

NEWS

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Editorial

Unfortunately, a great deal has happened during the last few months and weeks. Future political and economic developments are causing us to view the world apprehensively. Regrettably, false information and half-truths contribute substantially to our fears and concerns because correlations can not be properly understood, misjudgements are made and data are not correctly evaluated.

Therefore, precision, comprehensibility, and especially sincerity are of utmost importance in all areas of life.

For more than ten years the FGF has been making every effort to support and advance independent, comprehensible and verifiable research. This was not only validated at our annual meeting this year, but also in the current issue of our Newsletter, which you are holding in your hands right now; we do our best to ensure that all editorial contributions are impartial and objective.

The FGF was able to contribute to an empirical study conducted by the Wissenschaftliches Institut für Kommunikation (WIK) - (Scientific Institute for Communication) - on the current state of affairs concerning the public's opinion on EMCE by making its long-standing press evaluations available to the WIK. A summary of the results of this study and the development of the EMCE debate are published in this Newsletter.

Since the controversial Salford study is still being discussed at length and has drawn the public's attention again to mechanisms involved in the blood-brain-barrier, we have decided to take a more detailed look at several different areas pertaining to this subject.

An article in this Newsletter reports on an international conference held in Moscow and St. Petersburg and on the informative findings of Russian research projects.

In the meantime, in its usual place, you can find the column heading "The latest scientific news" where there are a few short articles and an article about the EU's 6th framework programme. Of course, also included in this issue is the obligatory report on our 11th annual meeting, which took place this year in Munich.

Best regards
Gerd Friedrich

Table of Contents

MEDIA ANALYSIS

Electrosmog in the media p. 2

SCIENCE

Articles on the blood brain barrier

Structure and function of the blood brain barrier p. 14

Field effects posed by mobile radio communication systems and the blood brain barrier p. 18

Does the Salford study deserve all the media attention it is getting? p. 22

GENERAL MEETING

The 11th annual meeting of the Forschungsgemeinschaft Funk p. 26

RESEARCH

The latest scientific news p. 30

CONFERENCE REPORT

"Electromagnetic Fields and Human Health, Fundamental and Applied Research" p. 34

POLITICS

Topic: "Mobile radio communications and the Environment" is an outsider p. 41

NEWS

p. 43

IMPRINT

p. 44



The results of an empirical study commissioned
by the Federal Ministry for Industry and Employment

Electrosmog in the m

Franz Büllingen

Since the mobile radio frequencies for universal mobile telecommunication systems (UMTS) have been auctioned off and the license holders have started to roll out the network infrastructure, there are considerable indications of a growing resistance to and acceptance of new mobile radio communication technology. The effects of electromagnetic fields (EMF) on human health and the possible consequences is increasingly developing more into a political issue, which is controversially discussed throughout society, by political parties, by municipalities or by public institutions.

Some municipalities have already been trying to restrict the extension of networks by referring to restrictions placed on buildings under historical preservation or municipalities are being confronted by citizens vehemently demanding that the locations of base stations be disclosed to the public. Especially regarding media coverage the possible acute and latent health risks stemming from the increasing expansion of high frequency electromagnetic waves is seen more frequently as a topic for reports in the media.

To date, research on electromagnetic compatibility concerning the environment (EMCE) has revealed that no problems have arisen from UMTS, but for more than two decades the media has very often chosen this subject to be a central theme. In the 1980s during the course of increasing technical advances in households, possible health risks from sources of low frequency emissions, such as high tension lines, electrical power lines in homes and many electrical appliances in households were given high priority by the media. At the beginning of 1990s it was then pushed out of the picture by the increasing number of reports on mobile radio communication systems. In the beginning the discussion was about the significance of electro smog caused by setting up transmitter masts for Global System for Mobile Communications (GSM, the abbreviation commonly used for D- and E-networks). Today in almost

every large municipality there is a citizens' action group concerned with this in spite of the fact that at present, Germany has a penetration rate of almost 70% and a high level of acceptance of mobile phone use.

To date, it seems as if the public's opinion on mobile radio communications has focused more on the issue of convenience, for instance, being able to be reached at all times, more mobility and an increase in personal safety. However, arguments stating that mobile phone use is associated with possible health risks have overshadowed the convenience and personal safety aspects. Nevertheless, in the meantime, with regard to local political resolutions in Munich or Berlin, it can no longer be ruled out that the EMCE debate will bring about far-reaching consequences concerning the extension of UMTS-networks and will affect the demand for mobile radio communication services.

In this context the question arises as to which direction the EMCE debate will proceed, in spite of there being legally established limit values and despite the fact that in the public debate there is a lack of general indisputable scientific causal proof. A prognosis on further progress requires a fundamental understanding of the following aspects:

- what roles the different groups of actors in EMCE discourse play,
- how they communicate,

- how the situation will change by the upgrading of GSM-networks
- and the introduction of UMTS,
- how potential risks are perceived and discussed in public,
- and how these risks in comparison to other types of risks are evaluated.

Only a heightened knowledge of the EMCE-discourse can initiate starting points which can influence this process. Within this context the Federal Ministry for Industry and Employment (BMWA) commissioned WIK-Consult in 2001 to carry out an extensive analytical empirical investigation.¹

The first step in this study was to do a fundamental theoretical investigation of the significance of technology induced risk discourse. The second step involved the investigation of how the EMCE problem is dealt with in print and in audiovisual media (AV media). The media analysis was based on circa 1,200 articles relevant to the subject, these articles were taken from press data banks. The Forschungsgemeinschaft Funk's (FGF) extensive documentation of articles on the topic was also used; the FGF has been regularly evaluating media coverage since 1995.

The third step was concerned with risk perception and its evaluation by the public. This was investigated with a representative survey in cooperation with Ipsos Germany; an institution which conducts

opinion surveys throughout the public. The results were validated in numerous extensive interviews by laypersons.

The fourth step involved an analytic comparison of the corresponding discourse process in the following countries: Austria, Switzerland, Great Britain and Italy. For the final prognoses experts from different fields were interviewed. Based on these interviews, future development prospects were worked out by means of a scenario technique.

I. The EMCE-Risk Discourse

Modern risk communication research offers an important approach to understanding social communication and its process concerning risks posed by technology, such as those discussed in the EMCE debate. If the sociologist Ulrich Beck's analysis is correct, which states that dealing with incomplete information concerning modern technology is a structural characteristic of today's society and that technical problems are in essence social risks, whose evaluation, acceptability and regulation are the result of negotiation processes then communication processes regarding all significant technology and its potential risks are unavoidable. This is especially true for system innovations such as mobile communication systems, which have an effect on all areas of work, and leisure and have changed our communication habits completely.

Some of the peculiarities of this debate are that the risks are first constituted through political discourse. Risks in a social context are only significant to the extent in which they are perceived, evaluated and communicated. Objectively, in most cases this happens almost independently of its explosive nature, of how extensive it is or of the factuality of a technically caused risk. A formula originating in the insurance industry is determined according to the risk of a technology (R), according to the possible extent of the damage (D) and according to the probability (P) of the damage occurring, ($R = P \times D$). This formula has really no practical relevance at all for public risk discourse. The debate in Germany and France on the risks posed by nuclear energy took different courses and had different results. This elucidates the fact that comparable technology and risks can be perceived and assessed completely differently. They point out that the process of this discourse is principally open and therefore suggestible and can lead to totally different results.

In this context controversial debates between various actors and social groups should not be regarded at all as an interference factor and seen as unnecessary public vexation, delays and high costs. They must much more be understood as a meaningful contestation concerning the determination and the layout of social embedding and the behavioural use of a new technology. Hence, a society's relationship to the environment and its attitude towards health, different cultural values inherent in a society, and its regional or national characteristics, the basic standpoint a nation has towards innovations as well as the subjective and collective evaluation of the use and risks all play a central role.

However, discourse about risks should not have too many positive expectations that conflicts and conflicting interests can be totally resolved in the end. This seems difficult because conflicts are invariably

normatively charged and one must proceed from the assumption that a pluralistic society will have divergent value concepts. Regarding risk communication many more attempts should be made, even with insurmountable dissent and conflicting interests, to reach socially compatible and if possible versatile and acceptable compromise solutions.

All risk discourse can be described as constituting a political arena, where social groups, and actors such as associations, standardization institutions, public administrations, industrial corporations, courts of law or political institutions enter into negotiating processes. Presently, the media, local citizens' action groups, the law as well as the network operators have the greatest influence in the EMCE arena, whereas, numerous other actors, e.g. political parties or medical associations are gradually beginning to get involved. In this respect, we can assume that when more actors enter the arena the conflict will intensify rather than move towards a settlement.

As a rule, value limits and the stipulation of these value limits set the stage where acceptance or unreasonable demands concerning collective risks are fought over. The more the public responds and the more intense the debate becomes, the greater the probability is that a dissent or a conflict will lead to a political solution and consequently, the management of risks will have been organized. Concrete results, such as the publication of new scientific findings, reports on health risks, protests, court cases, (e.g. the law suit filed for billions against Motorola) and their proliferation by the media can bring the debate to a critical head. Inversely, measures such as agreements being made between municipalities and network operators (issues dealing with location) by means of more transparent information, could to a great extent, contribute to easing the situation, since this would give a considerable signal to the public that their concerns about risk prevention will be paid attention to.

2. The presentation of the EMCE-problem in the German media

For public perception and the communication of risks caused by technology, the media has a central function to act as a coordinator and reinforcer. Scientific investigations of media coverage have pointed out, on the one hand that mass media is seldom biased when reporting on controversial issues having to do with technology. On the other hand, media competition for coverage and the goal of reaching as many people as possible often causes journalists in their articles to play the role of advocate for their readers and to dramatize certain subjects. Whether or not an accident is perceived as positive or negative depends on how it is reported on, it is seen as positive when the words “number of probable survivors” is used and the report is perceived as negative when the words “the number of expected deaths” are used. The choice of words can, therefore, have an enduring effect on the public’s perception of risks and their evaluation of risks. In this context, the general significance of the media’s presentation and life-cycle of a risk issue poses the question of the media’s role in the EMCE debate.

2.1 The frequency of EMCE articles appearing in the media

At the beginning of the 1990s the EMCE problem was only sporadically mentioned in the media. Less intense periods were replaced by periods when the subject was more intensively reported on as a central theme. The situation fundamentally changed when the GSM-900 network was set up. Nationwide in 1994 there were already more than one thousand newspaper articles reporting on the potential risks posed by mobile radio communication systems. The following year 1995, there were more than 3,000 articles published, circa 280 per month. In the following years the number of reports remain constant, but later in July 2000 the number of articles

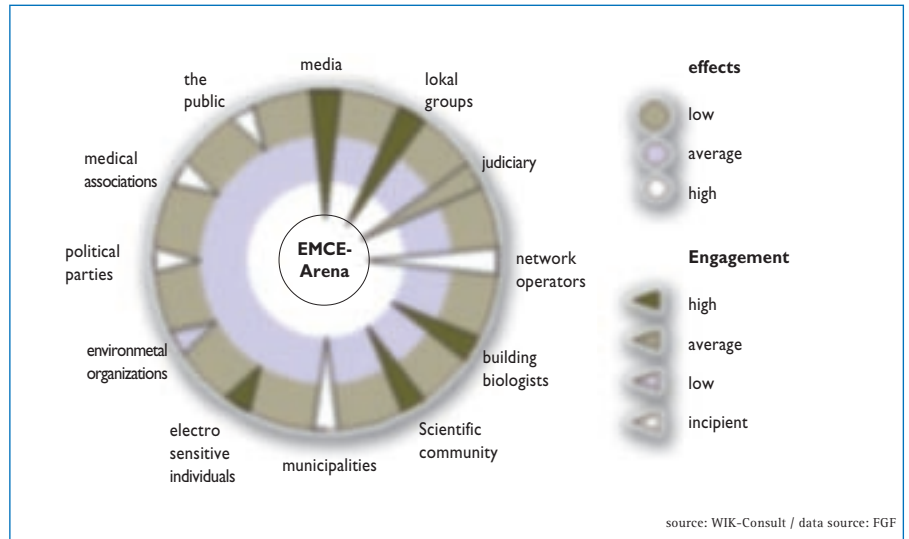


Diagram 1: actors' rolls in the EMCE-arena

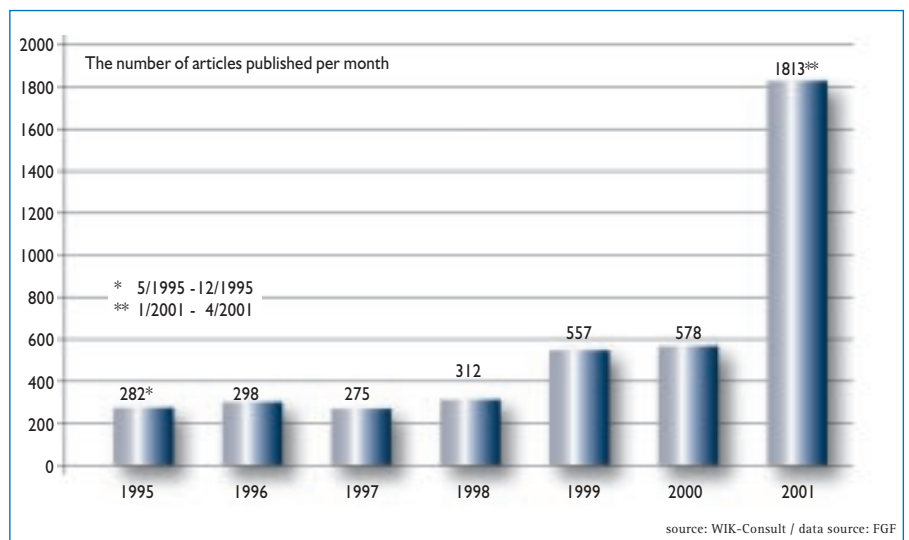


Diagram 2: the frequency rate of EMCE-problem presented as a central topic in print and AV media

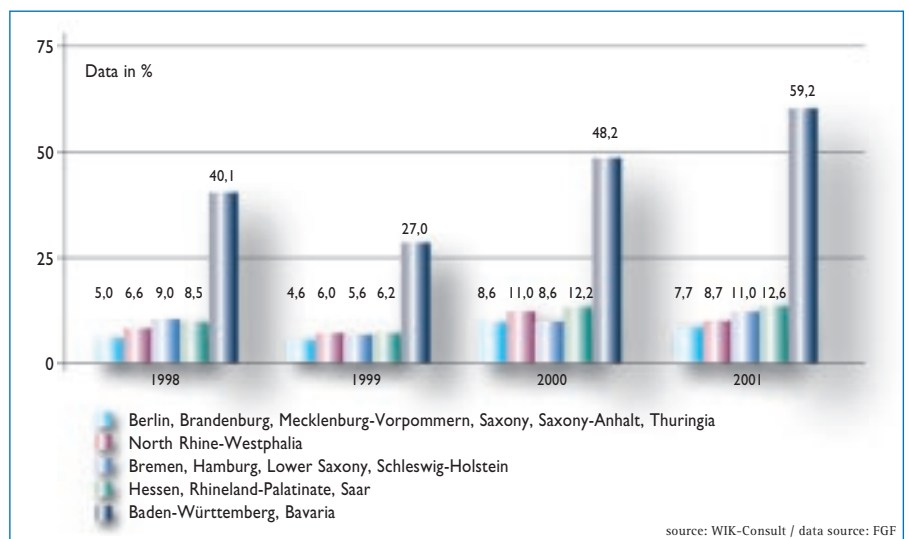


Diagram 3: Regional distribution of media coverage

skyrocketed due to the media's response to the increase in UMTS-frequencies. The number of reports tripled until 2001, when there were over 1,800 press clippings per month. In 2002 the number was more than 2,500.

2.2 The distribution of articles according to the type of coverage in the media

The EMCE-problem is, in particular, a subject for the daily press, these articles very frequently appear in the local news sections of newspapers. Usually, the information found in this section of a newspaper refers to current events, which usually receive a lot of attention in the media, such as court rulings, the founding of a new citizens' action group or the release of the results of a new study. Weeklies or periodicals that appear every two weeks and have the possibility to thoroughly present all the relevant background information give the EMCE problem very little priority as a topic of interest as opposed to daily newspapers.

2.3 Regional Distribution

If one has a look at the distribution of the articles in the media with regard to the federal states, there is a clear south-north inclination. Especially for the years 1998 - 2001, a noticeable asymmetry is exhibited. More than half of all the articles (59.2%) can be allotted - with an increasing tendency - to the federal states in the south, Baden-Württemberg and Bavaria. All of the other states were recorded as having a consistently low level of media coverage. In 2001 8.7% of all of the articles published on the EMCE debate appeared in North-Rhine Westphalia, for the federal states, Bremen, Hamburg, Lower Saxony and Schleswig-Holstein the percentage was 11%. For Hesse, Rhineland-Palatinate, and the Saar the corresponding percentage was 12.6%. The EMCE played only a marginal role in the media in the eastern states.

2.4 Referring to the field source

For the most part equipment for the infrastructure and terminal equipment was referred to as causing biophysical effects. The majority of the reports stated that radio masts (75%) and mobile phones (43%) were the major source of emissions. When radio and television technology is included (4%) in the statistics then reports on high frequency technology dominate this type of media coverage, whereas low frequency sources such as high-voltage power lines were almost ignored in the media. Altogether the number of reports on radio masts and mobile phones both increased continually since 1996, however there were less reports on mobile phones than masts.

2.5 Coverage referring to the biophysical effects of HF

Since the mid 1990s the causes or the promotion of cancer and effects to the head (the brain) have frequently been a topic chosen to report on. The number of reports on cancer and the weakening effects on the immune system have been relatively constant. Effects to the heart, hormonal problems, or deformities, in contrast are problem areas which are not reported on very often. Surprising is that reports on adverse effects on people's well-being has taken on much more relevance in public discussions during the last few years. Functional complaints such as headaches, sleeping problems, nervousness and symptoms of stress are mentioned more often as well in the last few years. Thus a mobilization effect of this media coverage cannot be ruled out, because the number of people potentially affected by this could increase considerably.

2.6 Legal aspects

Since 1998 a clear increase has been established in the media's interest in covering the legal aspects of the EMCE-problem. The EMCE -legally drawn framework

(such as, 26.BImSchV) as well as lawsuits and proceedings pending in court, have all been since 1998 the subject of media reports. These facts are reported on so often in the media that citizens along a wide front are fighting legally against the setting up of mobile radio infrastructures. On the whole, one has the impression that the conflict has increased on a broader scale. Approx. 22% of all media reports in 2002 dealt with the legal aspects of the EMCE problem.

2.7 Tendencies in media coverage

Since the FGF started to document media coverage in 1995, it has been determined that the tendency to report on the EMCE debate fluctuates widely. During the mid 1990s a large part of the reports maintained a neutral weighing up of the risks and opportunities involved with mobile radio communications (articles were written in question format: "Will using a mobile phone make you ill?"). However, nowadays when articles are neutral or rather the coverage tends to be positive emphasizing usage, it is almost always an exception (less than 10% of all articles). In contrast, what was noticeably high was the percentage of reports where various health and other risks were emphasized as well as focusing on the deficit in dealing with the EMCE-problem by the network operators and by the municipalities or other public institutions, such as state parliaments or the federal government. This kind of reporting has tended to increase since 1999.

2.8 Argumentative Stereotypes

For years media coverage on EMCE problems has been consistent in characterizing the content of the presentation and the roll of the various actors.

Upon close inspection the critical or rather the negative reports can be sub-divided into the following argumentative stereotypes.

Information and Explanations

- “Network operators do not inform municipalities at all about the planned locations for base stations or they inform them shortly before they set up the base station.”
- “The information that the network operators provide does not exactly inspire confidence in mobile radio communication systems because they do not answer or only inadequately answer the questions that concerned citizens ask.”

Knowledge Aspect

- “The mobile radio infrastructure is being expanded further even though the potential health hazards have not been thoroughly researched.”
- “It is doubtful, if questions concerning electromagnetic effects will ever be objectively answered with verifiable answers.”

Precautionary Aspects

- “The existing value limits, in view of the large infrastructure density in Germany, are generally too high.”
- “The value limits relate only to the thermal effects and the athermal effects which could occur below these value limits are not even considered.”

Democracy and Legitimation Aspects

- “The financial interests of the industry prevent any kind of preventative health protection. In order to protect their own commercial interests the network operators are trying to greatly influence the public and politics.”
- “There is a lack of fairness on the side of the mobile radio communications industry when dealing with the interests of the public.”

Enforcement Aspects

- “Not all transmitting installations comply with the value limits.”

If network operators and public institutions want to have successful risk communication, it is imperative that they deal intensively with these argumentative stereotypes.

3. Risk perception and the public’s evaluation

Fundamentally the survey was based on a representative demographic variable according to sex, age, education, income etc. Information was obtained through telephone interviews (CATI), 1000 people were interviewed. 14-17 year olds were included

in the survey but they were asked questions which were different from what the other interviewees were asked. In different sets of questions the interviewees were asked to give a general assessment on mobile phone use, they were also asked about the latest information on the subject, about an evaluation concerning risks related to mobile radio communication, about possible precautionary measures and providing information. Since the survey itself was so broad the results can only be presented in a condensed outline form.

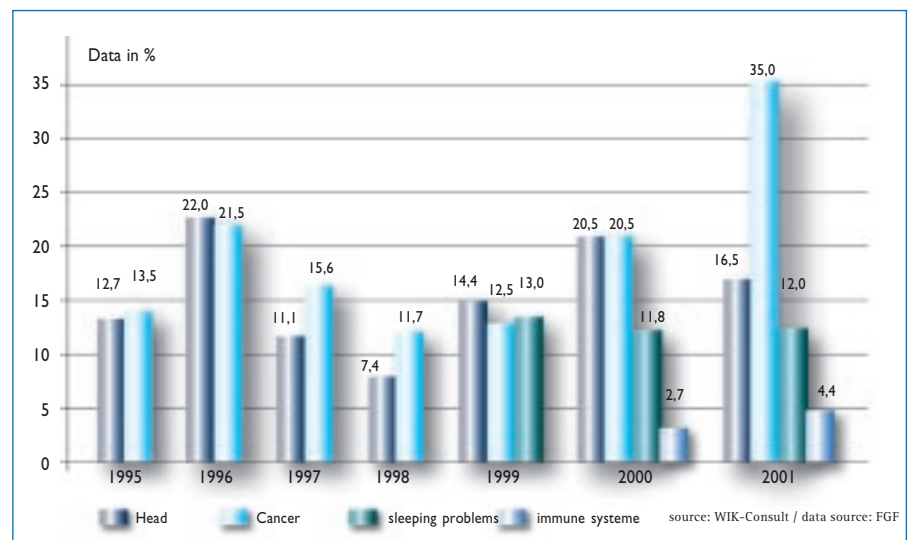


Diagram 4. How often potential health risks were mentioned in % with regard to all media reports (I)²

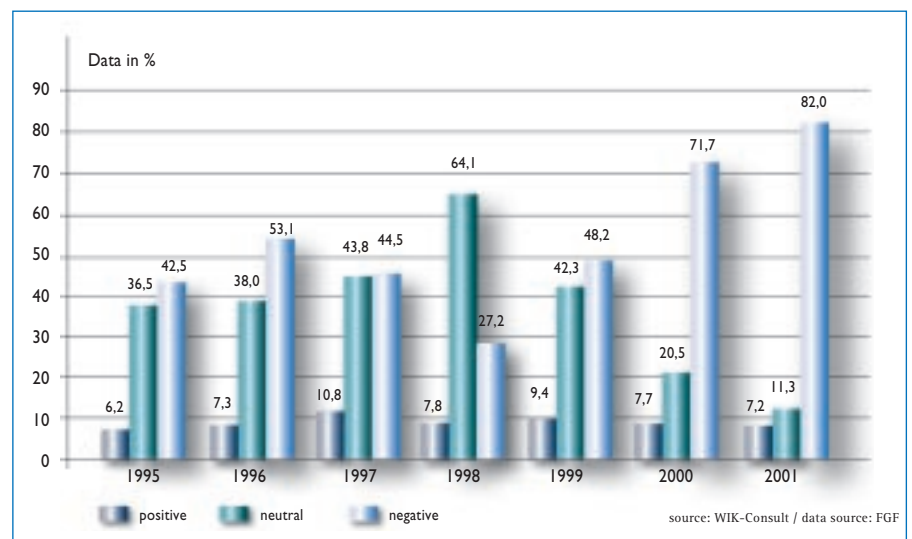


diagram 5. Tendencies in media coverage

3.1 The use of mobile phones in Germany in 2001

- Within Europe, Germany has a leading market share of 20% for mobile phones. The high penetration rate of more than 67% and the fact that more than 55 million phones are connected to mobile networks indicate that there is an extremely high level of acceptance of mobile telephones.

- A saturation of the mobile radio communications market seems to have finally been reached. The enormous growth rate of the last few years is clearly declining.

- The percentage of people who do not have a mobile phone has stabilized. About 90% of non-users do not plan to get a mobile phone one day. These people are primarily the elderly, people without children and people with low incomes. Circa 4% plan to sign a contract in the near future.

- A high percentage 46% can be considered to be those who do not use a mobile phone very often. This segment uses a mobile phone only a few times or even less per week. 54% are people who use a mobile phone very often. They use it many times a day.

- Mobile phones are used most of all in households with children. They are very helpful for maintaining the necessary daily communication and they provide families with a feeling of being psychologically close. Fears relating to EMCE-emissions alleged to be especially harmful for children and adolescents did not influence people's decision to get a mobile phone.

- The mobile phone has transformed itself from a luxury item into a commonplace device, which is obviously used at all times for many different purposes. It is also being used more and more as a substitute for the fixed network, which alternatively would be completely free of risks provided that no DECT-based (digital enhanced cordless telecommunications) cordless phones are used.

- Mobile phones have undeniable ad-

vantages. More than three-quarters of those interviewed said that a mobile phone gave them a feeling of security, just about three-quarters concluded that they are more mobile and flexible with a mobile phone and two-thirds said that a mobile phone made the organization of their daily lives easier.

- Mobile phones are used mostly for personal use; this stresses the aspect of spontaneity. The percentage of those who possibly had to use a mobile phone for professional reasons is minuscule, especially for women.

- The public regard mobile radio communication positively as an economic factor. Approximately two-thirds believe that mobile phones create jobs.

3.2 General information – knowledge and self-assessment

The second set of survey questions dealt with general information about the potential risks posed by mobile phone use. What was especially relevant in this context was in what way can fears be traced back to subjective assessments and what was based on objective knowledge. What had to be taken into account was whether or not the person being interviewed lives near a base station.

- Approximately one-third of those interviewed were not aware of a radio mast in the area where they lived. One-third could not answer the question. A majority of the population showed little interest in the question pertaining to location.

- More than one half of those interviewed said that the physical sight of a radio tower did not disturb them. Especially, men, frequent users and younger users of mobile phones were not critical when it came to giving their opinions on the aesthetics of having mobile radio masts blighting the landscape and rooftops.

- About 90% of the population had already heard of the possible health risks involved with mobile radio communica-

tion systems. However, most of them felt that they were not well-informed on the subject. Many people had already heard of important terms relevant to the EMCE-debate, but they could hardly associate them with anything concrete.

- Young men, frequent users and those interviewed with a high income were considered to be the most informed on the subject. Women and the elderly were the least informed.

- An important source of information for 95% of the interviewees was the media, almost one-third obtained their information from their peer-groups (friends or acquaintances). For 13% interviewed environmental organizations played an important role as a provider of information. Remarkably, very little attention was paid to information provided by public institutions (5.4%) and especially information from the network operators (4.6%).

3.3 The public's perception and assessment of potential risks posed by EMCE

A third set of questions dealt with the public's assessment and perception of EMF posed by mobile radio communication systems. At this point in the survey the interviewees were asked to compare the actual or potential risks of various technologies. They were also asked if they knew anything about EMF with regard to some electro-technical devices such as PC-screen, a microwave oven, or a mobile phone, in order to estimate just how well informed they were on the subject. Then they were asked to estimate which health risks are connected to mobile radio communication systems. Finally, in order to get an idea of who is directly or indirectly affected they were asked about their own experiences, or experiences friends or acquaintances had regarding health problems in conjunction with mobile radio communication systems.

- When the possible health risks posed by mobile radio communications are com-

pared to other technologies, they were basically estimated to be less harmful. However, only one-fifth of the population believe that there are no risks at all.

- Those who regard mobile radio communication systems harmful also rated the risks of other technologies to be high. High risk assessment and high acceptance- combined with intensive use- cannot be ruled out with regard to mobile radio communications. This indicates that perhaps a pragmatic relationship has developed regarding contact with a potential residual risk.

- More than one-half of the population is convinced that the risks posed by mobile communications will increase in the future. One-fourth believes that exposure to EMF-risks will remain the same.

- The high level of insecurity which has developed from this situation is the expression of a great need for information dealing with future developments. ("What will happen next?")

- The public's knowledge on the EMF-phenomena, especially concerning household appliances, is extremely limited, and as a rule it has nothing to do with the actual facts.

- Two-thirds of those interviewed stated that the primary source of health risks came from mobile phones and not from transmitting masts. This is a clear contradiction as to what is reported on by the media.

- When mobile phones are rated - when at all - they predominate completely as a potential risk because they are held close to the body.

- Mobile radio masts are rated as a high risk because of the intensity of their "radiation". How close the transmitting mast was to a place of residence played a very small role in the risk potential assessment.

- In spite of the public's insecurity, the number of people who believe that they have already had experience with health problems caused by mobile radio communication systems or have heard about

someone who has in their peer groups, is very low. If there were any problems at all they were functional disturbances or feeling out of sorts. Due to the low number of cases who claimed to have had such a personal experience, a statistical conclusion cannot be drawn.

3.4 Precautionary measures, evaluating the uses and the risks

A complete absence of risks has to be regarded as a typical ideal situation, which cannot exist in a hi-tech world. Public controversies about risks posed by technology evolve around evaluating the uses on one side and the acceptance of the risks on the other side. In this context a set of questions was used to find out how prepared people are, who regard mobile radio communication systems as harmful, to take precautionary measures. With this in mind they were first asked how willing they were to personally take precautions and if they were willing to protect their interests by becoming involved in a citizens' action group. The second question asked them about the conditions and their acceptance of general precautionary measures. Since questions concerning the necessity of precautionary measures are generally answered positively by the public, they were also asked if they were prepared to pay for the reduction of potential health risks.

- More than two-thirds of those interviewed said that they would personally take precautionary measures. Time limits for phone calls was the most popular measure, since it also includes the incentive to keep the cost of phoning down. Older people as opposed to younger people, are more willing to personally take precautionary measures.

- Uncertainty about possible mobile communication risks leads to restrictive telephone behaviour and this results in lower air-time.

- Those interviewed who said they personally took no precautionary measures,

as a rule they did not take any precautions because they felt they were not at risk and they did not want to restrict their mobile phone use.

- The willingness to become involved in citizens' action groups fighting to stop the erection of mobile radio masts is relatively high. Approximately 15% of the population would become involved, or perhaps take part in a citizens' action initiative or they are already actively involved. Women with children under 13 showed the most willingness to become active.

- Two-thirds of those interviewed who had already heard of a citizens' action group regard their activities as meaningful. Even though very few of them are involved themselves, the activities of these groups are silently supported. More frequently than average, older persons with a high level of education regarded the work of citizens' action groups fighting against mobile radio masts as meaningful.

- More research on health risks as well as a compulsory declaration for mobile phones are the most popular precautionary measures.

- More than 80% of those interviewed think that a reduction in value limits makes sense. Circa 45% also find this meaningful even when a reduction in value limits means more mobile radio transmitting masts would have to be erected. About two-thirds are in favour of a decrease in value limits even if it entails higher fees and charges when using a mobile phone. Therefore, the ongoing debate about limit values will remain a central focal point for all of the actors in the EMCE-arena.

- Just about one-third of the interviewees were prepared to pay an additional Euro 2.50 per month, if the money would be used for precautionary measures. A little more than one-fourth of the interviewees would be willing to pay Euro 5.00 per month, one-sixth would be prepared to pay Euro 10.00 per month and almost 10%

would be willing to pay Euro 15.00 or more per month. This willingness to pay indicates that for many people precautionary measures are a serious concern.

3.5 Improving the information status on EMCE

The fifth set of questions dealt with the aspect of improving information. The public's need for information concerning EMCE, despite intensive media coverage, is estimated to be very high. Most people are aware of the discussion taking place in the media on the possible health effects posed by mobile radio communication systems, but they expect more information. Obviously media reporting is highly regarded. Therefore, it can be reckoned that in the future reports in the mass media will receive a lot of attention.

- More than 80% of the interviewees asked for more information on the possible health risks posed by mobile radio communications systems. Especially young people (up to 29) felt the need for more information. Obviously, the public's insecurity with regard to this subject runs deep.

- This also indicates a need for more information regarding possible preventative measures. More than two-thirds of those interviewed would like to be better informed regarding this.

- Circa two-thirds of the interviewees expect more data and facts from the mobile radio communication providers. People have very high expectations concerning experts working in the industry and concerning the level of involvement from those responsible. Just about three-fourths of the interviewees demanded more involvement from the mobile radio communication providers in dealing with possible risks and precautionary measures. Especially the young people who were questioned made this request.

- The opinion of older people and people with children was that authorities and official offices should be able to inten-

sively provide information. Within this group, they are trusted the most.

- On the other hand, more than half of the older people questioned expect a high level of involvement from the authorities and official offices when dealing with possible risks and precautionary measures.

- Altogether from the perspective of those questioned, they want to receive more advice from environmental organizations. Apparently these groups are associated with being very active and being strongly committed to certain interests.

3.6 General Assessment of the debate on risks posed by mobile radio communication systems in Germany

The discussion regarding possible health risks posed by mobile radio communication systems in the media has apparently reached a climax. The majority of the public is concerned and would like to be better informed. Therefore, it was interesting to determine if the EMCE-risk debate in its totality is perceived as necessary or superfluous and what value does the public generally place on dealing with the risks and opportunities involved in new technology. With regard to a general assessment of the current risk debate, all of those questioned were confronted with 11 theses. The following results were concluded:

- Precautionary measures for children were met with much approval. Households with children are more aware of costs and therefore they were not as willing to pay for a reduction of potential risks.

- The majority proceeds from the assumption that despite the EMCE debate the number of people using a mobile phone will not change. Hardly anyone seemed to be willing to give up using a mobile phone altogether.

- The desire for more research and information emphasises the widespread doubt with regard to the extent and the relevance of mobile radio communication

systems regarding possible health risks.

- There is a marked willingness with the public to engage in discourse evaluating the risks and chances. 80% of the population agreed with this statement: "If you want to telephone with a mobile phone, you have to accept the antennas."

- A large share of the population is willing to put up with extra costs when it comes to precautionary measures. The high level of willingness to pay more indicates that precautionary measures have a high value status with the public.

- The thesis that inherent risks are involved with mobile phones, is correct in the opinion of two-thirds of those questioned: in an analogy to motor traffic those questioned expected the debate on the risks posed by mobile radio communication systems will be as intense as the debates which took place earlier on major projects dealing with roads and traffic.

- On the whole, the level of uncertainty among the population is high. Therefore, only a few believe that the discussion on the possible risks posed by mobile radio communication systems is superfluous. The actors - especially the mobile radio communication companies and the authorities - have to prepare themselves for an intensive discourse and understand that a debate is a normal and necessary social process with regard to the embedding and the use of modern technology.

- Online-emissions data banks, which create transparency concerning the actual rate of EMF-emissions are regarded as meaningful in order to have indirect control over the compliance regulations of the limit values. An important aspect for those questioned was that the information should be available to anyone who is interested and not just the municipalities.

- A reduction of value limits was assessed by many as an admission that risks actually exist. Therefore, precautionary measures for sensible zones were largely rejected. An either-or-attitude prevails. Ei-

ther protect all of us, because the actual risks have been proven to exist or there exists no need for any further precautionary measures.

- Self-regulating measures from the side of the providers, received positive resonance when the opinion of those questioned was asked. They were regarded as sound and reliable because of competition among companies they would be forced to comply to regulations.

- The term SAR-values (Specific Absorption Rate) is practically unknown. If the specific absorption rate is used as the characteristic quantity used for a stamp of quality than more explanations are necessary from the side of the providers and manufactures.

- Altogether, mobile phone users need a lot more information on EMCE and the demand for neutral and objective information is high. Generally, in this context laypersons expect public institutions to be highly involved since they come across as being the most trustful. In this context the authorities are especially being called on to take action.

- From the point of view of the interviewees mobile telephone companies, although interested in their advantages, are highly competent when it comes to technology and they are the ones who know about existing networks and networks in the planning stage and because of this an intensive information policy, especially from the providers is called for.

- Environmental and citizens' action groups are the ones who were perceived as informing the public about location disputes between residents and providers, and for safeguarding the public's interests. Although the involvement of these groups was seen as positive, those interviewed regarded this the job of the municipalities, who are obligated to provide the necessary information.

- Information concerning electro smog was partly perceived as contradictory. In-

formation campaigns seemed successful when they focused on eliminating uncertainties and obfuscating information.

- As a rule people are not informed about the competency areas of individual organs under government control. Therefore, it seems to make sense to process information uniformly under the same roof in order to increase the level of consistency and credibility. A high level of involvement with regard to the EMCE debate is expected from the Federal Environmental Ministry, the Federal Ministry for Industry, and from the Ministry of Health.

4. The results of a study comparing different countries

The debate on the possible risks posed by electromagnetic fields in other European countries is based on different focal points. As a general guideline almost everywhere the ICNIRP-value limits (International Commission on Non-Ionising Radiation Protection) recommended by the European Council are valid. There are, however, a few exceptions on a national level, where a country has legally established these value limits, for example in Germany. There were essential differences with regard to value limits and other basic conditions when the different countries were compared within the framework of this study. In particular, the debates that are taking place in each individual country proceed very differently.

Great Britain can be used as a "positive" example for its rational dialogue on EMF-residual risks. In Great Britain the authorities and the network providers have been successful in extending their networks and have successfully continued to expand without any disturbances or protest. This is due to an early and foresighted information policy. Plans as to where a base station will be set up are published and the municipalities are to a great extent included in the decision. In regions where

the protest potential may be high, mediators are sent in and clearing offices are set up. Moreover, already years ago projects on potential risks were carried out with scientific investigations. The Stewart-Report, where many different actors participated, contributed to the excellent reputation the British have with regard to their value limit policies. Many of the recommendations made in the report have in the meantime been put into practice, for instance intensifying the measuring operations in accordance with German location procedures as well having the network operators expand their information policies.

"Negative" examples for how a national EMCE-debate is progressing are: Switzerland, Austria and especially Italy. The politically normative introduction of the so-called "precautionary value-limits", which are currently well below the ICNIRP values, have on the whole lead to an intensification of the public debate. The Swiss value limits which are lower by a factor 10, the "Salzburger milliwatt" and the different regional value limits in Italy have made people become more apprehensive and has caused the protest potential to increase. There is no end in sight to the new demands being added to the catalogue of demands by citizens' action groups, constant inquires about value limits has led to a "value-limit spiral". Precautionary value-limits which are not based on plausible scientific correlations, can be correctly regarded as the result of a political negotiating process and correspondingly they are subjected to continuous demands from the public to keep on lowering the value limits.

A significant result of this comparative study is that many measures and demands are merging closer together in order to de-emotionalise the public debate and to re-establish trust in public and research institutions and in the network operators; information campaigns, dialogue processes among social groups, locations being

announced to the public, control measurements, intensifying research all belong to the set of measures that are being taken by the network operators and the authorities. Informing the public as early as possible about extension plans as well as including municipalities in location decisions are additional steps which will reinstate trust. The measures which have been taken in Germany are being closely watched from abroad.

5. Future prospects on how the course of the EMCE-debate will continue

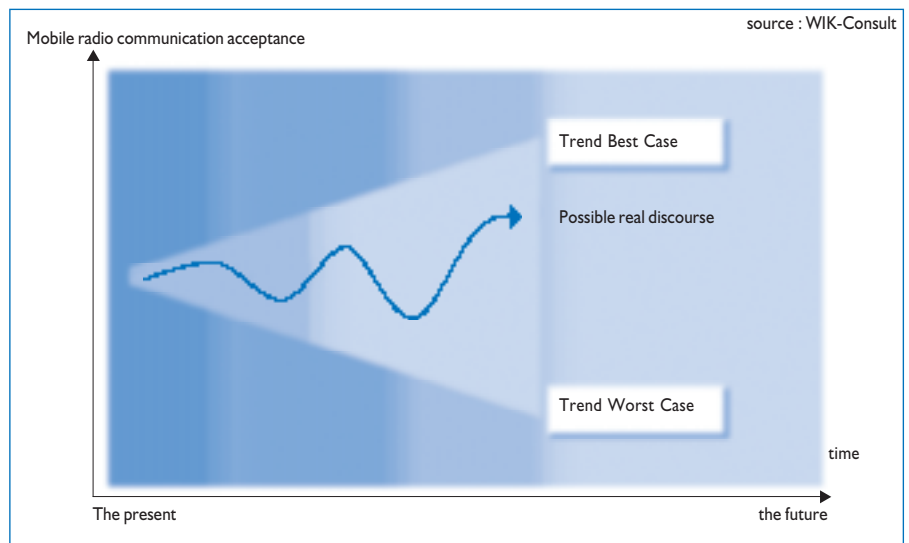
Without a doubt the EMCE-debate in Germany is in a decisive stage. All of the involved actors are aware of this. In the middle of 2001 when the protest potential was on the rise, associations, municipalities, and network operators undertook some important measures, but it is still not clear today if the effects of these measures had any significant influence or if they are sustainable with regard to the de-emotionalization of the EMCE-debate. The cornerstones of these measures are: the federal government adopted a catalogue of precautionary measures, intensive support of research, the commitments the network operators made concerning self-regulation, as well as the agreement the network operators and the municipalities made that in the future they will work more closely together concerning location decisions.

With regard to these measures, two scenarios were described in the survey to find out to what extent the public, the experts, the network operators and politicians were willing to compromise. On this basis, approaches and measures were discussed in detail in interviews with experts, representatives of different authorities, companies and associations, to find out what could contribute to a more objective debate. In one of the scenarios a negative development was outlined as the "worst case scenario" (latent conflict), in this sce-

nario during the course of the debate the confrontation intensifies. As a result many municipalities, cities and townships are forced by their citizens to exert influence on the extension of the networks. The other scenario the “best case scenario” (“discourse and compromise”) was conceived, where trust is regained and there is a growing acceptance of network infrastructure because numerous measures providing information and aiding discourse have come from the side of the public institutions and the network operators.

If further developments along the lines of “discourse and compromise” continue or the scenario “latent conflict” is more probable, essentially depends on the success of the measures described above. Citizens’ demands should be urgently met; specific information should be made available to specific target groups. In the meantime there is a real flood of EMCE information and it is getting more difficult for laypersons to acquire the relevant information needed for making decision. The setting-up of a EMCE-information portal supported by the BMWA can contribute a great deal to this, and to structurally process information in such a way that it is understandable for different sections of the population. It is also just as important, especially with regard to network operators that they proactively discuss the problem on site.

For the development of the EMCE-discourse along the lines of the “best case-scenario” it is decisively important that harmonization of the value limits is maintained. Therefore, discussions with cities and municipalities should be sought out, so that the menacing situation of “island solutions” does not occur in Germany, where different value limits counteract each other. It is also important that there is some kind of uniformity to the argumentation the actors are communicating. A comparison of the different countries urgently indicates that non-uniformity or



Szenario: Entwicklung der EMVU-Debatte

contradictory statements considerably contribute to the public’s uncertainty.

It can finally be said that the results of the research programmes initiated will play an essential role in the future course of the debate. However, one should not trust that these results will automatically result in a de-emotionalization of the debate; what the political side is currently hoping for. Moreover, from a scientific/theoretical and methodological point of view there are too many fundamental objections. They could however have a positive effect when they are communicated and conveyed to a broad public so that they are easily understood by laypersons.

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Footnotes

¹Franz Büllingen, Annette Hillebrand, Martin Wörter: Electromagnetic Compatibility Concerning the Environment (EMCE) in a public debate- situation analysis, the acquirement and evaluation of strategies while taking into account UMTS-technology in a dialogue with citizens., Bad Honnef 2002. The study can be obtained from WIK for a fee of •50.00.

²The difference mentioned resulted in: sleep being affected, and in the fact that the immune system and pacemakers were not regularly taken into account during the last years.

Blood Brain Barrier and Mobile Communication Systems



In recent years the interest of researchers and the general public has sporadically and then more intensively focused on the possibility that under certain conditions mobile communication systems could effect blood brain barrier function. The first step the Forschungsgemeinschaft Funk undertook with regard to this was in 2000 to commission the University Clinic in Münster to do a literature study on this subject. The results of this study are published in the "Newsletter", issue 1/02 and in issue no.15 of the publication "Edition Wissenschaft". Additional articles concerning this subject can be found in a report on the BEMS-annual meeting written

by Dr. Helmut Franke in the "Newsletter" issue no. 2-3/02.

In the meantime, the Forschungsgemeinschaft Funk has commissioned a study to investigate the effects of high frequency fields on in vitro blood brain barrier function, which should be concluded at the end of 2003.

In January 2003 the publication of a study by Leif Salford created a world-wide sensation. Therefore, this subject is being taken up again. In the articles that follow, there is fundamental information on the blood brain barrier, an overview on the current research situation as well as an experts' opinions on the Salford study.

Structure and Function of the Blood Brain Barrier

Ingeburg Ruppe

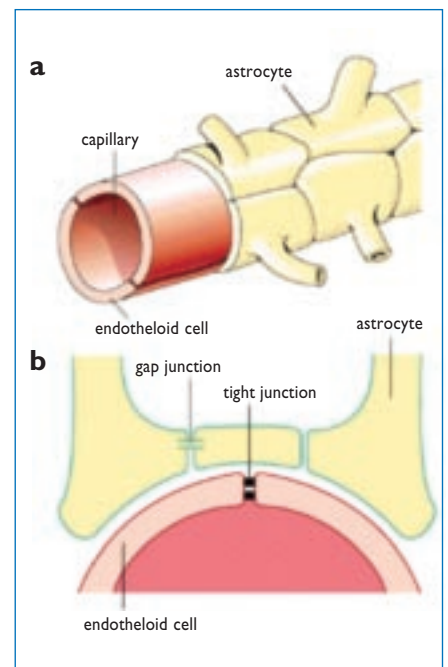
Introduction

Every living creature on the earth is surrounded by natural and artificially produced electric, magnetic and electromagnetic fields of different frequency ranges and intensities. The use of modern technology and further developments in information and communication technology is constantly increasing and this in turn has caused an increase in the above-mentioned fields in our daily environment. Consequently there have been lively public discussions on the possible effects these fields may have on human, animal and plant life and moreover in many generally accessible publications, reports on the effects of these fields on humans are very superficial and very effective in terms of the media. Information obtained from magazines, whose content is not always scientifically confirmed, can cause the reader to become alarmed when reading that through the use of a mobile phone the blood brain barrier can be permeated and brain damage results. After talking to these alarmed and worried people, one comes to the conclusion that the ideas they have about the blood brain barrier are rather bizarre. Very often one hears that an organ opens up, the idea they have is similar to a train crossing gate, and then harmful substances can enter the brain and poison it.

Barriers which exist between the blood and organs

Of course, the situation is not that simple, therefore, the anatomical situation has to be explained. Our body consists of individual organs and organ systems, which require different but constant conditions to function, such as nutrients, hormones and electrolytes. All of the body's organs are connected to each other by the circulatory system. Since the blood contains all of the components needed for providing the body with what it needs and for purification processes, filter systems have to ensure that the necessary substances pass through the organs and that some substances are partly held back. Some of the known blood barriers are as follows: the blood tissue barrier, also known as the blood parenchyma barrier, the blood liver barrier, the blood-cerebrospinal fluid barrier, the blood brain barrier, the cerebrospinal fluid brain barrier, the blood nerve barrier, the blood retina barrier, and the placental barrier. This filter mechanism functions with a so-called barrier effect, this means certain substances are permitted to permeate the barrier and others are restricted when the organ system does not need the components or only needs them in lower concentrations.

These "barriers" are not independent organs but are made up of many cells and space that exists between the cells allowing blood gases, nutrients, and certain chemicals permeate the barriers. They are made



Construction of the blood brain barrier

Schematic view

a) spatial

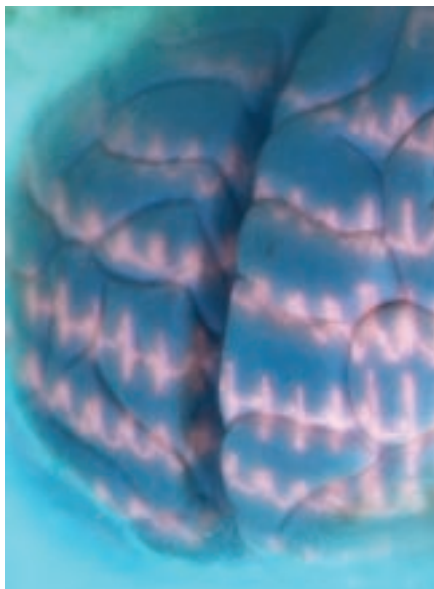
b) cross-section, source: Deetjen/Speckmann, *Physiology*

2nd printing, Urban & Schwarzenburg, 1994

up of endothelial pores which hold back macromolecules, or they could be lipid membranes located in vascular walls which have an inhibiting effect on the permeation of non lipid soluble substances or they have the selective effect of taking an active part in capillary transport processes. The brain and the nerve tissue are protected by two filter systems, the blood cerebrospinal fluid barrier and the blood brain barrier.

The blood-cerebrospinal fluid barrier

This fluid is a brain and spinal cord fluid, which fills the inner and outer cerebrospinal fluid space in the cranial vault and in the vertebral canal. During cerebrospinal fluid production as well as when substances cross over from the blood into the fluid, filtration, diffusion and active transfer processes of carbon dioxide, glucose and amino acids take place. This exchange of substances is regulated by the blood-cerebrospinal fluid barrier, which is formed out of capillary endothelial cells and brain covering and can be found between blood vessels and the cerebrospinal fluid space. The different concentrations of glucose, protein and electrolytes in the blood and in the CSF is regulated by these filter functions in order to maintain optimal concentrations in the brain.



The Blood Brain Barrier

The existence and the function of the so-called blood brain barrier has been known for more than 100 years and as early as 1885, Paul Ehrlich proved its existence in experiments.

Within the central nervous system the space between the neurons is almost completely filled with glia cells and their end feet/expansions. The entire nerve cell metabolism takes place via these glia cells- or endothelial cells, whose purpose is to install nerve cells and -fibres, and to nourish and isolate them. A type of glia cells are astrocytes. One type of astrocytes has numerous expansions of end feet which adhere to capillary walls and another type encloses the capillaries on all sides with a nearly leak-proof lining of endothelial cells. These endothelial cells are joined together by connective elements, or tight junctions (see diagram) and are equipped with a selective substance permeability which allows only particles with a diameter of less than 20nm to cross over. In this way the entire metabolism of nerve cells takes place via this endothelial network, so that when necessary any substances present in the blood are immediately passed through a biological filter. However, any substances which may harm brain function are kept away from the nervous system.

Blood brain barrier function

This endothelial network and the endothelial cells which cover the capillaries as a basal membrane, is designated as the blood brain barrier. Unhindered oxygen, carbon dioxide, D-glucose, D-Hexose, some L-amino acids and lipid soluble substances permeate the BBB, which are all necessary for proper brain function. In this way breakdown products are also passed on into the blood.

The feet end and extensions of astrocytes represent a certain barrier for specific hormones, non soluble lipids, water soluble and numerous other chemical substances, and this ensures that a constant

environment is maintained for neurons and the nervous system.

Blood brain barrier malfunctions

The cell structure of astrocytes is so constructed that it is able to build an effective shield against higher molecular substances and organisms. However, under normal conditions it is not completely sealed, so some particles are able to permeate the barrier. In cases of infection, trauma, inflammation, poisoning, hypoxia-dose, fever and in cases of tumours, the tight junctions between the endothelial cells become stretched out due to astrocyte swelling and this in turn makes the BBB more permeable for other substances. Changes in the width of the openings are due to the swelling and the de-swelling of endothelial cells. Even the capillary basal membrane is not a sealed layer. Whether or not there are pores in the membrane, which play an active part in the exchange of substances, depends on the density of the fibre network. The vascular systems of pathological tumours do not develop any blood brain barriers. Since this has been known, it has been used in diagnostic procedures. A contrast medium is administered into the vascular system to check if the contrast medium stays in the vascular system or passes over into the tumour.

Long before the use of antibiotics, physicians increased the permeability of the blood brain barrier by inducing an artificial fever, similar to what occurs during an infectious illness. This type of treatment was used to treat syphilis of the central nervous system and for shock therapy in the field of psychiatry, with this type of treatment medication could be administered directly to the brain. When the conditions that produced the blood brain barrier's temporary increase in permeability are stopped it returns to its original state.

Conclusions

When considering this article in its entirety it would make more sense to consider

the blood brain barrier as a selective filter rather than a barrier. Investigations have shown that permeability increases when there is an increase in the body's temperature and when there is an increase in function. An increase in the brain's temperature while using a mobile phone hardly ever occurs. Concerning this, after the test person had been using the telephone for a quarter of an hour at maximum power, the temperature under the cranial calotte was increased by 0.1°K. During a warm bath, hard physical labour or being exposed to the sun for a longer period of time all lead to an greater increase in temperature. How the blood brain barrier reacts in these situations or how the body tolerates such changes is yet to be investigated.

Since the extent of permeability returns to its original state after an increase in temperature, experiments should be done investigating these effects shortly after the influential factors produce an effect. If changes are discovered weeks after exposure, as described in the Salford (5) study, it can not be ruled out that in the duration there were other effects which could have affected the test animals and gave rise to changes affecting the filter function of the blood brain barrier.

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Developments in research concerning this subject

Is the blood brain barrier effected by mobile radio fields?

Roland Glaser

Again and again the public is alarmed by reports stating that telephoning with a mobile phone will cause the blood brain barrier BBB to open and nerve damage will result or even brain tumours may develop. How serious are these warnings and how protected are we by the current limit values?

Firstly, it must be established that the blood brain barrier is not an anatomically localized organ but is a special feature of the blood capillaries located in most areas of the brain. In order to protect the brain, which is the most sensitive organ in the human body, from toxic substances the capillary endothelial cells are joined by tight junctions, a sealing mechanism that makes it difficult or impossible for certain substances to permeate the BBB. Only soluble gases required for cell respiration, oxygen and carbon dioxide, as well as nutrients such as D-glucose, D-hexose, L-amino acids and lipid soluble molecules are able to permeate this barrier. In stress situations, cranial trauma and with various illnesses a malfunction of the barrier

can occur, these malfunctions are usually quickly repaired. (Blasberg et al. 79).

Quite early on one thought that high frequency fields could cause an increase in temperature and quasi induce an artificial fever and this in turn would lead to the BBB being affected. This unwanted side-effect had been observed in conjunction with the so-called short-wave therapy. However on the other hand, it was used to administer medication directly to the brain (Lin et al. 98). Therefore, this effect has been investigated for more than three decades.

The first animal experiments in connection with possible harmful effects to the BBB caused by radio and radar fields were done in the 1970s by Frey et al., at first they thought that this would also promote cancerostatica in the brain (Frey et al. 75, Frey 79). Sutton and Carroll (79) have pointed out that when the temperature of rats' brains is increased to 45° C induced by a 2450 MHz-field there is an increase in protein absorption.

Oscar and Hawkins (77) examined in rats the absorption of ¹⁴C marked sugar molecules of various molecular weights, while they were being exposed to different power densities of continuous and pulsing fields of 1.3 GHz. While dextrin with a molecular weight (MG) of 60.000-75.000 was not absorbed at all, they discovered that mannitol (MG = 182.2) and inulin (MG = 5.000-5.500) had an absorption intensity as a function of the applied power flow density, which showed the maximum to be at about 10 W/m². Pulses of the same average power flow density but of differ-

ent lengths and frequencies showed differences in absorption intensities. These results could not be confirmed later (Meritt et al. 78, Preston et al. 79, Gruenau et al. 82, Ward et al. 82, 85).

How can this contradiction evident in different investigation be explained? Obviously there is a series of methodological difficulties which are easily open to misinterpretations (Rapopor et al. 79, Williams, Hoss, et al. 84, Williams, Plattner et al. 84). So for example, a change in capillary perfusion could slightly increase the permeability of substances, without a change in normal permeability taking place. However, artefacts are to be seriously considered, which can occur during the dissection of the brain and during its histological processing. If the fixation process or the freezing of the tissue which follows is not done properly, the substances being investigated could during this process permeate the BBB. During the storage of preserved brains the diffusion of these substances can enter into areas of the brain that are not protected by the BBB. What can also occur is that the indicator substances can smear during dissection and this can especially happen when histological slides are being prepared. Since the BBB is without a doubt permeable for larger molecules when there is a clear rise in temperature, an exact dosimetry is all the more necessary. An erroneous assessment of local SAR-values in the brain with the application of HF-fields can easily lead to such an effect being produced by warming.

In various studies Salford et al. (92, 93, 94) as well as Persson, Salford et al. (92) have shown with histochemical techniques that pulsing as well as continual 915 MHz-fields are able to temporarily make the BBB permeable to plasma-albumin. Unfortunately, in these studies there is no reliable data on the power density and SAR-values. In spite of this the results received a lot of attention and different attempts have been made to verify the re-

sults. Fritze et al. (97) exposed rats during the course of 4 hours with these frequencies, where different SAR-values were applied, from 0.3-7.5 W/kg. Only with extreme irradiation, 7.5 W/kg, could these authors produce with certainty an increase in brain temperature and consequently a significant cross over of albumin into the brain. Even this effect was rather slight when compared to the effects produced in the positive controls where the animal had to undergo a cold shock. Recently two articles on this subject were published by Finnie et al. (01, 02). In the first publication, the Australian team reported on experiments where rats were irradiated for one hour at SAR-values of 4 W/kg (898,4 MHz, 217 Hz pulsed). In contrast to the positive controls after applying clostridium toxin, no difference could be found between the irradiated rats and the rats which were not irradiated. In the second publication they attempted to find an answer to the question as to whether or not during long-term exposure albumin could permeate into the brain. During the course of 104 weeks, mice were exposed to a 900 MHz far-field, five days a week for one

hour per day, which corresponds to SAR-values ranging from 0.25 to 4 W/kg. In this long-term experiment in an extreme case there were some negligible traces of albumin detected in the brain. However, these can be ignored when compared to the effects the toxin produced.

Even experiments testing the BBB permeability to other substances while under the influence of high frequency fields with intensities below the limit values showed no results (Lange et al. 91, Lin et al. 98, Masuda et al. 01, 02). The work of a Japanese study by Tsurita et al. (2000) has to be mentioned in this context. In this experiment rats were irradiated with fields according to the Japanese TDMA-standard for two hours a day for 2 to 4 weeks (1439 MHz, SAR for the head: 2W/kg, the entire body SAR 0.25 W/kg). In this carefully conducted experiment neither the absorption of the vital staining substance Evans-blue nor morphological changes in the cerebellum nor could Purkinje cells be detected. On the other hand, clear effects were shown in the positive controls, where head temperature was increased for a short time or where they were under cooled. In



an analysis of the work done by the Salford group, Tsurita et al. criticized it in this publication for their faulty irradiation and dosimetric techniques.

If one were to sum up the current developments in research regarding this area, one could come to the conclusion that no effects to the BBB can be verified stemming from weak mobile radio fields. Only concerning flow densities which have a thermal effect on the brain, is the BBB temporally permeable to proteins and other large molecules.

A short while ago, after a 10-year break, an report by Leif G. Salford's working group on new experiments involving the effects of mobile radio fields on the brains of rats appeared. In contrast to the first experiments, which were published in a journal that uses a referee system, this report was published in the National Institute of Environmental Health Sciences own journal. (Salford et al. 2003).

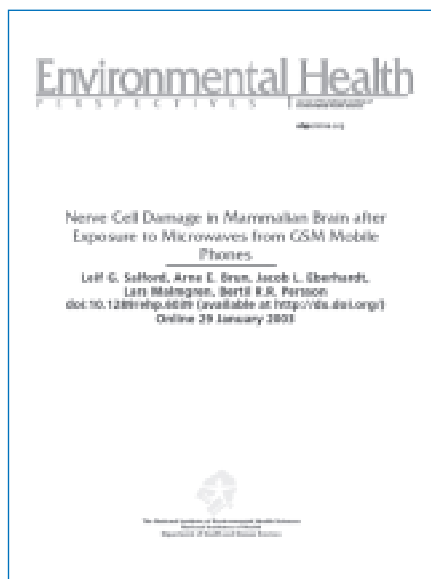
The article pertains to an experiment conducted on 32 rats of both sexes, which were divided into 4 groups each containing 8 rats. The rats from 3 of these groups were irradiated individually and only once for 2 hours in a TEM cell at a power flow density of 0.24; 2.4 and at 24 W/m². The rats in the fourth group were the control group. Calculations resulted in entire body SAR-values of 2; 20 and 200 mW/kg. After a course of 50 days the rats were finally examined, they were sacrificed being anaesthetized and the brains were fixated with a formol-perfusion. Histological examinations revealed that the irradiated rats had albumin-positive staining near the smaller blood capillaries and there was further albumin spreading between nearby cells and neurons. Moreover, with regard to the irradiated rats it was demonstrated with Kresyl-violet staining techniques that there were scattered dark and obviously shrivelled and degenerated cells. The evaluation of the histological tests blindly ensued according to a half-quantitative evaluation system in three steps: 0

= no or very few dark neurons, 1= moderate occurrence, 2 = frequent occurrence. When these figures are applied to the intensity of the exposure, a correlation can be made despite the heavy scattering effect. The authors gave a significance effect of $p < 0.002$.

The authors concluded from this experiment that through a non thermal effect, (the experimental set-up was located in a room with a thermostat), resulting from HF-irradiation an increase in BBB permeability occurred. As the authors had already hypothesized in an earlier study, when albumin penetrates the brain from the blood it could lead to a degeneration of nerve cells.

Since the experimental animals were young rats, 12-14 weeks old, the authors considered the results especially relevant concerning the question as to whether or not teenagers are exposing themselves to any risks while using mobile phones. However, it has been conceded that the effects which were observed here are in principle repairable and therefore not an immediate health risk. Nevertheless, in the long-run they can accumulate, or damage could occur in conjunction with other negative effects. The authors failed to mention that the low depth of penetration from these fields affected the entire brain of the rats, however with regard to humans only the surface layer is affected.

Such findings are naturally well suited for causing alarm; this could have been the reason why the authors presented their results immediately to the public, instead of submitting them to a journal with a referee system, for example "Bioelectromagnetics". On the other hand this way of doing research is deplorable because the study contains a great deal of inaccuracies and regulation violations which the international community of scientists agreed on in order to ensure the quality of such experiments. These regulations are also recommended by the WHO. The reviewers of a scientific journal would have



certainly reproached the authors about this. What is it dealing with in particular?

The authors themselves concede that the number of rats was really too small to draw any valid conclusions. Of course, this applies all the more since the study deals with half-quantitative evaluations concerning the effects, only with an absolute secure double blind evaluation while using several independent invigilators and a large number of slide preparations is it possible to make a conclusive statement. The appearance of degenerated nerve cells, proven with a Kesyl-violet staining, has been described in various neurophysiological studies without reference to the problem related to field effects. What triggers this mechanism and its cause are not fully understood. Usually it can be contributed to the phenomenon of differentiation, age or it is the result of different illness or stress factors. They occur in different regions of the brain in different intensities. Salford et al. did not go into any detail regarding this neurobiological aspect

The above-mentioned regulations which are recommended for investigations on the effects of electromagnetic fields include the so-called "positive controls". As already mentioned, they have been observed by other working groups. For example, for a malfunction of the BBB to occur temperature shock is applied (Fritze et al. 97,

Tsurita et al. 00) or certain toxins are administered (Finnue et al. 01, 02). Only through the use of such positive controls is it possible to evaluate the sensitivity and the meaningfulness of the observed effects. Only when such a comparison is made is possible to determine if the observed changes are relevant or not, or if it is merely a chance stray occurrence. In none of Salford's et al. studies, and not in his most recent study, were any positive controls done.

One poses the following question: why were the rats first examined 50 days after exposure? Did they want to report on damage occurring much later? It is well known that slight changes in the permeability of the BBB occur, for instance, with the flu accompanied by a fever, and that these changes and effects are quickly repaired by the body. Different authors have proven that the effects triggered by HF-fields of very high intensities lead to an increase in the temperature of the brain, however after a few hours it can no longer be proven. 50 days after exposure the albumin serum would be reabsorbed, wouldn't it? On the other hand, one must consider that 50 days after exposure the rats were subjected to other influences, which can not be left out of a daily control.

Despite a great deal of criticism concerning the preceding experiments, the exposure conditions of animals in this paper are very inadequately controlled. The regulations stipulate that actual energy-absorption measurements of the irradiated object or in a suitable model object must be taken. However, in this case the SAR-value was reported on theoretically without any experimental control. This can lead to serious false assessments, e.g. the body of an animal in a narrow space can destroy the field considerably. It must also be taken into account that during exposure, in a narrow cage fitted out with ventilation ducts, a possible increase in the animal's body temperature was not measured. It cannot be ruled out that the ani-

mals perspire during irradiation. This would be enough to explain why so few measured effects were produced.

It is unimaginable that the above-mentioned recommendations and criteria of the Bioelectromagnetic Society (BEMS) and the WHO for performing reliable experiments were not known to those doing this study.

There is, however, an even more general codex for scientific investigations which was not observed in case: this codex stipulates that a study's results are to be discussed in light of current developments in research. In this case this would have been especially important. We have seen above that there were negative findings even before the Salford group's first experiments. But then, triggered by the first Salford investigation, a number of unsuccessful attempts to verify their results were made. In these publications the weak points of the previous Salford study were exposed and discussed. It would correspond to scientific honesty to quote these studies and at least to explain why in Lund and nowhere else, the effects of weak fields on the BBB can be measured. Actually in the report in question only publications are quoted from acceptable authors, even if they do not really have anything to do with the subject being discussed. So in this way the impression the unbiased reader gets from the report is that the findings of the Salford-group are in complete agreement with international research.

How seriously the world took the Salford findings in 1993 became clear at the international BEMS conference in 2001 in St. Paul, Minnesota. At this conference there was a special section devoted to the problems surrounding the BBB. J. Merritt, P. Mason, J. Lin, H. Nagawa, H. Masuda showed with posters and lectures that it was not possible to verify the Salford findings or to find any other effects for that matter. Everyone was eager to hear the lecture the group from Lund (B. Persson, A. Brun, L.G. Salford) submitted for the conference. Unfortunately it turned out

that none of the authors attended the conference. Their paper was presented by a colleague who had not taken part in the study. It only contained findings from the previous publication that were already known. Unfortunately, the speaker could not answer any questions because he said he had not taken part in the experiments. It was suggested that the investigation of the Swedish group be done again in an extensive study, including the Swedish authors, but without making the same methodical mistakes. This was not however mentioned in the publication in question.

It is a pity that findings are reaching the public more often than have not undergone a voluntary scientific quality control, as it is done in peer review systems. These are findings that at the end of the day do not hold up against objective criticism. This does not help the urgent necessity to gain recognition in this area, but all it does at most is to stir up emotions.

Professor Dr. Roland Glaser was the director of the Institute for Biophysics at the Humboldt University in Berlin

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Does the new Salford study deserve all the attention

**Frank Gollnick,
Helmut Franke,
Sheila Johnston**

Leif Salford and his working group in Lund (Sweden) have recently published an alarming new study, which has gotten a lot of attention, in which the effects of mobile radio emissions on the development of “dark neurons” (DN) in conjunction with the occurrence of microscopic leaks allowing protein to enter the brain are described. Two reputable scientists closely examined the publication, which has only been published online and offered their opinions of it to the FGF. The following article is the joint opinion of Dr. Sheila Johnston (neuro-science expert, in London) and Dr. Helmut Franke (Clinic and Policlinic for Neurology, Münster)

In the publication “Nerve cell damage in the mammalian brain after exposure to microwaves from GSM mobile phones”, Salford et al., 2003, the reported nerve cell damage was brought about by the effects of mobile radio fields of unknown frequencies (only the GSM-standard was given) at a field strength of 0.24-2.4 W/m², corresponding to 2-200 mW/kg.

The publication is based on a single experiment, which has not been done again or reproduced. For such an experiment a very small test sample was used; 32 rats (altogether there were 4 groups, 8 in each group). Not earlier than 50 days after being exposed to a mobile radio field brain slides were first prepared with two different stains. The following serves as proof for Salford et al. that brain damage occurred:

- firstly, the staining of protein which had permeated the blood brain barrier in an unwanted (pathological) way; staining was aided by a protein specific antibody. Normally the blood brain barrier in a healthy state does not allow harmful substances and proteins to cross over to the brain into actual brain tissue, see Stögbauer, 2002.
- secondly, with a second staining an additional pathological finding was examined: namely, the development of the mentioned “dark neurons” DN. In the literature they are described as proof of diverse damage to nerve cells, caused by various kinds of mechanical effects and harmful metabolic processes (Vohra et al. 2002). A direct quote taken from the arti-

study it is getting in the media?

cle in question reads as follows; “DNs develop under so many various conditions that the reason why they develop will remain a mystery”.

Generally, DN to be more exact are described as “argyrophile” neurons, whereas the medical term “argyrophilie” merely means the dark tissue staining brought about by silver coating with a ammoniacal silver nitrate solution followed by a reduction caused by formol, tannin etc. (Roche Lexikon Medizin, Ver.3.5). Physicians usually use this staining procedure for particular proof of something e.g. in special tissue regions or in special cells. The staining method used by Salford et al. differed from the one described above. On one side the genetic makeup of the cells (DNA, RNA) is stained and on the other side another stain colour (cresyl violet) is used. On the other hand, this is a normal method of distinguishing damaged cells, (damaged, i.e. cell coverings pitted with holes) from undamaged cells. However, the results in this case are also called dark neurons.

Gallyas et al. (1992) described numerous causes for the development of DN. Moreover, in his publication the appearance of DN is independent of their cause. Even after death, severe shaking of a brain that has not yet been dissected could be responsible for the appearance of DN. These are however not distinguishable from DN which previously occurred when the animal was alive.

Basically various other causes should be considered for the development of DN,

however the development of DN from mobile radio fields has to be considered since it cannot be completely ruled out. With the exception of a concussion occurring after death, other causes were not taken into account and discussed nor were any corresponding control experiments conducted by Salford and his colleagues.

It is hard to understand why the rats, after undergoing 2 hours of field exposure, were first examined 50 days later. It is especially true in view of the fact that Vohra et al. (2002) described the development of DN as an aging phenomena that to date has not been explained. So without any outside influences rats that are already 6 months old show almost double the number of DN when compared to 3-month old rats. The rats at the beginning of the Salford et al. experiments had exactly this age difference.

Moreover, for a publication with high academic standards, among other things, the specific absorption rate was not adequately standardized. The variation in SAR-distribution was given at 6 dB, (SAR = “specific absorption rate”). This indicated a four-fold range of variation. It is amazing that a publication that receives international recognition in the field of mobile radio research only stated that GSM-field irradiation was applied but did not even once mention the frequency used in the investigation. Apart from that a great deal of the usual information for such a study was lacking.

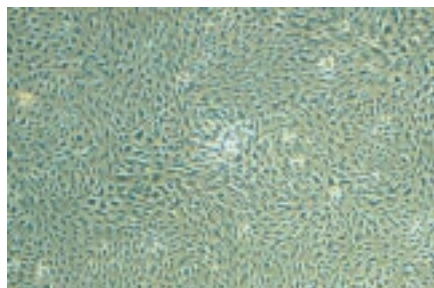
Statistics

In order to be able to make a conclusive statement with such a small sample, “exact tests” have to be conducted. Nevertheless, this could apply to the type of statistics used, however, if this was really the case it was not mentioned. It is questionable why no numerical recording of the DN was done, but only a ranking was done. The experiment would have been more meaningful if a numerical recording had been done and not a ranking test. Finally a critical reader would ask, are pathologists’ assessments reliable with regard to assigning individual rankings. Can these assessments be reproduced by other pathologists?

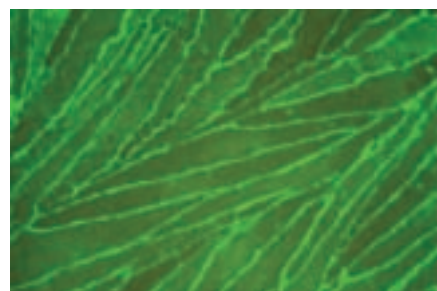
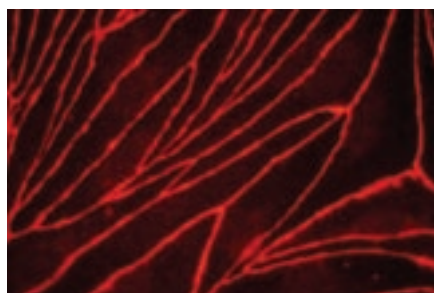
Results and the Discussion Section of the Publication

Remarks and comments made on the results in the discussion section of the article are very superficial. Salford did completely without a comprehensible numerical description of the exhibited transport of protein out of the vascular system (see above). A clearer correlation between the transport of protein and the development of DN was not demonstrated.

In the rather short presentation of the results concerning protein staining, Salford et al. pointed out that the staining in the control group, displayed more often a dubious positive reaction (a reaction that really should not occur in a control group). Consequently a reliable assignment of the three ranks that he de-



A microscopic image of endothelial cells (see picture page 25) in a cell culture dish, the spirally formed shape of the cells which are tightly packed together is typical for the blood brain barrier.



With the help of staining one can see in a culture dish how the special protein has been made the tight seals of the endothelial cells visible.

terminated for assessing protein staining were obviously not given.

(“Quote: the control rats exhibited no positive reaction or only infrequent reactions and often they exhibited a questionable positive reaction to protein in the hypothalamus”).

In one of the pictures in Salford’s publication, two images of brain slides taken from an irradiated rat are compared to a slide taken from a rat in the control group. To which group the rat was assigned to was later indicated in a corrected version of the paper. By looking at the external form of the brain slides one can determine that they were not taken from the same area of the brain, a comparison is, therefore, only partially valid. Another image shows DN staining exclusively of rats which were exposed to mobile radio signals. Negative control images, in other words the images taken from the brains of rats that were not irradiated were completely lacking in the study. The field strengths assigned to these images were also not given. In a scientific publication this is a matter of course that this information is given.

Moreover, what is very unusual for a scientific publication is that Salford et al., in the discussion of their results, did not cite any other references to substantiate their findings. Another point to consider concerns other similar studies conducted by the authors, where their results could not be reproduced. This was also not discussed or analysed in this publication. The hypothesis concerning a secondary opening in the blood-brain-barrier, which is supposedly caused by the observed flow of protein was mentioned in the discussion but this was not dealt with in detail nor was the reason for it discussed and therefore its existence is rather questionable. Ascertaining that 12-26 week old rats

in their development stage are especially suitable for a comparison to teenagers addicted to mobile phones, is really a very daring statement, especially when there is no data to support it. Further statements regarding the special susceptibility of adolescents in this part of the discussion can only be considered as assumptions. For a scientific publication the facts and statements made in the discussion part of the paper seem to be rather sketchy.

Inadequate Dosimetry and questionable significance of DN

Sheila Johnston especially emphasizes in her opinion on Salford’s publication that little attention was given to dosimetry and she questions the medical significance of the discovered “dark nerve cells”.

Regarding the given SAR-values, they obviously deal with *estimated* total body mean values, where the SAR-distribution in the brain was determined by a computer simulation. For this kind of study this does not fulfil the criteria of the World Health Organization (WHO), because the SAR-values for the brain are not measured but are only indirectly calculated. Moreover, Johnston noticed since 1998 in a whole series of Salford’s investigations on the blood brain barrier that it is not possible to draw a conclusion from the actual SAR-values he employed because of defective dosimetry. Since these SAR-values were derived from the electrical field (E-field) that existed in the exposure chamber that was employed (a so-called TEM cell) these E-fields *cannot* correspond to the E-fields in the brains of the rats, it can be deduced that the SAR-evaluations are false.

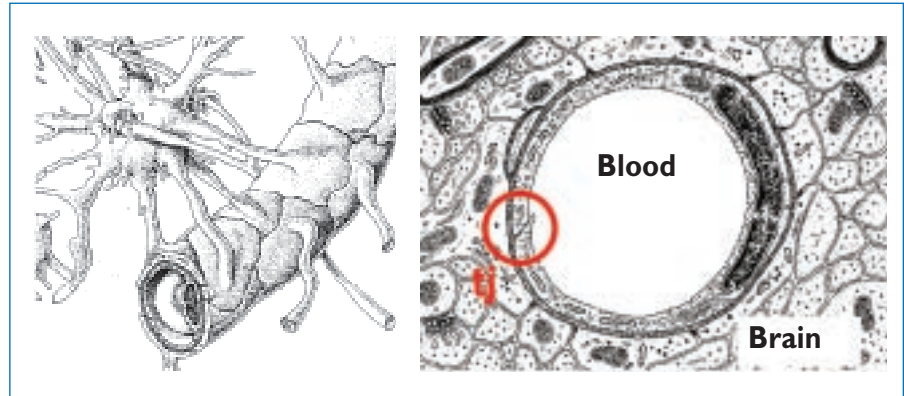
Sheila Johnston has disputed the rather far-reaching interpretations in Salford’s et al. discussion with regard to the possible

negative effects DN could have on human memory during the course of the aging process with the following arguments:

Neuro-degenerative illnesses, (e.g. illnesses with memory loss) occur when the brain's main switching circuits are destroyed, which is caused by nerve cell death and the loss of synapses. This degeneration is selective, i.e. there are nerve cells that are more or less susceptible to such processes. The occurring symptoms of such an illness are dependent on the particular switching circuits which are detrimentally affected and hence give a picture of the selective vulnerability of the nerve cells. In the normal aging process, a reduction in the number of brain cells, caused by the dying of cells, is not a crucial process, at least not in the area of the brain that Salford et al. referred to. With regard to the counting of nerve cells, it is generally very difficult to make a functional association, because the regional differences and the dissimilarities among the cells of the cerebral cortex are enormous. Therefore, the studies which give the most insight into the aging process are those where a certain area of the brain is investigated which is correlated with bodily functions that are well understood (Morrison & Hof, 1997).

However, the "dark nerve cells" (DN) that Salford et al. reported on were randomly distributed everywhere in the rats' brains and therefore it is *not* possible to make an association with particular switching circuits. Hence it is going too far, to try and derive some kind of neurological significance from the results or to interpret them as being indications of possible symptoms of an illness.

Currently many investigations are being conducted on the possible effects to the blood brain barrier from electromagnetic fields by internationally recognized research groups in France, Japan, Germa-



The blood brain barrier forms a special wall covering within the microscopic blood vessels (capillaries, illustration on the left) in the brain. Larger molecules (e.g. protein) and toxins have no excess to the nerve cells in the brain. In the cross-section illustration of a capillary (on the right) one can see how the endothelial cells are tightly layered and packed together, they cover the inside of the capillaries and are sealed together by the so-called tight junctions (tj). All around them on the outside are the star shaped astrocytes and of course the nerve cells can also be seen.

ny, and in the U.S.A. The first results are expected to be published this year and one can hope that more solid results will come to light than what was discussed here. Obviously Salford's et al. work is more of a speculative nature than anything else.

Dr. Frank Gollnick is a biologist and worked for a long time at the Physiological Institute II at the University of Bonn: he is currently working as a scientific expert at the FGF.

Dr. Helmut Franke is a biologist and is currently working at the Clinic and Polyclinic for Neurology at the University of Münster. He is a specialist on the blood brain barrier and actively does research in this field.

Dr. Sheila Johnston works as an independent expert and consultant, among other things, in the field of neuroscience, she also works for a number of committees and organizations. She is internationally recognized and has her own information service.

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The 11th Ann of the Forschung



At the 10th annual meeting, the chairman of the Forschungsgemeinschaft Funk, Mr. Eike Bär, announced the organization's leitmotif, "a research organization, must do research", he emphasized previous extensive research projects undertaken in 2001 and at the same time he focused on the numerous research projects that the FGF was responsible for initiating. At the 11th general meeting held on January 30, 2003 in Munich, 27 member representatives were proudly informed that this had been done consistently during the last year. The chairman informed the members – supported by the directors of the working groups – "Public Relations", Dr. Olaf Schulz;

"Research", Dr. Eberhard Kühn; and the managing director of the FGF, Dr. Gerd Friedrich – on the following topics in his annual report:

- the main focal points of projects
- profiling the Forschungsgemeinschaft Funk
- research plans
- Internet and Intranet services
- cooperation with international and national institutions

During the last ten years the FGF has promoted exhaustive scientific research dealing with the problem of biological effects posed by electromagnetic fields and health risks. In the past, the collecting of

Annual Conference Forschungsgemeinschaft Funk

such data had to be a main priority of the FGF. Now is the time to compile EMCE research findings - and FGF supported research - because during the last two years the scope and the conditions of the research has changed. What this means is that support from public funds or organizations other than the Forschungsgemeinschaft Funk are commissioning research, so that it is no longer of utmost importance for the FGF to allocate research projects and funds. What especially speaks for this is the extensive funds allocated by network operators and the federal government for further research. Therefore, it seems that the evaluation and the circulation of existing research findings by the FGF would be more effective and goal oriented.

The work of the FGF will now focus more than it has been in the past - while working with many international scientists - on scientific reviews, colloquiums and seminars, which scientifically evaluate important questions and concerns. The results will then be published. Moreover, an expansion and an intensification of public debates along with all of the political implications has taken place. This makes it necessary to reassess the FGF's position in its research policy and public relations.

In 2002 a research project was completed

Dr. Kühn evaluated the research done by the "Arbeitsgruppe Forschungs-

vorhaben" (AGF) in the past few years as successful. The sub-groups were able to deal with the work that arose during the project. The concept the AGF employs of forming sub-groups based on competency - in order to deal with specific subject areas - has proven to be worthwhile. Currently, the AGF is divided into the following sub-working groups:

- biological effects of EMF in the cm/mm wave-length range
- implants and other medical devices for the body
- in vitro/in vivo
- standardization
- knowledge based literature data bank (KBLDB)
- goal of the AGF.

In 2002 a project was completed "The effects of HF-EMF (GSM 900) on sleep quality and well being during the day-supplementary investigations", another project is in its final stages of evaluation and 8 other projects are in progress. In addition to these projects some highlights during the year were a scientific workshop on "Genetic and Cytogenetic aspects posed by HF-fields" and a seminar was held on "Statistical Methods". In order to have a clearer insight into how FGF projects are awarded and how third-party-funds are allocated, the FGF has presented, for anyone interested, this information clearly and comprehensibly on the Internet in a graph format.

To round off the year, the third international FGF-workshop, "Genetic and Cy-

togenetic Aspects of RF-Field Interaction", was held in Löwenstein with many international participants. The results will be published after the rapporteur's report is finished.

In order for research findings to gain more attention in scientific circles and with the public the FGF has strongly influenced those awarded FGF contracts to submit their results to "peer reviewed" journals, (i.e. in scientific journals, an evaluation of the research results is made before the paper is accepted for publication). This is extremely important since it enables other interested research groups to discuss and evaluate the results, which is urgently required if research results are to gain international acknowledgement. It is more of an established procedure in the English speaking world than in German speaking countries. This is a deficit which must be worked on.

One of the platforms used for presenting and discussing FGF commissioned research projects and their results within a scientific framework is, for instance, the 24th Bioelectromagnetics Society Conference (BEMS) in Quebec. We are also continuing our dialogue with EU institutions. In particular, in supporting the COST Action 281 (the follow-up of COST Action 244) the FGF sees a good basis for gaining recognition with regard to its research efforts. In taking over the position of scientific secretary for the COST 281 programme the FGF is providing a great deal of support for this European scientific project.

A Brief Description of the Association

The development of the Association

- At the end of 2002 the FGF had 55 members.

- The association's financial situation at the end of 2002 was as follows:

membership fees, donations, interest proceeds, public funding, came to 1.45 million Euros. Expenditures were 1.74 million Euros, which created a deficit of 0.28 million Euros. This deficit was covered by reserve funds. The sum to be carried forward in the new financial year is 0.14 million Euros. For the year 2003 0.8 million Euros are available for research projects alone.

- Altogether the Forschungsgemeinschaft Funk allocated 0.96 million Euros in third-party-funds to scientific and research working groups, who were awarded contracts for research purposes. This is a 26% increase in the amount of financial support in contrast to last year.

- In addition to the 2 issues of the "FGF Newsletter" containing current reports on conferences and topics in detail, the journal "Edition Wissenschaft", has been revived after a pause of several years with the publication of the last 3 issues on the subjects of the "Blood Brain Barrier", "Melatonin- Hypothesis" and "Embryonic Development".

- The FGF's Internet homepage is visited about 40,000 times per month. Infoline and Intranet continue to be a major source of information for requests concerning the FGF.

- After an immense increase in media reports (press clippings in 2001) there has now been a decrease of 18%.

- The next general meeting will be held on January 29, 2004 in Bonn at T-Mobile.

- Further information can be found in the Annual Report 2002" and in the "Festschrift" published especially for the 10th anniversary of the FGF. (www.fgf.de).

The management board was discharged

The members present who were eligible to vote unanimously discharged the board for the previous year.

No cause for complaints with regard to the treasurer

Mr. Nobis presented the treasurer's report. The cash audit and the accounting records were done by Mr. Michaels (Deutsche Telekom AG) and Mr. Nobis (Marconi Communications). They concluded that proper accounting procedures were used and the money was spent according to the association's regulations. There was no cause for complaint.

The new board of directors were elected unanimously

The members of the board elected a new board of directors, which is made up of 8 members and 8 deputies. The new board of directors 2003/2004 is as follows:

For the group of network operators:

- Dr. Wolf Haas, D2 Vodaphone;

deputy: Dr. Ulrich Hermann, Swisscom

- Dr. Friedrich Lauer, T-Mobile;
deputy: Joachim Claus, Deutsche Telekom

- Dr. Karsten Menzel, E-Plus;
deputy: Wolfgang Krüger, O2

For the group of Service Providers

- Herbert Tillmann, Bayrischer Rundfunk;
deputy: Helwin Lesch, Bayrischer Rundfunk

For the industry

- Eike Bär, Motorola;
deputy: Heinz Friedmann, Alcatel
- Dr. Christian Payer, Bosch;
deputy: Dr. Werner Irlner, Lucent Technologies
- Peter Zapf, Siemens;
deputy: Ralf Grafe, Nokia

For the group of Authorities

- MinDir Horst Ehrnsperger, BMWA;
deputy Dittmar von Schilling, BMWi

Mr. Eike Bär was re-elected as chairman of the board and Dr. Wolf Haas as deputy. In the name of the FGF, Mr. Bär thanked Mr. Marklund, Mr. Pfirstinger and Dr. Krüger, who are no longer on the board for all the work that they did.

Information provided by the FGF

The FGF's Internet sites are intensively used, records show that the site is accessed about 43,000 times per month. However this number on average fluctuates between 26,000 and 65,000 visits per month. Striking is that the number of visits to the site has clearly risen from countries whose language is not German. The Internet site of the FGF can be assessed as a success. The Intranet is for internal use only, i.e. informing members about information they need for their jobs. It has been very successful and its daily updates and reports are a great asset for our members in dealing with their daily work.

A new stand on public relations

The FGF has added to its regulations that it will promote informing the public about electromagnetic compatibility concerning the environment (EMCE) as well as promoting relevant discussions on the subject. In the past the FGF was accused of being biased. The FGF's reaction to this in 1999 was to show as much restraint as possible, i.e., only scientists will make statements concerning their own research and the FGF will remain impartial.

The FGF is regarded and highly accepted as a neutral trustee of scientific knowledge for scientific circles, for courts of law and for municipal authorities, and it hopes to further intensify its standing. The strategy of "strict neutrality" with regard to scientific research and knowledge and also with regard to the public has proven to be worthwhile. In the present situation it is however, essential that the FGF does something about the lack of public well-founded and objective information in the media. It is necessary that scientists, specialists and journalists cooperate in conveying to the public their own findings and other reputable research findings.

In particular the FGF has set the goal for itself that scientific publications, facts

and the unusual features concerning new technology will be presented so that it will easily be understood by laypersons. This will be done with lectures, information on specific topics, explanations, and terminology explanations whose contents will be more accessible and understandable by a wider public.

What the future holds

2003 will be the year of consolidation for the Forschungsgemeinschaft Funk, because unfortunately, the 10th anniversary of the FGF, which was celebrated last year, cannot be celebrated every year. So on September 19, 2002 in Berlin, at the Museum for Communication under the auspices of the Federal Ministry for Industry, scientists held a symposium on the EMCE research results obtained during the last ten years. In addition – posters were displayed representing the major research fields of the FGF and the results.

For the current year the FGF has a great deal planned. Cooperation with international and national institutions will be intensified, numerous projects will be continued and preparations for new research plans will be made, which will start in 2004. The FGF will extensively provide information to the public via the Internet, with journals and brochures. With regard to projects more and more specifications are being added, such as details and quality standards. We have found out that this type of project planning requires more work in the initial stages but it has proven to show positive results with regard to how the projects are conducted.

A complete report on the activities of the FGF can be found on the Internet (www.fgf.de) under Annual Report.

Summary

To sum up the following can be emphasized:

in the last 10 years the FGF while utilizing all of the possibilities at its disposal, was successful with its endeavours and

Planned Activities 2003

- research program for 2003 with new invitations to tender
- coordination among the WHO, EU, BfS, BauA with regard to research
- the publication of research results of FGF research funded with third-party-funds on the Internet and in "Edition Wissenschaft": more involvement with regard to publications in peer-reviewed journals.
- the presentation of research results of the BEMS 2003 and EBFA 2003
- participating as the national coordinator (together with BfS) for COST 281 and as scientific secretary for COST 281

Special Events

- a dialogue with the European Union pertaining to supporting special research programs within the framework of the 5th framework program (started in Feb. 1999, 5-year time period)
- participating in the 24th BEMS in Quebec City, Canada (Presentation of our own research results: 25)
- participating in the WHO-research project EMF: determining outstanding research and the harmonization of international standards

therefore substantially contributed to research being done and to providing information concerning the biological effects posed by mobile radio communications.

At the end of the session, Mr. Bär thanked the members of the board, the working groups, and the office of the FGF for their work and support.

The following reports are concerned with recent original scientific publications on the effects of high frequency fields posed by mobile communication systems. The author, Professor Dr. Roland Glaser, personally selected the publications to be discussed and has subjectively assessed the relevancy of each publication.

The Latest Scientific News

The epiphyse (the pineal-organ) produces melatonin, a time regulator for the body, and therefore it is still a major subject of discussions regarding field effects on humans, be it low or high frequency ranges.

For some time now, it has been known that in humans and in animals calcium deposits form in this organ, these deposits consist of hundreds of micrometer sized structures in the shape of mulberries and small 10-20 micrometer sized crystals, which look completely different. The latter have been for the first time crystal graphically analysed and identified as octagonal single crystals, whose characteristics can be ascribed as piezo-electric. Even though they cannot be compared to the magnets Kruschvink described, the idea in this case that there **could be non-thermal mechanisms of high frequency fields, should be carefully considered**. This concept seems to be far-fetched, since there are many other piezo-electric structures all over the body and besides that the effects of weak HF-fields on melatonin production is highly unlikely (Bacconnier, S., Lang, S.B.; Polomska, M.; Hilzler, B.; Berkovic, G.; Meshulam, G.: Calcite micro

crystals in the pineal gland of the human brain. First physical and chemical studies. *Bioelectromagnetics.*: 23, 488-495. 2002)

Is the incidence of skin cancer (melanoma) dependent on the intensity of the surrounding FM transmitters? Örjan Hallberg und Olle Johansson, dermatologists at the Karolinska Institute in Stockholm believe they have found such a correlation. **They correlated an increase in the incidence of skin cancer with the number of surrounding transmitter masts and even with the transmission frequency**. They do, however, concede that in the former east-block countries which transmitted low FM-frequencies (70 MHz) had fewer problems since these frequencies were further away from the resonance frequencies of the human body than those in countries where 87-108 MHz are transmitted. Nevertheless, it is surprising that as an antenna measurement arm-leg and torso were used and not the entire length of the body because when measurements are taken in this way the conclusions would not be correct. Since most transmitters are horizontally polarized, the most dangerous position for humans would be a hori-

zontal one and the most dangerous time would be during the night. Correspondingly, one would recommend placing one's bed in the direction of the weakest fields.

The section on confounders is very short and only states that an increase in traffic density has been observed or recently more attention has been paid to the diagnose of melanoma. The effects of UV were only marginally mentioned. Changes in holiday and travel habits, which will certainly have a sustained effect on northern Europeans or an increase in the number of visits to solariums was not dealt with in this paper. (Hallberg, O. and Johannsson, O.: Melanoma incidence and frequency modulation (FM broadcasting. *Arch. Environm. Health* 57, 32-40. 2002).

After the first investigations concerning the influence of high frequency mobile communication fields on EEG and sleep. (Borbely et al. *Neurosci. Lett.* 1999, 275, 207; Huber et al. *Neuroreport* 2000, 11, 3321), this Swiss group presented the results of investigations, which also included measurements taken on regional cerebral blood flow by means of Positron-Emissions-Tomography (PET). It could

be shown with great significance that probands who had been exposed for half an hour on the left side with GSM similar pulsed fields (900 MHz, 1 W/kg), exhibited after 10 minutes an increase in local circulation in the exposed half of the brain. With regard to non-pulsed fields of the same intensity, these effects could not be established. The authors came to the conclusion that the effect could not be attributed to an increase in temperature. (Is the space-time temperature gradient in both irradiation modes really identical?) In a further experiment the effects on sleep were investigated with an identical irradiation plan. A EEG frequency analysis done before falling asleep showed an increase in the intensity of the alpha-spectral range, which only occurred after irradiation with pulsed fields. Even when the sleep phase itself was not significantly effected by irradiation, with pulsed fields a similar EEG-change was also measured in the NREM sleep phase, which even increased during the course of the night. The authors stressed that the measured effects were slight and no conclusions could be drawn with regard to health but their results should not be disregarded. (Huber, R.; Treyer, V.; Borbely, A.A.; Schuderer, J.; Gottselig, J.M.; Landolt, H. P.; Werth, E.; Berthold, T.; Kuster, N.; Buck, A., and Achermann, P.: Electromagnetic fields, such as those from mobile phones after regional cerebral blood flow and sleep and waking EEG. *J. Research.* 11, 289-295. 2002)

D.L. Hamblin and A.W. Wood from the Swinburne University of Technology in Melbourne, Australia analysed in an exhaustive and meticulous study on current research pertaining to the **effects of mobile phone emissions on brain activity and sleep parameters**. Basically, since 1995 up to the point when this paper was concluded in January 2002 there were only 18 publications on the subject. Low frequency effects have been investi-

gated in the past and these types of publications are more frequent, however it must be emphasized and rightly so that these results are at most relevant with regard to the magnet fields which originate from the working currents of mobile phones. An overview of the study shows that there is little consistency regarding the results. Occasionally, the same authors could not reproduce their results in a second series of experiments which they obtained in the first study. What could be the cause of this? A series of methodical limitations has been discussed: e.g. differences in frequencies and intensities, as well as antenna configurations; differences in measurement time schemes and in irradiation and differences in how the results are statistically worked out. While some authors investigated changes **during** irradiation, only some registered such changes at different times **after** irradiation. The number of groups investigated did not always allow for reliable statistical statements. What was generally criticised was that all of the measurements were carried out on young healthy probands and therefore, it is not possible to make any direct statements concerning children or the elderly. In any case it seems as if fields of a maximum mobile phone intensity range held to the head can temporarily have an effect, especially on the alpha-waves of EEG. How can this be explained? Are they subtle thermal effects, which promote blood flow, or must a cellular mechanism be held responsible, this is always discussed over and over again, (but never proven) namely calcium efflux? Could it be that perhaps the effects can not be attributed to HF-fields but attributed much more to the circa 7,5 microtesla, 8Hz magnet fields of the working currents of mobile phones? (Concerning this point the authors see a need for further research to be done!) Other methods proving brain activity should be incorporated, e.g. the positron-emissions-tomography (PET), which can provide in-

formation on blood flow changes (please see the report by Borbely et al. in this review of scientific publications). To sum up, the authors have come to the conclusion that there are indications of effects that must be scientifically explained, but there is no reason at all to be concerned about health risks. The current valid limit values are completely adequate in protecting the public from possible risks, particularly when currently published epidemiological results indicate that there is no evidence whatsoever indicating a risk to health. (Hamblin, D. L. Wood, A.W.: Effects of mobile phone emissions on human brain activity and sleep variables. *Int.J. Radiat. Biol.* 78, 659-669. 2002)

Professor Roti Roti's working group (Division of Radiation and Cancer Biology, Univ. St. Louis, USA) published the results of an extensive study on the **effects of FDMA and CDMA modulated HF-field systems on the induction of micronuclei in the fibroblasts cell-lines of mice**. In contrast to the positive control group where irradiation was carried out with gamma-rays, between 0.3 and 1.2 Gy and where a clear dose-effect-curve could be shown. With regard to the HF-fields, even in extreme cases (5 W/kg, 24 hours) with the three independent experiments a significant effect could not be found neither in the exponential phase of growth nor in the plateau phase. The authors discussed the divergence of these results with the findings of Tice et al. (*Bioelectromagnetics*, 23, 133-126.) 2002, compare "Neues aus der Wissenschaft" (The latest scientific news) issue 1, 2002 of this journal) which reported on a four fold increase in the number of micronuclei but with a double SAR value. Perhaps this is due to differences in cell sensitivity (Tice used cultured human lymphocytes) which was also evident in the number of micronuclei in the control group, perhaps when there is an increase in the field strength there is

also an micro-thermal effect in the experimental receptacle? In any case these findings should be more closely and critically investigated. (Bisht, K.S., Moros, E.G., Straube, W.L., Baty, J.D., and Roti, J. L. R.: The effect of 835.62 MHz FDMA or 847.74 MHz CDMA modulated radiofrequency radiation on the induction of micronuclei in C3H 10T1/2 cells, *Radiat. Res.* 157, 506-515. 2002)

A Finnish working group reported on an **increase in protein-phosphorylation and an expression of heat shock protein (HSP) in cultured human endothelial cells which were in vitro irradiated with 900 MHz GSM signals.** The SAR- values in the two Petri dishes, which were simultaneously irradiated, were calculated so that the thermal measurements of the inhomogeneous fields were between 1.8 and 2.5 W/kg. Since the Petri dishes were cooled from below by a flow system, and the temperature corresponded to the measurements taken before and after irradiation, which complied with the limit of 0.3 degrees, the authors considered this to be a non-thermal effect. Unfortunately, no statistical evaluation was given, not for the three-fold increase in the total protein-phosphorylation nor for the extent of the increase in HSP-development. The error bars shown in the diagram 2D and 5 do not indicate any significance. From a qualitative perspective it seems that the hsp27 presents itself in two different conformations. Within the study there is an extensive scheme recording the way from these changes to the induction of cancer and its consequences are discussed. However, since HSP-development is a normal physiological protective mechanism, which occurs frequently when various cell stress related conditions are present, one wonders why cancer does not occur more often. (Lesczynski, D., Joenvaara, S. Reivinen, J., Kuokka, R.: Non-thermal activation of the hsp27p38MAPK stress pathway by mobile phone radiation in human endothelial cells:

Molecular mechanism for cancer- and blood-brain barrier related effects. Differentiation 70, 120-129. 2002).

In 1998 a working group of the University of Freiburg published the results of their investigations in which the **radio fields of a mobile phone lead to an increase in the blood pressure of test persons** (Braune et al., *Lancet.* 351, 1857.1998), and this study was criticised due to its lack of statistics (Reid et al., *Lancet.* 352, 576.1998). In the meantime, the authors have done the experiments again, but this time under stricter experimental conditions. In simple blind experiments conducted with 40 probands between the ages of 20 and 34, finger measurements were taken of blood pressure, heart rate and capillary blood flow. In contrast to the earlier experiments no effects were found from the fields of a mobile phone held to the head (GSM 900 MHz, 0.5-0.84 W/kg) (Braune, S.: Reidel, A. ; Schultemonting, J., and Raczek, J.: Influence of a radio frequency electromagnetic field on cardiovascular and hormonal parameters of the central nervous system in healthy individuals. *Radiat. Res.* 158, 352-356. 2002)

Is hearing affected by the electromagnetic fields of mobile phones?

The working group of the medical faculty of the Inonu-University (Turkey) set out to answer this question. Experiments were conducted with 20 probands, a mobile phone was held to the left ear in order to measure possible oto-auditory changes after a 10 minute telephone call with a Panasonic GD 600 device. No effects could be found. Unfortunately, the study did not contain a dosimetry, it was merely mentioned that this device functions with 900 MHz in GSM mode and has an electrical power of 0.02 and 2 watts (Ozturan, O., Erdem, T., Miman, M. C., Kalcioğlu, M.T., and Oncel, S.: Effects of the electromagnetic field of mobile telephones on hearing, *Acta Oto Laryngologica* 122, 289-293. 2003).

Are there any **"non thermal" effects stemming from high frequency electromagnetic fields,** effects that occur below the intensity-level, which can be proven as thermal? Robert K. Adair has quoted from two 1996 studies where it was established that such supposed effects have been proven to be the result of measurement errors. As far as the experiments are concerned, we may question from a biophysical point of view if such effects can be expected to occur at all. Robert Adair, who has repeatedly critically analysed publications on this subject by various authors, systematically analyses the problem. A focal point is of course thermal noise. A physiological primary reaction is only possible when a special mechanism has been found where the absorbed energy exceeds the thermal energy. It should not be forgotten that in the range of the HF-fields the effect of the magnetic field vectors, e.g. through the radical-pair-recombination mechanism, has to be ruled out. Even with a power flow density of 10 mW/cm² the magnetic field is still four powers of 10 smaller than what is required for this mechanism. The author categorised conceivable electric mechanisms into three classes: A - charge motion, B - the triggering of dipole motion, C - electro restrictive effects. With regard to category A he calculated charge movement and molecular rotation. Even when coherent behaviour is considered, it would be many powers of ten below thermal noise. In the process a power flow density was respectively presupposed at 10mW/cm², which corresponds to an E-field of 200 V/m. Category B was assigned the concept that a field could affect the dipole of a transport protein and, therefore, effect the excitation process of the membrane. What speaks against this is not only the time constant of this process but the lack of energy as well. However with regard to electrostriction, about one cell (class C) in fields of this dimension effects occurred, but on the other hand,

these were concealed by thermal membrane oscillations. Resonance-effects have to be ruled out because of the viscosity characteristics of the cell. The Fröhlich theory of coherent excitement is also being discussed and it has been established that even when the viscous loss is not considered, this mechanism placed in class B, cannot function. On the other hand the experiment and the theory seem to be in agreement that athermal reactions of this kind do not exist and they cannot possibly exist. Nevertheless, the author refers to the electrostrictions as the only possibility, at least with regard to energy that cannot be completely ruled out. Comprehending this train of thought is well worth it (in spite of a few printing errors in formulas and in the text). (Adair, R. K.: Biophysical limits on athermal effects of RF and microwave radiation. *Bioelectromagnetics*. 24, 39-48. 2003).

While directly deducting nerve impulses with the aid of micro-electrodes, it was found out how cells in the cerebrum and the cerebellum of zebra finches react to weak GSM-signals (900 MHz, 217 Hz-Pulse, 0.1 m W/cm², 0.05 W/kg). For this purpose the birds were anaesthetized and were irradiated in a tuned wave guide. The microelectrodes were put into place through a 4 mm hole in the skull. From the 133 cells which were examined, 52% exhibited under field effects a circa 3.5 fold increase in spontaneous impulse rate and 17% showed a slight decrease. The effects occurred after switching on the field with a latent time of 104±197 seconds and faded out with a time constant of 308±68s after turning off the field again. Nonpulsed fields triggered no reaction. The authors are aware of the possibility of artefacts, which among others, could occur when the measuring electrode under the effects of the field could turn into a stimulus electrode. This is avoided with the corresponding field orientation. A reproduction of the results done

with independent methods seems to be required here. (Beason, R. C. and Semm, P.: Responses of neurons to an amplitude modulated microwave stimulus. *Neuroscience Letters*; 333, 175-178. 2002).

K.A. Hossmann and D.M. Hermann at MPI for neurological research published a **literature overview on the possible effects of mobile radio emissions on the central nervous system**.

The results of in-vitro investigations, animal experiments, investigations with probands and epidemiological evaluations were critically assessed and refereed. The authors came to the conclusion that some of the material has to be more closely examined. For instance, the effects that were found on sleep and cognitive functions, which are very difficult to reproduce, should be pursued further. However, all together there is a slight possibility that pulsed or continuous mobile radio emissions can effect the functional and structural integrity of the human brain. Only in thermal cases is the effect consistent, but this is beyond the normal mobile phone exposure. On the other hand, there are indirect effects for instance the increase in the number of traffic accidents caused by using a mobile phone while driving. This has to be taken into account and how to avoid such accidents has to be more intensely discussed. (Hossmann, K. A. and Hermann D.M.: Effects of electromagnetic radiation of mobile phones on the central nervous system. *Bioelectronmagnetics* 24, 49-62. 2003).

Three years ago, the working group of Lennard Hardell used data (from 1994-96) taken from the Swedish cancer register and compared the incidence of brain tumours with mobile phone use (Hardell, L. et. al.: *Intern. J. Oncology*, 15, 113-116. 1999). Now there is a new study, emphasizing the years 1997-2000, without using the old values. It deals with data from patients who are still

alive (total no. of patient 588, aged 20 to 80). These patients were compared to the same number of test persons. Data on the test persons was recorded with questionnaires, and sometimes telephone consultations were made concerning the private exposure, smoking habits etc. and also on the settings of the telephone calls (e.g. the average time spent on the phone per day, if the telephone was held to the left or right ear. The study dealt with analogue (18.7%), digital (34.7 %) and cordless phones (30.4%). With regard to these three categories, as in the previous study, no significant risk increase could be found. However, the results would be different if a correlation between both sides would be taken into account with regard to the incidence of cancer and normal telephone use and the occurrence of brain tumours. Analogue- telephones resulted in an OR of 1.85 (95% confidence interval: 1.16-2.96) digital telephones 1.59 (1.05-2.41) and cordless telephones 1.46 (0.96-2.23).

These values are not high and statistically they are not very certain, but nevertheless they must be considered. It must however be considered that the absolute number of cases with regard to this differentiation decreases drastically (analogue: 50/27, digital 59/37, cordless 55/37). It is an open question whether the authors can justifiably ascertain that the patients even after a diagnose and therapy did not know in what part of the brain their tumours were located. In any case the objectivity of the statement if the probands telephoned on the left or the right side does not seem certain. The authors are of the opinion that statistical errors can of course not be excluded, however it seems that due to this, the results cannot be explained. (Hardel, L.; Mild, K.H., and Carlberg, M.: Case-controlled study on the use of cellular and cordless phones and the risk for malignant brain tumours. *Int. J. Radiat. Biol.* 78, 931-936. 2002).

Electromagnetic Fields and Fundamental

Report on the 3rd International Conference on:
“Electromagnetic fields and human health, fundamental and applied research”
in Moscow and St. Petersburg

Eduard David

In September of last year an international conference took place on the subject of “Electromagnetic fields and human health, fundamental and applied research”.

It was of particular interest for scientists from all over the world since research that has been done in the former USSR on EMCE has not been completely revealed to the rest of the world and stipulation criteria for value limits in Russia are still not fully understood. The following article is an overview of the six-day conference, e.g. the programme of the conference, the schedule and the results.



Professor David with Andreas Wojtysiak and his wife in Peterhof (St. Petersburg)

The conference was organized by

- The Russian Academy of Sciences (Department of Physicochemical Biology)
- The Russian Ministry of Health
- The World Health Organization (WHO)
- The North-West Russian Scientific Centre for Hygiene and Public Health
- The Russian Centre for Electromagnetic Safety
- The Russian Centre for Bio-electromagnetic Compatibility
- The Russian National Committee for Non-ionising Radiation Protection (RNC-NIRP)

The conference is a part of the WHO's programme for the international harmonization of guide lines concerning health

relevant effects and for fully comprehending limit values.

The conference was supported by the World Health Organization (WHO), the European Office for Astronautic Research and Development, the Air force Centre for Scientific Research and the U.S. Air Force Research Laboratory.

In cooperation with the following organizations:

- MS Air Force Research Laboratory (AFRL)
- The International Commission for Non-ionising Radiation Protection (ICNIRP)
- The European Bioelectromagnetic Association (EBEA)

and Human Health, and Applied Research



For some time the Americans have been especially interested in the results from research programmes compiled in the east, since the results have not been made available to foreigners. This could explain their willingness to help finance such conferences. According to Murphy of the US Air Force Research Laboratory, it is less expensive to gain knowledge in this way than to analyse the results in our own laboratories. On the other hand, we in the west would like to know why the Russians are demanding such low value limits.

Members of the International Programme Committee:

- Onischenko, G.G.; Ministry of Health in Moscow
- Repacholi, M.; WHO, Geneva
- Burlakowa, E.B.; Director of the Scientific Radiation Protection Commission for Biological Problems
- Ilyin, L. A.; Director of the Public Research Centre for Biophysics in Moscow
- Kheifets, L.; Representative for the international WHO EMF project and director of the Radiation Protection Programme
- Fesenko, E. E.; Director of the Bio-physical Research Institute in Puschino, near Moscow
- Murphy, M.P.; Director of the Radio-Frequency-Radiation Department of the US Air Force research laboratory in Texas, USA
- Klauenberg, B.J.; Vice-chairman of the NATO, TG-002

- Chaslim, V.P.; Director of the North-West Centre for Hygiene and Public Health in St. Petersburg, Russia
- Grigoriev, Y.G.; Vice-chairman of the RNCNIRP

The committee made every effort to stimulate a marked discussion between the Russians and western scientists and used the results to substantiate the determination of value limits. Therefore, several western scientists were invited to take part in the conference who originally came from the former Soviet Union.

The Organization Committee consisted of:

Six Russians and two Americans members under the auspices of the Russian Academy of Sciences and the Russian Ministry of Health.

The conference interestingly enough took place at two different venues, in Moscow on 18-20 of September 2002 and in St. Petersburg on 23-24 of September 2002, each venue was separately organized. In Moscow five scientific sessions were held followed by a discussion. In St. Petersburg there was a round-table discussion which was carried out by participants, who actively took part in the conference, the round-table discussion was followed by a discussion on the harmonization of EMF standards. A resolution was agreed on at the end concerning the results of the conference.



A fountain in St. Petersburg at the summer residence of the Czar



"The tower of silence", in this tower Pawlow (see bust) carried out his experiments with dogs.



Dr. Repacholi (WHO) and Professor Grigoriev opening the conference

Main Topic of the talks

These talks took place in Moscow and covered the following points:

- Basic problems with regard to research on electromagnetic effects and public health
- Biological effect mechanisms from exposure to electromagnetic fields
- Somatic effects of exposure to radio frequencies and pulsed electromagnetic fields
- Problems of field irradiation from a hygienic standpoint, in particular the pathology of occupational medicine
- Electromagnetic fields in mobile telecommunications
- Dosimetry and Therapeutics (medical) using electromagnetic fields

Further sessions took place in St. Petersburg in the form of a round-table discussion, participants of the conference took part in the discussion.

The following topics are subdivided into individual subject related categories:

- Harmonization of EMF-standards in conjunction with scientific findings of east European countries;
- A discussion concerning the results of chronic field exposure experiments (conducted for months or for years) which were carried out in the former USSR;
- EMF-standards in the USSR and Russia and how they were derived from the chronic experiments;
- The opinion of the foreign (not Russian) scientists regarding the EMF-standards in the USSR and Russia;
- Discussion concerning any questions on the harmonization of the different EMF-standards.

The main points listed above were dealt with in 55 short talks (15 minutes), main seminar papers and with 71 posters. The majority of the authors are from Russia (the number of contributions: 84), followed by the US with (14) and White Russia (11). The other authors came from the following countries: Armenia (4), Azerbaijan (1), Bulgaria (2), China (1), Germany (1), England (1), France (2), Georgia (1), Italy (3),

Croatia (1), Latvia (1), Poland (2), the Republic of Kazakhstan (1), Riga (1), Sweden (2), Republic of Serbia (1), the Ukraine (3). Two authors represented the WHO (Geneva).

Individual lectures

Dr. Michael Repacholi (WHO Switzerland)

In his opening lecture Mr. Repacholi referred to the necessity of having a universal international harmonization of standards and in particular, in conjunction with the effects of electromagnetic fields on technology, the environment and especially on human health.

This harmonization should not only minimize international trade barriers but to serve the purpose of integrating our eastern colleagues into our information system. In connection with this he presented an international EMF-project dealing with the frequency ranges of 0-2000 GHz, which was started in 1996, the project will be conducted over a 10-year period and requires 150 million dollars. It covers scientific reporting, technical innovations and risk perception. Its goals are to collect results, to establish health effects and to set up guide lines incorporating effects, safety factors and limit values. The project aims to lower the value limit by 10 fold for those working and by 50 fold for the general public.

Dr. Leeka Kheifets (WHO Switzerland)

spoke about risk perception, safe value limits, and "ALARA"- promotion ("as long as reasonable is achievable") while considering the correlation between the extent of the individual influences and the assured effects. Therefore, in 2002 a European commission was founded in order to deal with sensible protective measures. This commission is trying to proceed according to the benefit/risk ratio. What is required here is: weighing the evidence, the knowledge of the costs (effectiveness), and

if necessary to reduce any probable effects or to prevent them altogether.

The commission is investigating the following questions:

- How much weight can be placed on the data gathered from animal experiments with regard to humans?
- How should false positives and negatives be evaluated?
- What measures make sense from a financial point of view “prudent avoidance”?
- Finally it must be explained, which client will be granted the task of checking and monitoring?

**Professor Grigoriev
(Russian Academy of Sciences
and the Russian Commission for
Non-ionising radiation)**

In his anxiously awaited introduction talks, he first introduced the Russian institutions involved in this type of research. These institutions are those which do research in the following areas: radiology, radio-biology, hygiene, standardization, dosimetry, therapeutics, and many others, with a total of 32 specifications. In addition, there are centres for biophysics, medicinal biology, physical and technical measuring technology, boards of health (hygiene), astronautics, the military etc.

Chronic and acute effects are sought and questions are posed about dosages and cumulative effects. Russia is especially suited for doing this kind of research. The scientific structures still exist that were set up by the previous political system. Russia has many people at its disposal due to the great size of its population. Since in Russia many regions have different technical standards this allows for the use of comparison groups which have not been exposed to any mobile telephone emissions. Moreover, there is a great capacity for astronautic research and the heterogeneity of the landscape makes it possible to find many confounders. In contrast to many western countries (Germany) the limit values in Russia are recommendations

and not decreed by law. They are generally at least by factor 10 lower than in the west, so the export industry in the west has to adjust its exports. In Russia results from hygienic epidemiological studies are available, these studies concern children, the ill (unfortunately most of them were done without negative controls), the elderly and pregnant women (the so-called genetic effects) and investigations were done with rats and HF-irradiation at 5-10 mW/cm² with modulated frequencies, however these studies must be done again in compliance with international research quality standards. The question was raised in the discussion as to who will do the experiments again (east or west). The question was also raised as to who will finance it and who will be authorized to evaluate the results.

**The next speakers gave 15 minute
talks on biological effect mechanisms
caused by EMF-irradiation.
(Chairmen: C. Chou and E. Fesenko)**

This set of talks was principally held by scientists from Russia and the U.S.A., at first they dealt with the fundamental principles of the physical interaction of fields with material, and questioned if entropy, thermal noise and the law of energy conservation play an important role in this interaction. While the Russian scientists mainly described phenomenological reactions concerning lowly organized forms of life, such as insects, the Americans concentrated more on causal analyses. The Russians reported in their data that an increase in the production of pheromone occurs when the feelers of insects are irradiated. In this case action potential sequence of neurons in the feelers of insects showed a higher open state probability, i.e. a higher rate of excitation – when the Ca-ion canals in the nerve cell membrane are frequently in an opened state. The experiments were done with the Patch clamp technique. Magnetic, constant and alternating fields in combination with ELF-

fields exhibited clear effects with regard to amplitude and frequency windows, especially with regard to the photo receptors.

**Participants from China, Russia,
Poland and the U.S.A. presented
the next set of talks on additional
results obtained from single cell
experiments.**

The effects concerned cell-cell communication changes or their suppression brought gap junction interference caused by ELF magnetic fields (low frequencies). Hereto, Russian scientists demonstrated a single cell physiological mechanism specific to the phosphate cycle. This mechanism while under the influence of weak ELF-magnetic fields produces changes in the life of organisms, which only live for a short time. In the discussion it was pointed out that no negative controls were done. Effects with low probability could occur on a purely statistical basis. In the same way, positive controls are required here, which could reveal the natural occurrence of the investigated effects without any field influence taking place.

This is also valid for the gene technology studies, such as those done by the Italian working group. Their investigations were concerned with ETS-genes (genes which play a role in the occurrence of cancer and in embryonic development) and EMF-exposure. The Polish group, under the direction of Szmigielski presented their findings on the immunotrope potency of isolated, immune competent human cells (lymphocytes) in in vitro experiments by means of pulse modulated 1300 MHz microwaves.

The Russian as well as the Americans keep on looking for primary physical and or biochemical mechanisms during HF-field exposure; mechanisms which are triggered by changes in protein-water structures. They are also attempting to solve the “KT-problem”. An attempt is also made to explain the effects demonstrated by the



Dr. Murphy (US-Air-Res.Lab.)



Prof. Grigoriev

Italians (but only for 0.8 mT ELF) on the phosphorization of the connective protein found in gap-junctions with a laser scanning microscope. Even in the field of molecular oncology, studies have been conducted, for example, in Italy which show at 50 MHz amplitude modulation and at 60 V/m that different "domains" are affected (protein structures, respectively their fractions). These effects influence gene expression in mRNA (messenger-RNA) in the cell-cell bonding process. It is assumed that the metastasising of carcinoma cells is based on this mechanism. With special methods, e.g. with the gyroscope a structural analysis of fluids can be done, which is based on a kind of polarization microscope. V.N. Binhi, who is an internationally known biophysicist, used this to explain the "window-effects" in the microwave range. Nevertheless, the problem lies in transferring this micro effect to humans.

The following session on the somatic effects of radio frequency EMF-exposure was moderated by S. Szmigielski (Poland) and A. Pakhomov (Texas, U.S.A.)

The talks were given by scientists from many different countries but the majority were from Russia, they reported on function changes in live organs. Merritt reported on experiments that were reproduced on the calcium out-flow of nerve cells in the brains of chicks while being exposed to microwave irradiation. This observation was of interest because normally the extra cellular space has a higher concentration of Ca-ions than the intra cellular space. This means that when the Ca ion canals open, Ca ions should actually flow into the cell. There were other reports on the subject of morpho-functional changes in specific areas of the brain (in chickens, rats, cats, etc.). Another large subject area is the field of immune modulation, for the most part it deals with isolated lymphocytes, which were exposed to microwaves, some of the lymphocytes

investigated were intra vital - before they are taken out of the blood - and some in vitro. The working group of Hansson Mild (Sweden) together with Lyskov (Russia, St. Petersburg) showed in a 24-hour monitoring that sensitive people exposed to field effects had a restricted variability in heart rate. This observation has been reported on from different sides in Russia and has even been used by employing the long-term Fourier-Analysis all the way to astronautics research. The results from the above-mentioned authors are regarded as preliminary because there is no exact definition as to electromagnetic over-sensitivity, whereas exact information on normal heart rates exists.

Further investigations on the plasticity of cerebral synaptic connections lead to changes in behaviour and how people cope with stress while exposed to continuous pulsed microwaves.

The following session moderated by M. Murphy (Texas), L. Kheifets (WHO, Geneva) and Khudnitsky (Russia) dealt with the hygiene problems and occupational medicine.

In his introduction Murphy described the mode of operation employed and the subject areas investigated in the research laboratories of the Air Force. Most of the studies dealt primarily with animals' reactions to being exposed to highly energized, radio frequencies. If exposure intensity is substantially higher than exposure in everyday life than it is all the more suited for making a statement on the validity of limit values. His opinion on HF-effects and hearing was also interesting.

The following Russian authors, N.B. Rubstova, to mention one, interpret hygiene problems as the occupational medical conditions of certain occupations and a correlation to the health status of each occupation.

Several presentations were on studies done with airport personnel and their ex-

posure to radar, however, a causal correlation between EMF-exposure and illness was difficult to detect. For example, those reports dealing with highly stressed personnel working in out-patient wards exposed to radar, this exposure has not been quantified.

In the following sections talks are presented which deal with the problem of EMF-communication:

French scientists, for example (F. Batelier and others) observed the direct effects of mobile radio radiation on a large number of chicken embryos and described their results in a kind of epidemiological evaluation. The fact that only very slight effects were observed, lead to the reproach that the results lacked significance thus rendering them very difficult to assess.

A very large group of Russian scientists working in the field of industrial medicine investigated the possible effects posed by telecommunications to those working in the industry. These talks especially focused on the setting up of standards which would make it possible to institute precautionary measures. In this case some information has been borrowed, as Grigoriev described in his talk, from information concerning radio technology in the region of Moscow. In Bokitko's talk he held up the plans of the Russian Ministry of Health's and the Ministry of Health's working group "Mobile Communication" as examples of researchers striving to create and set up guide lines for measurements, planning, information and for safety measures.

In the next section the talks on dosimetry and the evaluation of absorption rates are summarized together. These talks were moderated by Yu Spodobaev (Russia) and D.Simunic (Croatia):

Real measurement data and calculated absorption rates were individually presented and compared to dosimetric data from computerized models of humans and ani-

mals. Moreover, data from models was compared to experimental data on HF-skin absorption and analysed. C. Andenna (Italy) presented the ISPESI (National Institute for Industrial Safety and Prevention). Requirements for organ resonance and whole body models were presented by A.L. Lyssy (USA).

The last session held in Moscow on the use of EMF for medical diagnostics was lead by M.Markov and R. Gimranov.

M.Markov (U.S.A.) opened the session and presented his talk on the use of magnetic impulses in medicine and in biology. The session continued with a talk on the use of magnetic field applications, used to activate organic functions after irradiation damage. The report dealt with a retrospective clinical study. Moreover, from the U.S.A. there was a report on the treatment of osteoarthritis and epilepsy with magnetic fields. These types of treatments use, in part, extremely weak magnetic fields, whose interference with the substantially stronger magnetic field of the earth is not taken into consideration. Otherwise, the organizational question arises as to the use of medical applications and the general validity of limit values.

The journey to St. Petersburg

The conference in St. Petersburg served the purpose of a plenum discussion, with individual speakers who presented their opinions in a short talk. It ended with a presentation of the standards in each individual country and this was followed by a common resolution being made of the conference.

Conclusions

- Children and EMF: for the WHO this is still a current topic. In 2003 a conference has been planned by the WHO on the subject.
- Electro sensibility: lectures by Lyskov and Belyaev: as in the past, there is no

strong evidence indicating a correlation between field effects and health symptoms. Both find that various biological and medicinal parameters have experimental effects, but no differences were found among control persons and those with apparent electro sensibility.

- Pulsing: Review by Lu (US Air Force), there were various studies which exhibited pulsing effects but no effects were exhibited with CW. According to the author, altogether there was no strong or conclusive evidence with regard to any particular effects from pulsing fields.

- Combination effects: according to D'Andrea (US Air Force) there were no unexpected effects from irradiation at 2000 MHz and 3 GHz (2-6 W/kg) in behaviour tests done on monkeys. The reactions were as if they had resulted from a combination form of individual exposure according to their respective fields. The reactions were of a thermal nature.

- Russian Research: the work presented was often relatively old, done in the 70s and 80s in the area of high frequency/microwaves. It partly dealt with the correlations between field exposure and symptoms that arose (illnesses) partly with experimental studies, mainly with rodents and partly with studies on the mechanisms of field effects. Many studies were only published in Russian and were therefore in the English speaking world largely unknown and this was also the case for English publications in Russia. The language barrier still poses problems in communication.

- Mechanisms: no detectable significant progress:

- Epidemiological studies: Illnesses in the states and in the former USSR are systematically documented (especially on the job). The connection to electromagnetic fields, from a scientific standpoint, often seems to be of no harm.

- Point of criticism: Possible co-factors may not been determined and taken into consideration.



- Experiments with animals: The parameters that have been investigated are often relevant to health (for example, teratology, haematology, see Grigoriev's summary in conference publication). The methodology often seems quite sound, in part the methods used in the west were not customary, but on the other hand very often usual methods were applied. One can see that the research is of a rather good internal consistency (within laboratories and/or research groups). External consistency or no independent reproductions remained a point of criticism in the discussions. Moreover, in most cases the small number of animals (8-10) used per experimental group has to be questioned. In the Russian studies a lot of single parameters were determined for the animals, where many statistically significant changes were discovered. However, no conclusive statement can be made concerning the changes, many of them seem to be unsystematic and bear no relationship to each other.

- Value limits: The representatives of the Russian committee adhere to their opinion that the research presented and further research justifies the low value limits. The WHO's specifications on established health effects was discussed by the Russians and questioned. No agreement could be reached on the term "established".

Principal Problems with the harmonization of standards in Russia.

In the USSR studies were mostly published in Russian and in their own publications, these studies were done under very different conditions than those adhered to by western institutions. Firstly, a lack of communication with foreign countries in the west was fertile ground for creating their own independent ideas, however with the handicap that their investigations were not subjected to international controls. So the existing research results did not come about from the point of view of determining limit values but rather in a sense from a value free scientific approach. It is of course conceivable that their applicability, at least for political and military purposes cannot be excluded.

The establishment of value limits arose out of a necessity in the west to protect the population from so-called collateral damage, as it is called in the military, this was also the case in the USSR but under different prerequisites. The statement, "below the value limits there are no reactions whatsoever", was interpreted in such a way that even from a molecular point of view no changes could occur. It is generally known that in this sub-molecular region, e.g. at very low temperatures, weak effects which

are normally swamped by thermal noise, become visible, these effects on a cellular level or even with regard to the entire organism play absolutely no role. Finally, at that time psychological reactions were not properly classified and not given somatic parity. As early as the 1970s the Russians informed western scientists about such psychological effects -however the effects took place in low frequency ranges used for energy supplies- and started with their announcement an intense well-known debate that is still going on today.

Of decisive significance for the Russians was our definition "below the value limits nothing happens". Since in Russia, interestingly enough, low-energy therapy is very popular, we can ascribe this as an effect too. This type of therapy is used in an extremely low energy range, so that it must be below the value limits.

On the other hand, experiments are often not done according to the rule, "good scientific practice" and so often a negative control is lacking or an exact definition of the exposure parameters. So the Russians have extensive statistics on cases of illness from employees in different branches, but one cannot refer to the corresponding exposure parameters.

Therefore, it is clear to everyone that the experiments done earlier will have to be repeated, and this time under international control. The question is however, where will the experiments take place, in Russia financed internationally or in another country. In the end it is only possible of course when the exact parameters are made known.

Understandably, there is the desire in Russia, if possible even in a sense of a better utilization of scientific facilities, to carry out the experiments on their own. An agreement on this matter is reserved for a later meeting. The above-mentioned problem together with the necessity of harmonizing the value limits between us and east European countries was expressed in the final communiqué. ■

The environmental and health aspects of mobile radio technology have not been included in the 6th framework programme of the EU

The topic “Mobile radio communications and the environment is an outsider”

Christoph Bächtle

In 1994 the Europe Union carried out the so-called framework programme, an extensive programme which focused on the promotion of research and technology in Europe. In the 5th framework programme electromagnetic compatibility was still planned as a topic for one of the seven specific programmes, however in the 6th framework programme which started in 2002, it was no longer considered a topic for the programme currently running. At present, the topic “mobile radio communications and the environment” has been pushed out of the picture by the EU.



It has been almost 20 years since the European Union managed to set up the first framework programme for the development of research and technology in Europe. Those responsible earmarked 3.2 billion euros to promote the first framework programme for research and technology. Since then more than 7000 projects have been realized. The first framework programme ran for only four years, since 1987, five years seems to be the rule for each programme. Subsidies have increased substantially. For the first time between 1994-1998 during the course of the 3rd framework programme the 10 billion euro mark was exceeded by 3.12 billion euros. In the

current 6th framework programme the project coordinators allocated 16.27 billion euros for the programme.

The subventions are steadily increasing in Europe for research and in spite of this, important topics have been side-stepped by other topics. In the 5th framework programme which was conducted between 1998 and 2002 the subject “potential environmental effects of electromagnetic fields” was still in the programme. When the key words “radiation protection” is entered into a search engine, it comes up with: “Community Research and Development Information Service of the EU” - (CORDIS) -23 projects, three of which deal

with the question concerning health risks posed by electromagnetic fields of mobile radio communication systems or mobile phones.

The 5th framework programme has a multi-theme structure consisting of seven specific programmes, each of these 7 programmes is sub-divided into many thematic programmes. Projects dealing with investigations on the potential effects to the environment posed by electromagnetic fields were established in the first thematic programme, with "Quality of Life and Management of Living Resources", and in the fourth programme with "The Environment and Health". 31.1 million euros were allocated for the programme "Quality of Life and Management of Living Resources", the investigations on the potential effects of electromagnetic fields on people and the environment was financially supported in the 5th framework programme.

Now it is certain that the European Union in the near future will give other topics priority. In the 6th framework programme, which establishes the scientific goals for 2002 - 2006 of the continental countries in the EU, mobile radio communications still plays an important role but only with regard to the development and use of technology pertaining to it. Only in the thematic programme "Information Society Technology" (IST) is mobile radio communication, as a component of communication and information technology, given any significance. Questions concerning possible environmental effects are not included and the topic in question is also not listed under any other thematic focal points.

Scientists within the EU and scientists from partner countries submitted over 12,000 proposals about which issues should be dealt with in the 6th framework programme. When looking in the data bank of the proposals that were submitted using the key words mobile phones or elec-

tromagnetic fields; there were less than 20 hits. If the results of the search query are more closely studied, the results show that not one single suggestion submitted had something to do with the environment or health relevant aspects posed by mobile radio technology. This is not surprising since the seven thematic focal points of the 6th framework programme are selected in such a way that the topic electromagnetic compatibility to the environment (EMCE) would not be a suitable subject for the 6th programme. The topic "Quality of Life and Management of Living Resources" of the 5th programme has been replaced by the topic "Life Sciences, Genomics and Biotechnology for Health".

In the Official Journal of the EU of 29.08.02 the European Council pointed out at a conference held in Stockholm in March 2001 that "special efforts would be made in the area of new technologies, especially in the field of bio-technology". Bio-technology, genetic research and health are, therefore, being placed in the foreground. On the other hand, a professed idea of the Eurocrats is to push forward in the field of information and communication technology. In the above-mentioned Official EU Journal the following resolution is quoted, "Within this framework, research measures for specific initiatives should be more coordinated, for instance concerning the development of the next generation of mobile communication systems".

There are reasons why the responsible EU committees choose certain subjects and why others were replaced. The bio-sciences are an important field of research for the 21st century and developments in communication and information technology will change our habits in the future more than ever before. It is also essential that the links connecting the main focal points are strengthened by investigations which are being conducted at the moment on the potential effects posed by new technolo-

gies to health and the environment and as a result answers can be worked out on the basis of conclusive scientific data.

In 2002 pertaining to the work programme for the theme "Life Quality and Management of Living Resources" in the 5th framework programme, the EU was still informing those interested that proposals were welcome on potential health effects posed by electromagnetic radiation, e.g. cognitive and other effects, combined irradiation and exposure quantification. In the 5th framework programme there was still a need for this type of research, nevertheless at present the topic EMCE has, at most, been placed in a holding pattern.

How a framework's thematic focal points are determined is an extensive process involving the European Parliament, the European Council, the European Commission and many committees. Unfortunately, from official sources there is no sufficient explanation as to what criteria is finally used to determine the research focal points for the 6th framework programme. Written inquiries to the EU were not answered. The experts working at the 5th framework programme's national liaison offices are not involved in decisions concerning the 6th framework programme and the liaison officials for the 6th framework programme have not made any statements concerning EMCE.

So what has been established is that not all of the 5th framework programme projects are finished and their findings will still have to be analysed and evaluated. Only when these new findings are analysed and assessed, will the research strategists of the European Union decide whether or not "mobile radio communications, health and the environment" will be at the top of the list in the future for EU supported research or whether will be put on the back burner. In view of the next framework programme, perhaps this complex of topics should strive to be given top priority again in 2006. ■



A Curiosity

Although the FGF normally deals with serious scientific subjects, sometimes there is a need to become involved with curiosities. In 2002 levitated water was a hot issue. According to the suppliers of “levitation machines” our drinking water is polluted by environmental influences (toxins and mobile radio waves). Levitated water is water which is physically energized and regenerated with “amazing effects”.

From a scientific point of view, information pertaining to levitated water contained nothing at all about the biological effects or the impact of this water.

The Federal Office for the Environment knows of no evidence regarding the biological effects, and claims made about health benefits are considered to be highly improbable. “The effects of levitated water are not comprehensible”. The Swiss Federal Office for Health has assessed the claims about levitated water as unfounded. “This whole business is more esoteric than scientific”.

COST 281 – Workshop in Dublin “Mobile Phone Base Stations and Health”

The focus of the workshop is the alleged health risks from neighbouring mobile radio stations.

New radio masts for mobile radio communication networks result more often in the people living nearby complaining about health problems, which are mostly non-specific (headaches, sleeping problems or generally feeling ill or out of sorts). This is especially true when the masts were put up in areas that are solely residential. Even though in every case the limit values were complied with and in most of the cases exposures were considerably below the limit values, the electromagnetic radiation of these base stations was held responsible for existing health problems.

Therefore, there is public concern, even when the limit values are observed, regarding electromagnetic emissions from mobile radio communication masts and when looking at it in the long-run it could be problematic with regard to health.

Are there any objective reasons at all that speak for increased health risks for people who live near mobile radio communication masts? In order to investigate the public’s concerns from a scientific standpoint a workshop, within the scope of the EU’s COST 281 programme took place in Dublin on May 15 and 16, 2003 on the subject “Mobile Phone Base Stations and Health”.

The following subjects were dealt with separately:

Epidemiological studies: Which of the studies that have been done to date are relevant in this context? How should this type of study be conducted and what particular problems make this kind of study more difficult to conduct? In this context it is important to differentiate between the electromagnetic emissions from mobile radio communication masts and what is emitted while mobile phones are being used.

Testing measures: Is it possible to reliably determine the exposure rates in the areas where mobile radio communication masts are situated? (Is it in particular possible to estimate long-term exposure?).

Dosimetry: A simple dosimeter would be desirable, something similar to the device used to measure radioactivity exposure, a device which measures accumulated exposure over a longer period of time. What should this “mobile radio dosimeter” look like? Can it be designed so the person carrying it or wearing it can easily use it and carry or wear it at all times? Is a feasibility study worth doing?

Are the reported non-specific health problems occurring in the areas around mobile radio communication masts about objective effects or are they subjectively felt disorders which have no physical cause. How should the study be conducted, so that a clear distinction can be made between psychological and physical causes?

Risk communication: How can a dialogue be carried out between those concerned and those affected and between the authorities and science and how shall

News

the scientific results of this composite of issues be conveyed to the public? With regard to risk communication what are the possibilities, and where do the risks and pitfalls lie?

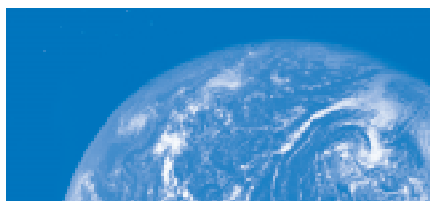
International Conference in Luxembourg

From 24 to the 26 of February 2003 a three-day conference took place in Luxembourg on the subject of "Application of the Precautionary Principle to Electromagnetic Fields". The conference was organized by the World Health Organization (WHO) and the European Commission. The first day of the conference was organized so that the participants who travelled to Luxembourg (WHO members, researchers, representatives of manufacturers, members of various citizens' action groups, and representatives from government agencies), could obtain some general information on the subject. On the following day, the experts who were invited discussed the precautionary principle concerning high frequency and low frequency electromagnetic fields (EMF) and presented the statutory regulations of different countries. And yet it still prevails that no agreement can be reached on the necessity and the possibility of making the precautionary principle a law. Those advocating a reduction in limit values based on the precautionary principle, base their arguments particular-

ly on the suspected long-term effects and the alleged proof of health risks posed by EMF. Transforming the precautionary principle into a law could be a sheer political act in view of the apprehension involved. However its necessity is doubtful when no existing findings stating that EMF are dangerous have ever been proven .

25th Annual Conference of the Bioelectromagnetics Society in Hawaii

This year the international scientific organization will meet again to discuss the effects of electromagnetic fields. The 25th annual conference of the Bioelectromagnetics Society (BEMS) will take place from 22-26 of June in the Outrigger Wailea Resort in Hawaii. As what is usually done every year scientists from all over the world will meet to express their opinions, to exchange information and to present the latest scientific findings. For further information on the venue, agenda and reservations please see the following Internet sites: (<http://www.bioelectromagnetics.org>) and the Forschungsgemeinschaft Funk e. V. (<http://www.fgf.de>, under the heading, conferences.



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