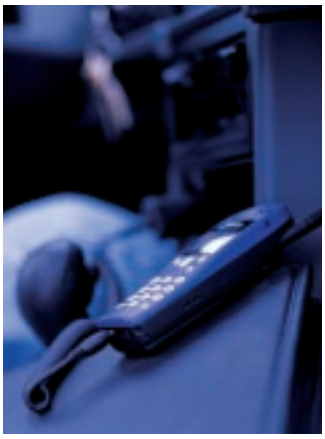
Discussion at BEMS 2000 broadcast by the Bayerischer Rundfunk (television) during the program „Kultur-Gespräch“ on July 2nd 2000

Who is afraid of “elektro

The second event on the agenda of the final press presentation at this year’s meeting of BEMS was a panel discussion about the topic „Who is afraid of electrosmog?“. The participants of the disussion broadcast by the Bayerischer Rundfunk, were experts from politics, administration, science and journalism. Dr. Walter Flemmer from the Bayerischer Rundfunk presented the event.



The topic of discussion was the uncertainty of a part of the public regarding the increasing use of radio services. Electromagnetic fields produced by radio transmitters in communications are suspected to cause adverse health effects. This phenomenon is popularly called „electrosmog“, a simplifying catchword referring also to the emissions of power supply. In the past the discussion about possible health dangers quite often was highly controversial and emotional. Public uncertainty mainly results from the fact that numerous partly contradictory studies on the topic „electrosmog“ are available. In addition, media approach to this sensitive topic is often characterized by sensationalist headlines.

The discussion round was meant to reflect the different views and the difficulties that arise in dealing with the topic. The focus was the role and attitude of politics, science, administration and media to the topic, particularly the question, whether the general population is sufficiently informed or whether there are gaps of knowledge needing to be filled.

Do media contribute to the uncertainty of the public?

Presenter Walter Flemmer came straight to the point addressing the uncertainty of the public concerning „electrosmog“: „‘Electrosmog’ - the term produces fear and emotion. Practically every week somewhere a new action group is launched aiming to prevent the installment of an antenna, and in newspapers and magazines we continually read of all the harm electrosmog does to us.“ According to Flemmer, scientific knowledge is greatly contradictory, ranging from insisting that there are effects to claiming that there are no effects at all. Thus, it is of great importance what attitude not only the individual, but, even more so, authorities, scientific disciplines and journalists take to the problem. Flemmer first turned to the representative of the media, scientific journalist Jörg Blech, asking following question: „Did we as journalists contribute to the fact that people are afraid?“ He cited headlines from media coverage such as „The hidden danger“ or „The danger from the dark“.

But in Jörg Blechs opinion media alone are not to be held responsible for the anxieties concerning electrosmog: „Media did contribute only partly to the problem, as they do not create the ‘Zeitgeist’. In the contrary, they react to it, and at some point reflect it.“ Blech continued that, incidentally, in the last few years worries have noticeably lessened. The media have grown weary of the topic „electrosmog“. Only with the boom of mobile phones the interest was rekindled. „As I see it there are two phases of press coverage: At first, the ‘classic’ electrosmog was in the news quite often; this phase gradually comes to an end. Now we have great media attention rather on ‘mobile phone smog’, as I call it.

smog?"

But I do have the distinct impression that the topic for the big papers does not hold interest anymore."

Do politicians have to be more cautious than scientists?

Walter Flemmer pointed to the „schizophrenic situation" regarding mobile radio antennas. On so-called sensitive buildings such as schools, hospitals and nursery schools antennas are not permitted to be installed, but at the same time more and more students take their mobile phones with them to school constantly using it. „They hold the antenna close to their head, while an antenna on top of the building is thought to be risky. Logically, we should prohibit both." Promptly, Walter Hofman of the „Arbeitskreis Landesentwicklung und Umweltfragen des Bayerischen Landtags" indicated that the precautionary principle has absolute priority regarding hospitals: „Though there have been carried out numerous scientific investigations on the topic, until now there are no definite results." Thus, in the opinion of Hofman in particular government must act „providing that above all the sensitive area of hospitals does not produce magnetic fields or emissions."

Do politicians therefore have to be more cautious than scientists aiming for the protection of the public? Ingeburg Ruppe from the Bundesanstalt für Arbeitsschutz und Arbeitsmedizin which is responsible for the protection of the public suggesting regulation standards and developing legal drafts answered to this question: „We seek to set limits which are certain to eliminate any risks", Ruppe explained. „As soon as we obtain recent research results, we decide on threshold values." The individual threshold value is then once again reduced at a safety factor given by bodies such as the International Commission for Radio Protection or the WHO and other institutions, above all for the protection of the public. The resulting „precautionary value" for the general public lies below the value of occupational protection, since employees generally are assumed to be healthy. Dr. Ruppe, however, admitted that science ultimately can not provide guarantees concerning the dangers of electromagnetic fields. „In fact, on balance the research results say us: We did not find anything, but at present we do not know for certain that there will be no effects."

Participants of the discussion – experts from politics, state authorities, science and journalism

- Dr. Walter Flemmer, Bayerischer Rundfunk, presenter of the discussion
- Dr. Ingeburg Ruppe, Bundesanstalt für Arbeitsschutz und Arbeitsmedizin - a public institution responsible for research and evualuation (administration, setting standards, legal drafts) for the protection of the public.
- Walter Hofmann (MdL), Arbeitskreis Landesentwicklung und Umweltfragen, as representative of politics' viewpoint concerning the practical consequences of scientific knowledge and the concerns of the general population.
- Dr. Roland Glaser, Humboldt University of Berlin, as a representative of the research community on questions such as: What is the contribution of science? Why can „compatibility" not be proved (zero effect)? Why is pure research necessary and where are its limits?
- Dr. Peter Neitzke, ECOLOG-Institut, editor of „EMF Monitor", representing the part of the research community with a critical attitude to effects of EMF on health and environment, primarily concerning the debate whether limits for the protection of the general population are sufficient.
- Jörg Blech, scientific journalist, „Der Spiegel", representing media concerning the question: How are research results perceived by the public? How do media use scientific news for manipulation?

Is sensitivity imagined?

The issue is made even more complicated by people who claim to be electrosensitive. Flemmer provocatively asked: „Is all that pure imagination?“ Peter Neitzke of the ECOLOG-Institut which is known for his rather critical attitude towards the compatibility of EMF, stressed that it may be difficult to answer this question, but „all in all there is a grain of truth in it.“ He told about inquiries of persons affected who accused their neighbours to operate a field-emitting appliance, but in the end it became clear that a ten-year-old conflict between the two parties involved was behind it all. However, there are numerous cases where „with high probability“ electromagnetic fields do play a part. „Only scientists find that difficult to accept, since in these cases numeruos symptoms are mingling.“ Neitzke pointed out how difficult it is to connect an individual symptom with ‘electrosmog’, as not even medical questions are satisfactorily solved. On the one side there are studies such as the one from America which comes to the conclusion that around 3% of the population are affected. „Others insist that laboratory studies can not prove this allegation.“ In spite of this uncertainty Neitzke demands that we „see to it that presumably affected persons are not unnecessarily harmed.“

Is setting limits simple?

But how can we set limits under such conditions? Roland Glaser from the Humboldt University of Berlin countered the impression possibly gained from the discussion that scientists are not as yet able to draw definite conclusions. He mentioned regulations concerning the case of potential accidents in the power system: „There we have very precise guidelines. After all, we know beyond doubt, at which potential a nerve cell reacts and when electric power causes cardiac disturbances.“ Concerning the relevant electric fields of the low frequency range it is definitely possible to set precise limits. In this respect Glaser pointed to the risk of brain overheating. But as to presumed adverse health effects below this heating range, Roland Glaser added: „Such effects are not known. But though they are not known, we can not claim to have given proof that they do not exist.“ A temperature rise during the use of a mobile phone alone is not sufficient to prove this connection, as also, for example, a lamp in the same position causes a heating of the ears. „We can only say that we are definitely able to set limits to those effects which are discernible. Show us a person who has been damaged by these heat effects, then we will react.“ As to precautionary measures he added: „The values known to have no adverse effects we reduce by a security factor. That’s all we can do so far.“

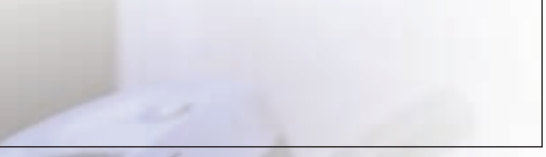
Are concerns a purely psychological phenomenon?

Ingeburg Ruppe reverted to the widespread concerns of the public which, in her opinion, have mainly psychological reasons. She argued that people, as they are passively exposed to electromagnetic fields from base stations, are unable to take any influence, in contrast to when they use a mobile phone or indulge in dangerous habits such as smoking or drinking. In addition, fields cannot be smelled, tasted or heard. „And this inability to take influence and to perceive causes the uncertainty, even fear.“ These frightening aspects often could trigger illness symptoms. „This means that not the fields are directly responsible, but at best a secondary factor, through knowing or not knowing about possible impacts.“ At this point Dr. Neitzke interfered to counter the impression to reduce this complex issue to „a psychological problem“.

Neitzke criticised above all Roland Glaser who previously had said: „Show me someone who has been harmed, then we may set new limits.“ In Neitzke’s opion, these words sum up our current dilemma: Limits in Germany, all in all, refer to visible, acute effects. He gave a number of examples of effects that limits as yet do not account for, „since we think that a chain of effects in the organism must be proven“. But, according to Neitzke, sometimes you must react to risks only thought probable. „Our limits do not account for these“, in contrast to limits of some other countries such as Switzerland, Italy or Canada orientated on the precautionary principle. Neitzke did not mean that we should not use mobile radio, but that we should „choose sites a little more carefully“. Antennas, for example, should continue to be banned from residential areas, nursery schools and schools. He pointed to the role of legal authorities: „In a situation like ours, when dangers are only presumed, legal authorities must act.“

Trapped in contradictions

Science journalist Jörg Blech for his part denied that there are risks involved. He mentioned two studies to emphasize his point: British scientist Alan Preece in his study on the impact of mobile phones claims that there is an increased fall-out



of stress proteins. In a test carried out with 15 participants, the users of mobile phones reacted 3.5 milliseconds faster (0.9%) than the control group. „As usual the conclusion of the study is that there are no immediate health risks involved, but that further investigations are necessary." This he characterized as irresponsible and as an example of manipulation of the media. The same would be true for a Swedish study that did not mention the fact that research scientists of the Max-Planck-Institut in Köln already had carried out a similar study concluding that there are no risks to be confirmed.

The same contradictions as in scientific research also apply to politics, as claimed Walter Hofmann, member of the Bayerischer Landtag. As an answer to the question whether there are health risks or not, he cited Dr. Lin from Chicago: „In the most a schizophrenic 'maybe'." Along these lines, politics should create a framework to make certain that possible adverse health effects through use of communication technologies are prevented. „Politicians always are very slow when science is not able to define under which conditions a health risk is to be presumed. Insofar, the only possibility we have is to go along with the precautionary principle: as little artificial waves as possible." To take precautions, however, is not only the responsibility of politics. All those concerned and affected should contribute to an active information policy, „since acceptance, trust and understanding of the public can only be gained by means of providing adequate information on the question which effects will come out from the use of a certain technology."

The dilemma is that there is no way to prove the impact of electromagnetic fields for example on cells. Science can not achieve this, as Peter Neitzke, editor of the „EMF-Monitor", explained. Therefore we should join „the side of precaution", as this would not necessarily would be connected with additional costs. Next to legal authorities and producers, each individual should be held responsible in the private sector, too. However, Neitzke pointed to the uncertainty arising whenever people voice their doubts on the precautionary principle. The situation gets particularly dificult „when there is spread conflicting information, in the end harming the public". There are obstacles that prevent taking precautionary measures, „on one side economical interests, second, inflexibility of politics, and, third, scientific conservatism. There is an overall tendency not to act and to openly accept new knowledge."

Public need for information

Dr. Ruppe criticized that scientific results quite often are published without being reviewed and that they are available only to a small group of experts - the reasons for the general uncertainty. Therefore she demanded an appropriate information of the public though conceding how difficult it is „to inform public objectively". The press should play its part in passing on matter-of-fact information. She stressed the role of the Bundesanstalt as a public institution for research and evaluation aiming „to inform working people", but unable to reach the general public. „In any case, ours is not the right institution to fulfil this task."

Concerning the role of the media Jörg Blech talked about the difficulties which journalists meet in their work. „I will give you an example: The English press cites a forceful statement that would be a good headline, but the correspondent in London at best has three hours to decide whether he should do a feature on it or whether there is further reasearch necessary." On the other side, according to Blech, scientists in conversation often are quite decisive, in their studies, however, they hold back „since the written word still has much more weight." He appealed to citizens and interest groups to read original sources to put worries to rest - an outrageous suggestion for Dr. Neitzke, who found that too much to ask from the public, as „they in every respect would have to be scientists or semi-scientists to be able to draw necessary information from scientific sources." He, for his part, diagnoses a great need for information in communities, cities and public authorities. „To this date houses are built directly below high voltage lines, because of the currently valid limits a legal, but in fact not necessary proceeding." Since there is an overall „lack of awareness", information should be given not only on the regional, but also on the level of communities, Neitzke concluded.

Conclusion

In his conclusive remarks Walter Hofmann as the representative of politics talked about information, too: „Concerning the selection of sites for mobile radio we will seriously think about the public need for information, together with municipalities, legal authorities and so on." He warned against playing down and trivializing the topic, but also against worrying the public out of whatever reasons. Walter Flemmer closed discussion with the words: „The need for information continues to be there, and we should dissipate widespread concerns by giving as much information as possible."

International Sym

„Electromagnetic Aspects of

CONFERENCE REPORT

Prague, July 9 - 12th 2000

Lutz Haberland

At this year's Prague symposium „Electromagnetic Aspects of Selforganization in Biology" up to 50 scientists came together in order to discuss the following topics on three subsequent days: „Endogenous electromagnetic fields (EMF) in biological systems", „Biophysical mechanisms of interaction between exogenous EMF and biological matter" and „Medical application of emerging technologies". The lecturers mostly presented still unpublished results of their experimental and theoretical research. Because of the subdivision in three thematic parts lecturers could report different aspects of their research, but this division also led to repetitions and certain lengths.

On the first day with the topic „Endogenous electromagnetic fields in biological systems" the event focused on presenting measurements of electromagnetic signals of cells and on theoretical models concerning the role of EMF in the selforganization of biological systems.

R. Hölzel of the Fraunhofer Institut Biomedical Technologies in Berlin in this respect presented results of indirect and direct measurements of HF-signals in algae and yeast cells. The indirect measurements based upon the observation that cells attract strongly polarising particles such as barium titanate which concentrate in the immediate vicinity of the observed cell.

posium
Selforganization in Biology“

This effect called „microdielectrophoresis“ has its reason in the existence of strong non-homogeneous electric fields surrounding the cells. Through direct measurements with microelectrodes and sophisticated electronics cell signals from a minimal power of 10 up to 17 watt were recorded. In three different cell types, for example bakery yeast cells, signals in a frequency range from 1.5 to 52 MHz were found. J. Pokorny from the Institute for Radio Technologies and Engineering Techniques of the Akademie der Wissenschaften in Prag presented similar results. In mutated cells of bakery yeast his working group recorded signals in the range of 8 to 9 MHz. During measurements the observed cells all were in the phase of cell division (mitosis). In certain phases of mitosis the spindle apparatus necessary for the division of chromosomes is particularly strong. Since the occurrence of the cells' electromagnetic signals correlated with an increased development and activity of the spindle apparatus, a connection between these two cellular events is assumed. But the biological meaning of these signals is still not clear.

The presented theoretical model calculations on the role of EMF at the selforganization in biological systems referred to a broad range of topics from the modelling of a molecular motor and the calculation of possible breaks in the hydrogen bridge bond within the gene transporting molecules (DNS) caused by electric fields up to calculations of resonance frequencies of the spindle apparatus consisting of microtubuli (x-ray/infrared range).

Further, there were quite a few philosophically inspired papers. So V.L. Vvedensky from the Kurchatov Institute in Moskow suggested a „Reset-Command“ which should transport the cell from a „disorder“ (like in the case of a disease) to „normal behaviour“. Here, he compared cellular processes to computer processes and in this respect speculated on a corresponding impact of different medicines and medical applications (laser therapy, electromagnetic stimulation).

The second day focused on possible influences of externally effective (exogenous) EMF. Studies on a wide spectrum of subjects, from humans, insects, bacteria up to molecular structures, were presented and hypotheses on the cause of the observed effects were discussed. L. von Klitzing from the Medical University of Lübeck for example presented studies on the impact of electromagnetic radiation on blood circulation in skin. Healthy subjects were exposed two times for ten minutes to mobile phones (936 MHz, 217 Hz modulated) and cordless phones (DECT 1.8 GHz, 100 Hz modulated). At the same time the blood circulation in skin was measured. The blood of some of the subjects periodically oscillated during exposure, contrary to the control group (without exposure) (frequency around 0.15 Hz). The results were interpreted as an effect on the autonomic nervous system, dependent on individual sensitivity. A possible impact of mobile phones (900 MHz, 217 Hz modulated) on biological systems has been examined by the working group around R. Jech from the research department neurology of the Karls University Prag. EEGs of narcolepsia patients were made (patients who by day suffer from several minutes long sleep seizures). Compared to healthy persons narcolepsia patients exposed to mobile phones showed no special characteristics in sleep and waking EEG. However, reaction tests showed significant changes of the visual potential in the right brain hemisphere (the mobile phone was placed to the right of the head). There was also a lengthening of reaction time of the patients

around 20 ms. Similar experiments with healthy subjects will follow.

Another focus of the day's topic was the impact of extremely low frequency electromagnetic fields (ELF-EMF). H.O. Gutzeit from the Institute for Zoology at the Technical University of Dresden presented a hypothesis surmising that ELF-EMF are so-called co-stressors. In an organism influenced by one or several sources (f.e. heat) therefore a 50 Hz/100 µT magnetic field is sufficient to unbalance the organism. Respective studies carried out on nematodes and drosophila flies confirm his hypothesis. He was able to demonstrate that ELF-EMF contribute to certain stress factors in nematodes (increase of expression in a certain gene controlled by a so-called stress promoter). In drosophila flies an influence (slowing) on the embryonic development was indicated. The condition under which these effects occurred, however, was a strong heating of the organisms up to the barely sustainable physiological level. M. Vácha from the Research Department for Animal Physiology at the Masaryk University of Brno (Czech Republic) also examined the impact of low frequency EMF (50 Hz) on insects. He observed the growth of the pupa of the meal bug at an exposure between 0.05 and 1 mT. An alteration of growth could not be shown. Further studies addressed the impact of ELF-EMF on cells of the human immune system (lymphocytes). The Italian research group around M. Milani from the University of Milan observed a change of the CO^2 production, a decreased cell growth as well as various morphological cell changes in lymphocytes at an exposure of 50 Hz (magnetic field, pulsed). A. Jandova and collaborators explored the influence of an exposure at 50 Hz, 1 or 10mT, on the adherence properties of T-lymphocytes in cancer patients and/or healthy study subjects. The adherence of these cells plays an important part regarding the mechanisms of specific immune responses and in healthy study subjects is stronger than in cancer patients. The indication of adherence intensity is used for example in immune tests to control the efficiency of lymphocytes. A. Jandova could prove an impact of low frequency EMF on the adherence ability of T-lymphocytes. Interestingly, she observed in the process that lymphocytes of cancer patients response with an increase of adherence, whereas the adherence of lymphocytes of healthy study subjects exposed to EMF significantly decreases.

Non-thermal effects of high frequency radiation (millisecond waves) have been explored by I.Y. Belyaev from the Department of Molecular Genetics at the University Stockholm in E coli cells. Following a detailed introduction into the applied method for viscosity measurement of lysed cells he presented the observed effects. Several „resonant" frequencies around 51 GHz have been recorded, showing an increasingly narrowing frequency bandwidth with a decrease of the transmitted power (up to 10-17 W/cm^2). The results were interpreted as an alteration of the DNA folding structure. Because of the low radiation intensity according to the author, we may only assume a quantum mechanical effect. His own model of mechanisms of „Electron-conformational Interaction" from 1996, however, was not mentioned.

The papers of E.A. Kovacz from the Medical University Bukarest and of E. Unger from the Institute for Molecular Biotechnology Jena presented studies on the impact of relatively strong EMF on biological systems. E.A. Kovacz, supported by H. Berg from the Virological Institute Jena, examined the behaviour of photo receptors of the eye retina in static and periodical electric fields (10-1500 kHz). Field powers were 400 V/m up to 200 kV/m. From the obtained results the authors derive conclusions on the dielectric properties and the living ability of cells during exposure. E. Unger presented a study on the influence of EMF on cell structures participating in cell stabilization (microtubuli). He demonstrated that microtubuli can be directed and moved by strong electric fields.

The third and last day of the symposium primarily dealt with possible medical applications of EMF. Non-invasive methods of temperature measuring combined with hyperthermical treatment, new therapies for the treatment of skin alterations (such as warts, tumors) using non-ionizing radiation in the visible wave spectrum (photodynamic therapy) as well as medical progress concerning the microwave-resonance therapy in the Ukraine were presented by J. Vrba from the Technical University Prag, M. Jirásková from the Research Department for Dermatology of the Karls University Prag and B. Grubnik from the Scientific Research Centre for Quantum Medicine Kiew.

The to date unpublished results concerning effects of electromagnetic fields presented at the symposium now will have to be repeated by independent scientists. In the area of possible mechanisms no new insights were given. Not least because of the absence of some referees certain lectures were characterised by in-detail depictions of the own working organisation und life philosophy, not necessarily a benefit for the event.

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News

Call for project „Electrosensitivity“ of the FGF concluded

The call for the research project „Provocation study on electrosensitivity“ issued last year by the Research Association for Radio Applications ended following a thorough evaluation of all applications. Over the past year eleven applications of university institutes from Germany, Finland, the Czech Republic and Great Britain came in. The applications have been evaluated and ranked by independent experts in a standard procedure based on precisely defined criteria. The proceeding ended on August 9th 2000.

Cooperation between American Health Administration and mobile radio industry

On June 8th 2000 the American Health Administration FDA (Food and Drug Administration) announced future cooperation with the association of the mobile radio industry (Cellular Telecommunications Industry Association, CTIA). Supervised by the FDA over the next three to five years the CTIA will promote studies on the safety of mobile radio devices. The amount of funding is not yet established.

The selection of the individual studies that will be part of the promotion program will be made by a commission of international specialists. The FDA will ensure that the research projects are carried out by independent scientists and that the studies will be scientifically exact. All results will be reviewed based upon scientific criteria and published in medical journals. Thus, physicians as well as consumers may have access to information and critically reflect studies' conclusions.

According to Harvey Rudolph, director of the FDA's department „Science and technology“, the first study will deal with the question whether weak radiation emitted by a mobile radio device can cause genotoxic effects or not. If genotoxic effects should be established, it is necessary to explore the radiation intensity at which the effect will occur. In the view of the FDA „we do not have sufficient information to be completely sure that these products pose no risks“. On the other side, the results suggesting possible health hazards for users lack convincing proof.

Further, research results from industry will be explored in order to find aspects which are worth further scientific interest. Advice and recommendations given by the FDA shall contribute to the aim that the studies to be carried out provide credible results.

Easier access to the Science Helpdesk of the Forum Mobilkommunikation in Vienna

Because of the great interest the FMK Science Helpdesk http://www.sciencefaqs.com in the future will be also accessible to state authorities. Thanks to the cooperation with international scientific bodies such as WHO EMF Project, ICNIRP, IEEE, BEMS, URSI, the FGF and a number of contributions from internationally renowned institutes standard and variety of knowledge sources could be significantly increased. The FMK appreciates the great willingness to cooperate.

News

Auction of UMTS licences closed

On July 31st 2000 the auction of licences for the mobile radio standard of the third generation, UMTS (Universal Mobile Telecommunications Standard) started in Mainz. Eleven candidates were allowed to participate in the competition on the much sought-after UMTS licences by the regulation authority. Three applicants, Vivendi Telekom International, WorldCom Wireless and Talkline, already left before the first round. Auditorium Investments Germany S.A.R.L. retreated too, since the shareholding company Hutchinson Whampoa from Hongkong originally went for a cooperation with the parent company of E-Plus, KPN. On August 17th the Asians put an end to this cooperation, too. SwissCom daughter Debitel from Stuttgart left the auction on the tenth day. On August 17th after 173 auction rounds the future six licence holders were found.

- T-Mobil of the Deutsche Telekom
- E-Plus (KPN)
- the syndicate Group 3-G
- Mannesmann Mobilfunk
- Mobilcom Multimedia and
- VIAG Interkom

will compete for clients at the future UMTS market. The companies' interest was worth between 16,37 and 16,58 billion DM. The final sum of the bids was 98,807 billion DM (50,519 billion Euro). During an auction on August 18th uncoupled frequency blocks were given to the competitors. These blocks went to T-Mobil, E-Plus, Group 3-G, Mannesmann Mobilfunk and Mobilcom Multimedia for 561 million DM (286,8 million Euro). Thus, the Federal Minister for Finances, Hans Eichel, may look forward to receive the substantial sum of 99,368 billion DM (50,805 billion Euro).

While some observers like Telekom spokesman Stephan Broszio characterised the bids as „economic madness", others, such as expert Josef Scarfone, suggested that after the UMTS auction future wins of mobile radio companies are at stake. For the company Talkline the high licence fees were absurd from the start. „Licence costs will in no case pay back", said Talkline manager Kim Friemer. Similar recriminations were the reason for Vivendi manager's Jean-Marie Messier early withdrawal.

The only German company among the future UMTS services is the Deutsche Telekom. The rest of the companies all are foreign consortiums or have foreign parent companies. With the Group 3-G led by the Spanish company Telefónica and the Finnish Sonera a new company enters the competition within the German market.

Beginning with the year 2002 German people shall be able to make calls with the new UMTS system. In the following years the network shall grow fast, as the companies by buying the mobile radio licences undertook the obligation to connect 25 per cent of the population up to the year 2003 with the network of the future and even 50 per cent up to the year 2005. The extensive promotion of the UMTS network will cost the companies further 7,5 billion DM.

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