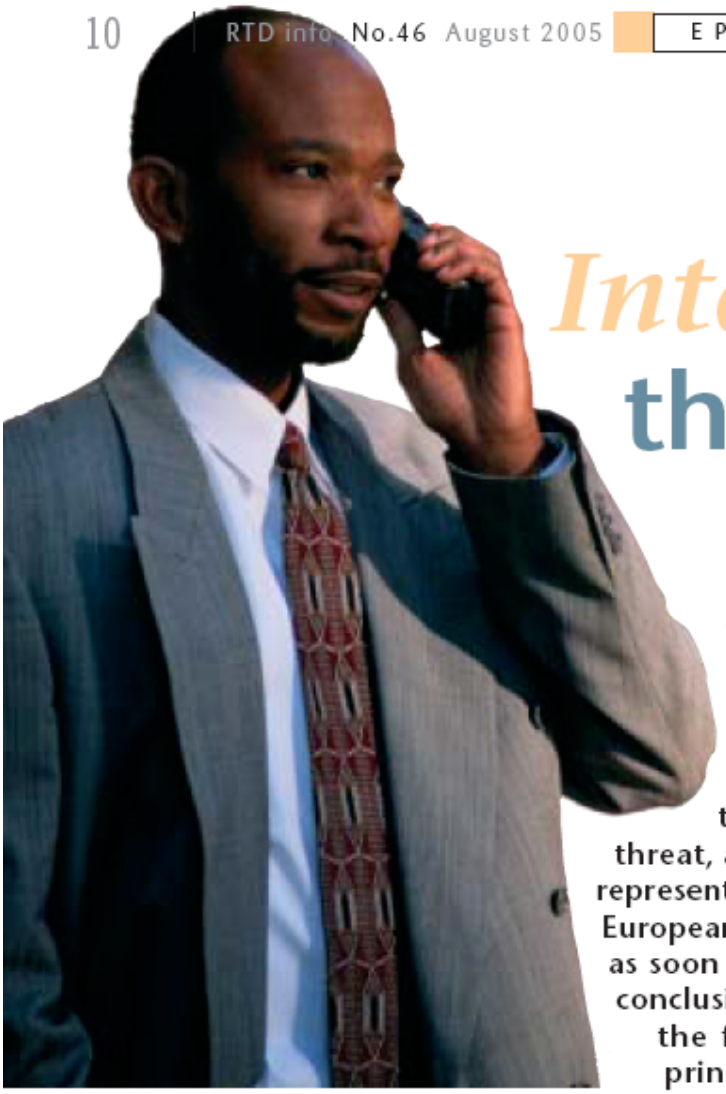
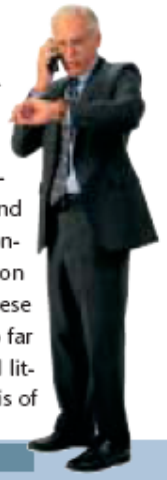


Interphone, the WORLD's widest survey

When it comes to risk prevention, epidemiology – the statistical study of the relationship between a potential threat and its real effects on human health – is the essential first step before any sound diagnosis can be made. But before such an analysis is possible, sufficient time must have elapsed since the appearance of the threat, and the study population must be sufficiently large and representative. In the case of mobile telephone use, the ambitious European Commission supported Interphone study was launched as soon as these two conditions could be met. Its initial global conclusions are awaited with great interest as they will provide the first knowledge base for an objective debate on the principle of precaution when using mobile phones.

It all began in 1998. The use of mobile phones was still very recent at that time but it was already becoming clear that this was a major technological invention destined to have a major social impact. Hundreds of millions of people were to become mobile phone users. Two major international organisations, the ICNRP,(1) responsible for setting electromagnetic protection levels, and the World Health Organisation, felt directly concerned by this technological innovation. They assembled a team of experts of global renown to look at its potential impact. What was known about the possible consequences and risks of the EM radio frequencies generated by these new devices, used in such close proximity to the brain and with very different properties to traditional telephones? The answer was: very little.

All the available epidemiological data on exposure to radio frequencies related to limited population groups who suffered exposure in a work environment (in radar or medical occupations, for example) and under very different conditions. The evaluation methodologies for these specific risks were also far from standardised and little suited to an analysis of



Diverse sponsors

The Interphone epidemiological study really took shape in 2000 when, in addition to national funding, it received substantial financial support from the European Union: maximum contribution of €3 850 000 for four years under the Fifth Framework Programme. Danish, Finnish, French, German, Italian, Swedish, Norwegian and British teams joined the project, as well as an Israeli institute of medicine. These were later joined by four other international partners (Australia, Canada, Japan, New Zealand), bringing to 13 the number of countries covered by the study. Additional financing was also provided by the UICC (International Union Against Cancer). The latter has a particularly important role in channelling funds from two private bodies representing the mobile phone industry, the Mobile Manufacturers' Forum and the GSM Association. "The acceptance of this material support from the industry is governed by a clause strictly guaranteeing the absolute scientific independence of the studies carried out under the aegis of Interphone," stresses Elisabeth Cardis.

this new invention that had taken the consumer society by storm.

Inventing a method

"Already at this time we were looking at the feasibility of a study that we named Interphone and that would be designed specifically to look at this new problem," explains project coordinator Elisabeth Cardis, director of the International Agency for Research on Cancer (IARC), an offshoot of the WHO with its headquarters in Lyons (FR). "Teams of specialists from 13 countries – the study would only be of value if it was conducted on a very wide scale so as to avoid any regional bias – agreed to concentrate their research on the development of very specific kinds of tumours of the cranial system: certain brain tumours (gliomas and meningiomas), tumours of the parotids or salivary glands, and tumours of the acoustic nerve (neurinomas) or of the lymphatic tissue (lymphomas).

It now remained to carefully select the control populations to be studied for mobile phone use. They were selected exclusively in areas where the technology had been adopted early on, at least between five and ten years previously. While this is the case for quite large areas of Northern Europe, elsewhere penetration at this time was primarily in large urban areas. Interphone also limited its study population to working people aged between 30 and 59, for whom there is the greatest likelihood of long-standing and continuous use of mobile phones.

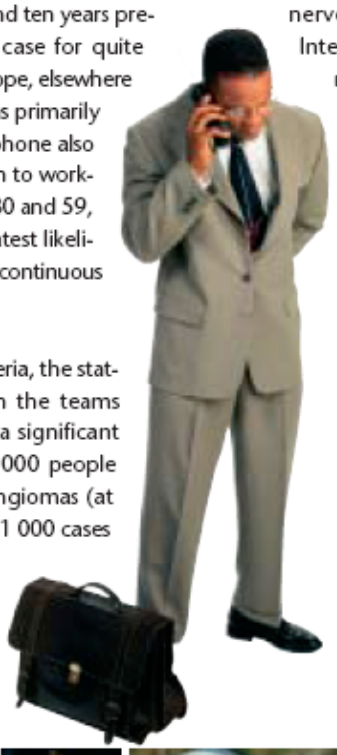
After defining all these criteria, the statistical potential on which the teams began to work produced a significant sample: approximately 6 000 people showing gliomas or meningiomas (at a serious or benign stage), 1 000 cases of acoustic nerve neurinoma, and 600 parotid gland tumours.

Interviewing and cross-checking

On this basis, the researchers carried out personalised and in-depth interviews of the control groups to assess for how long and how frequently they used mobile phones. Important details were recorded carefully – including which ear the mobile phone is usually held against. This is a valuable element, in particular when considering the condition of the acoustic or salivary system.

These recall data were then compared with the invoicing data available from the service operators, the network technical characteristics and the phones used. Finally, a personal investigation was carried out to detect other genetic or environmental factors that may have interacted.

"Many national or regional studies, either completed or nearing completion, are currently being gathered by the IARC," explains Elisabeth Cardis. "Various teams have communicated incomplete results. These all report an absence of effects, with the exception of one, published by a Swedish team and concerning acoustic nerve neurinomas (see box). But the Interphone results will only have any real value when they have been analysed and validated in their entirety. This global evaluation will not be completed before 2006."



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To find out more

www.iarc.fr

(1) International Commission for Non-Ionising Radiation Protection

Enigma of the Swedish neurinoma

In October 2004, the Institute of Environmental Medicine at Stockholm's famous Karolinska Institute issued a press release that caused a certain degree of concern. It revealed that the examination of 150 cases of neurinoma – a benign tumour of the acoustic nerve that grows very slowly and is quite rare (estimated at one case for every 1 000 000 people) – disclosed a doubling of the risk among intensive users of mobile phones "for at least ten years' duration". A worrying detail was that this risk increased fourfold for the side of the skull generally used for the device.

While not objecting to the publicity the information had attracted, the researchers themselves expressed the view that these findings should be treated with the greatest caution, primarily because the study sample of people presenting such tumours was very small. The Interphone study would provide more exhaustive results concerning 1 000 examinations of neurinoma sufferers. The specification of "at least ten years' duration" (no increased risk being identified before this period) perhaps also indicated a problem of technology. The first telephones used were analogue and "nothing permits us to affirm that these long-term results concern the use of digital telephones of the GSM generation...," point out the researchers.

The mobile keeps us on *our toes*

Launched scarcely ten years ago to rapid popular and commercial success, today the mobile phone is the subject of intense research to ensure that it poses no threat to human health. However, with the exception of traffic accidents due to a lack of concentration, no indication has yet been found that the mobile phone is in any way harmful.

This naturally begs the question as to why such attention is being paid to health risks that, to date, have not been proven. In part, no doubt, this is simply due to the phenomenal success of this new technology that already has 1.6 billion users. Yet at the same time, there is a distinct lack of scientific knowledge of the potential long-term biological effects of the technology employed. This is true despite the fact that electromagnetism in all its forms, both natural and man-made, has been extensively studied by researchers and exploited by engineers, resulting in a wealth of applications that have grown steadily over the past century. Particularly significant is the rapid development of telecommunications.

The safety boundary for the effects of electromagnetic fields on human health has been set traditionally at the famous dividing line between ionising and non-ionising rays. The biologically damaging effects of electromagnetic frequencies in the zone beyond visible light – from ultraviolet rays to radioactive rays – have been carefully identified and studied for decades by the specific scientific discipline of radiological protection. Despite the dangers, this has made it possible to master applications in the ionising sphere, both for producing nuclear energy and in the medical field – in which their development has enabled considerable technical progress in imaging and sophisticated treatment.

But one question has been neglected, at least until some 20 years ago: that of the possible effect on the human body of that extensive non-ionising electromagnetic 'smog' that remains largely uncontrolled and has ever-increasing power and frequencies. A smog to which we are all exposed in our everyday domestic, urban and professional environments.

The mobile telephone has given us a wake-up call. It is time to redouble our efforts to evaluate the potential risks and to take corrective measures, if necessary. It is time to find out more, not only about the ever-shrinking tiny device so frequently pressed to our ears, but also about so many other new technologies and the infrastructure they require. In particular, the high-voltage power lines that are such a familiar feature of the contemporary landscape must be studied for any effects on people living in their vicinity.

The *electromagnetic* bath

Throughout virtually the whole of the 20th century, very few questions were raised as to the effects on health of electromagnetic fields (EM), with the exception of waves generated by radioactive material. However, 30 years ago the tone began to change, and questions started to be asked about protection against non-ionising radiation. But what protection should we take when, to date scientists acknowledge that no consistent and convincing evidence has been found of possible damage to human health, despite the many technologies contributing to the electromagnetic smog that surrounds us? Yet these same scientists also point out that the data available, in terms of in vitro research, epidemiology and exposure readings, are incomplete and insufficient to draw a conclusive verdict.

Transported through conducting cables, electricity is an invisible but very tangible reality: the light comes on, motors start up, the hotplate heats up, the refrigerator cools, the TV screen flickers to life, the telephone rings … and the electric shock creates instant pain in whoever is clumsy enough to touch exposed wires!

At the same time, all these currents – inseparable from the oscillating electric field in which they originate – have a hidden component, one that is external to the conductors themselves and that we cannot feel. This leads to the creation of magnetic fields with the property of inducing, at a distance, the polarisation of the electrical charges present in their near environment.

Since the pioneering times of the late 19th century when this dual reality was demonstrated by physicist Maxwell – the founding father of the theory of electricity – this fundamental conjunction of the electric field, which is necessary for a current to travel, and of the magnetic field created when it does travel, has been combined in the unique concept of electromagnetism.

Common and universal spectrum

This key concept of electromagnetism relates to the transport of energy, whether in the concrete matter of a conductor or in immaterial space. As well as opening the door to an impressive increase in man's mastery of electrical applications, this also became one of the most fertile fields for modern physics.

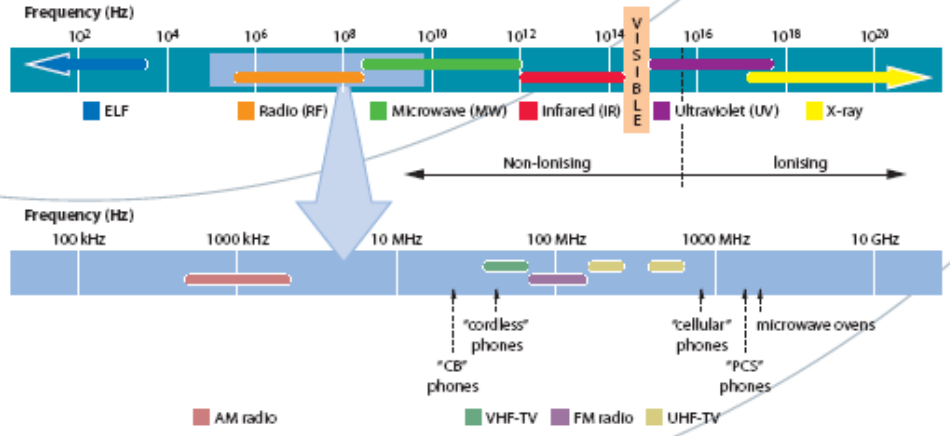
It made it possible to realise that the entire Universe is the site of an incredible variety of modes for the propagation of oscillating electromagnetic waves – waves that can be read in a vast spectrum of frequencies ranging from zero (continuous or unidirectional current) to 10^{20} hertz.(1)

This common and universal grid of the vibratory phenomena of the atomic or sub-atomic world includes, in the very highest frequencies, cosmic radiation, radioactivity (with gamma rays and X-rays), the characteristics of visible light and the colours of which it is composed, plus the vast zones of infrared and ultraviolet frequencies that lie below and above it in the spectrum.

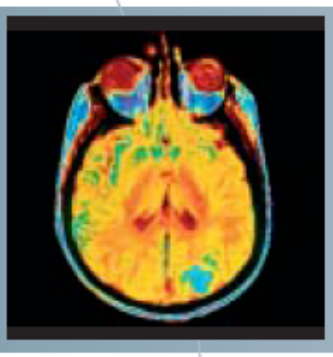
Within this continuous spectrum, it is at the very bottom of the scale that we find the frequencies of the electrical and electronic applications invented by man. Nevertheless, these have progressively climbed the scale of oscillations for increasingly diverse ends.

(1) A hertz (named after the German physicist who was a contemporary of Maxwell) is equivalent to one wave oscillation per second. On an inverted scale, values are also expressed in wavelengths (such as the 'microwave' category) that express the distance the wave travels during an oscillation cycle.

The Electromagnetic Spectrum



On a vast logarithmic frequency scale, the electromagnetic spectrum includes the primordial phenomena of the Universe (cosmic rays, radioactivity, light) as well as the man-made phenomena of electrical civilisation and telecommunications.



"Rays", although potentially dangerous and kept under a close watch, have enabled scinece to make tremendous progress in updating anomalies and diseases. Today they are used daily for dignosis, one of the most advanced methods being magnetic resonance imaging.

The precedent of radioactivity

As they propagate, by their very nature electromagnetic waves have an electrical influence on the atoms that compose the objects they encounter, whether inanimate or living. Man became aware of this in the first half of the 20th century when pioneering researchers were fascinated, often to their own detriment, by the properties of radioactivity, unaware of its potentially damaging biological effect. In this area of the electromagnetic spectrum, the power of penetration causes breaks in the atomic bonds, producing ions. At the biological level, this is expressed in major changes to DNA. This group of electromagnetic waves, which is closely monitored, became known as 'ionising radiation'.

Even though the power of this radiation could prove fatal, it also interested science for the formidable services it could render. During the First World War, Marie Curie devoted all her energies to demonstrating that X-rays could provide an unprecedented way of 'seeing' the bone fractures of the men wounded in the trenches. She herself was ultimately a victim of the radiation to which her research had exposed her throughout her life.

In the 1950s, with the development of the nuclear industry and the growing introduction of radioactive applications in medicine and other fields, a whole science of 'radiological protection' grew up to study the effects of ionising radiation, to develop the most effective methods of protection and to define the exposure limits – while at the same time exploiting the benefits of this unique form of energy to the maximum. Set up in 1965, the International Society for Radiological Protection (ISRP) began to play a role as a global forum for comparing and disseminating knowledge and updating the safety standards for this very distinctive family of ionising rays.

Non-ionising newcomers

Ten years later, scientists at the ISRP began asking the question as to whether concerns about radiological protection should be extended to other areas of the electromagnetic spectrum that were being used increasingly by new technologies – from the very low 50 hertz frequencies of traditional electricity networks to the increasingly broad radio frequencies, and up to the boundaries of the microwaves and infra-red zones. There is in fact a direct link between the wave frequency and the energy transported – and thus the potential impact on matter.

In 1977, in co-operation with the World Health Organisation (WHO) and the United Nations Environment Programme (UNEP), the ISRP set up the first International Committee for Non-Ionising Radiation to study and define the health criteria to be applied in these very extensive fields. In

High-voltage lines: guilty or innocent?

In the very low frequency of 50 hertz – the usual standard for electrical appliances throughout Europe – any EM generation has always been seen as posing no danger to the population. We are used to living under the vast network of high-voltage lines that criss-cross our countries, with particular concentrations at the exit of power stations and on the outskirts of major urban areas. Although voices have sometimes been raised to question the presumed innocuousness of the powerful magnetic fields, in the absence of any in-depth studies these concerns have not been acted upon. Over the past decade or so, experts have nevertheless looked at a possible link between leukaemia in children born and living for long periods in close proximity to these high-voltage lines. Incomplete data suggest a possible increase in cases, and it has been acknowledged that if the pattern is confirmed it would indicate 'more than just chance'.

In June this year, the *British Medical Journal* published the results of much more in-depth research carried out by a team from Oxford University. They embarked on a vast epidemiological study comparing some 9 700 recorded cases of leukaemia in children aged under 15 in Great Britain with the grid map of very-high-voltage lines and the 22 000 associated pylons. They found a 70% increased risk of leukaemia in children living less than 200 metres from these lines. Cautious of creating alarm, the authors added that, even if a relationship of cause and effect could be deduced from this, it would still represent less than 1% of child leukaemia cases in the country. The nature of the relationship must also be set against the fact that the global study of leukaemia cases generally shows the cause of the disease to be changes in DNA prior to birth or any later environmental factors, such as pronounced exposure to ionising radiation. The increased risk indicated by the British study is therefore only of relative value, if not set against these predominant factors. Nevertheless, in future, it seems that stricter national norms are to be adopted for acceptable distances when siting these high-voltage lines.

To find out more

- www.greenfacts.org/power-lines/l-2/power-lines-3.htm#2

GSM (Global System for Mobile communication) These three initials, which entered the language nearly 20 years ago, are emblematic of a long and sustained success story on the part of the EU. It is a success rooted in a commitment to constructive and close co-operation between technology companies in the telephony and electronics sectors (established under the EUREKA initiative), the national telecommunications organisations of the European countries and the EU institutions (European Commission, Council and Parliament). All these players made a major contribution to the successful harmonisation that was needed for GSM to be adopted as the standard without encountering the obstacle of international borders. Today the GSM cell phone is used by 1.6 million people worldwide.

The last two decades have seen an explosion in the most diverse electromagnetic fields.

1992, this Committee broke from the ISRP to become the International Commission for Non-Ionising Radiation Protection (ICNIRP), an independent scientific body charged with worldwide coordination on these issues. This field of research, which had been neglected for too long, thus began to take shape, but on the basis of very limited knowledge.

An all-electric society

The protection mission entrusted to this newly created organisation would appear to have been of staggering – and unnecessary – proportions. In our 'all-electric' society, it is difficult to imagine concern – and there is no evidence on which to base it – about the countless very-low-frequency electromagnetic fields generated by the many devices we use in our everyday domestic and working lives and the cables that supply them. There is a general consensus that these fields are not in any way harmful as the magnetic induction levels have a limited range and must respect standards that are set at a very low level.

However, the influence of these fields becomes much more extensive and intensive when the currents reach high values, bringing the need for more specific standards. This is the case, for example, for certain very-high-voltage industrial applications or network nerve centres such as power stations, transformation stations and high-voltage power lines. The latter have, in fact, been the subject of debate regarding their possible health effects – effects that recent research would tend to confirm (see box).

Invasion of the waves

Another key field is linked to the development of telecommunications. Here, too, exploitation of the transmission capacities of electromagnetic waves is not new. During the first half of the 20th century, our ability to use these hertz waves, in the range of 300 KHz to 300 GHz, gave rise to radio broadcasting and then to television.

Over the years, these remote 'wireless' transmissions continued to develop, using increasingly high so-called 'radio frequencies' and giving birth, during World War Two, to radar. Finally, over the past two decades, there has been a veritable explosion in the most diverse electromagnetic signals. With the advent of remote controls, WiFi and BlueTooth, these signals have invaded our space, both in the home and at work. We are being bombarded continually by satellite beams while in shops and airports, for example, we have to pass through a growing number of security points – anti-theft, luggage inspection, etc. – that use pulsed EM beams.

Knowledge control tower

Launched in 2004, the mission of the new European EMF-NET (Electromagnetic Fields Network) is to coordinate, evaluate and interpret the growing volume of research results on the potential impact on health of non-ionising magnetic fields, especially in connection with mobile telephone use. Participants include Europe's best scientific teams working in the Member States or engaged in EU-backed co-operative research.

The initial shortage has given way to a wealth, if not excess, of data. Wherever you turn, magazines, press releases and official health notices are responding to the latest in a steady stream of research results. Generally, the message is one of reassurance. But there are also the occasional less reassuring findings, figures that require further investigation, new fields to be explored and the need to apply the principle of precaution – as for the excessive use of mobile phones by children, for example.

So how can we find out what's what? The first service rendered concerns the scientific community itself. "The coordination action of EMF-NET is first of all comparable to a kind of research control tower, within which the principal European actors currently involved in these issues can engage in structured dialogue and consultation," stresses Paolo Ravazzani, coordinator of the network. "We publish a specialised newsletter that reports on this growing volume of information, rooting it in its most solid interdisciplinary bases."

Interpretation is key

EMF-NET's principal ambition is nevertheless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Following research on ionising radiation, the specific field of ultraviolet rays is now the subject of increasing attention in connection with many research projects on skin cancers. These rays do not originate in technical devices – except for sunbeds – but are linked to the sun's rays, the harmful effects of which are generally recognised. Today's sun worshippers are being targeted by information campaigns urging the need for precautionary action.

To find out more

- International Commission for Non-Ionising Radiation Protection
  http://www.icnirp.de/
- World Health Organisation (site on EM fields)
  http://www.who.int/peh-emf/en/
- GSM World homepage. An industrial association for mobile telephone operators
  http://www.gsmworld.com/gsmeurope/index.shtml

The mobile phone issue

However, it is without doubt the mobile phone and its phenomenal success that represents the pinnacle of innovation in this field. A major social phenomenon of our age, it is a means of communication used by all ages – including the very young – and all social categories. As there is nothing exceptional about the intensities and frequencies used, given the electromagnetic environment we already inhabit, initially this new technology did not raise any new questions.

There were, however, two exceptions. The first relates to the transmitting infrastructure that had to be quickly put into place to serve this technology – and increasingly often at the heart of our urban fabric. At first, this was the issue that aroused most of the complaints and concerns. However, to date, the balance of the scientific evidence indicates that there is no general risk to the health due to radiofrequency and microwave exposure (that is the working frequencies of the radio masts) when the exposure is below ICNIRP guidelines. In short, although they add to the already large number of such EM sources in our environment, they do not in themselves constitute a major aggravating factor.

The second question is that of the use of the mobile phone itself. They are devices that are pressed up close to the ear and thus in close proximity to the human brain. This is new and as such raises a new problem for scientists.

In the space of a few years, the exposure to magnetic fields in our everyday lives has increased to the extent that it has become an issue of priority concern. Therefore, a number of European Commission supported research projects have been launched in this field, enquiring in particular into the auditory system, cellular biology and epidemiology (see following pages). In 2004, the EU created the EMF-NET (Electromagnetic Fields Network), a scientific coordination network dedicated to mobile telephony and other technologies with an electromagnetic incidence. EMF-Net aims to harness the various scientific results in this field and to provide an interpretation that is as reliable as it is independent (see box).

interpretation. How to gauge the significance of an announcement coming from a limited group of researchers, or of results showing the absence of effects or, on the contrary, the possibility of their existence? What 'scientific opinion' can one deduce from them and what credibility can be lent to them?

"EMF-NET has adopted a joint evaluation mode that the network experts in our technical groups apply to study data and research results. These working groups are charged with providing the European Commission and health authorities with briefing notes and interpretation reports. To respond to precise and urgent requests from policy-makers, we have set up a fast response team able to provide succinct information and comments on the knowledge available on a given subject of topical interest."

Although the network has no research aim as such, it carries out forward study and scientific and technological monitoring missions in a number of fields – and, of course, on all developments in the emerging technologies. "Attention is far from concentrated solely on the subject of telephony, which is currently very much in the media spotlight. In addition to issues of general protection for the public in all areas of domestic and urban life, we want to place special emphasis on the effects and health risks of a very wide range of professional occupations, whether industrial, medical or in the services sector. Another important element is the perception and communication of risks."

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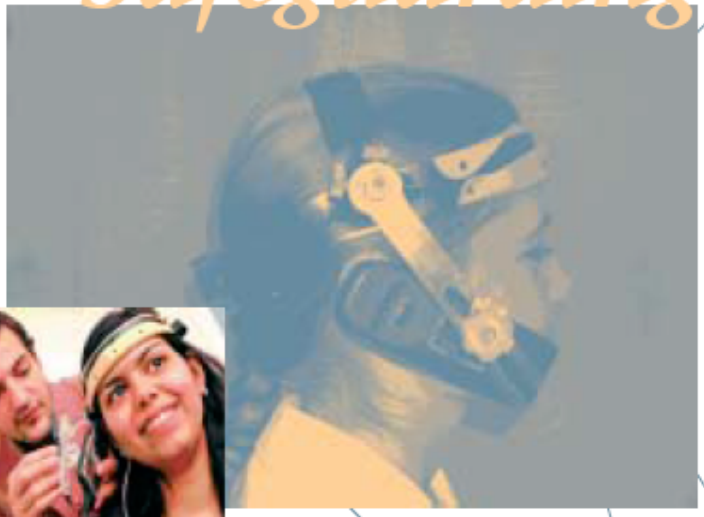
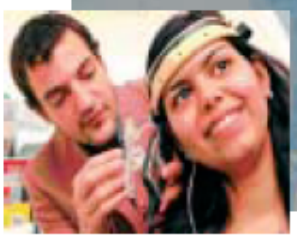
To find out more

- EMF-NET (Effects of the exposure to EMF: from science to public health and safer workplace)
  emf-net.isib.cnr.it/

Safeguarding the ears





Examples of direct tests, on volunteers, to monitor the reaction of the auditory system depending on the position of the devices. Research carried out by the Guard project.

The auditory system is clearly the human organ for which any questions regarding the effect of mobile telephone radio frequencies would seem to be the most pertinent. In-depth research carried out between 2002 and 2004 under the European project Guard *(Potential adverse effects of GSM cellular phones on hearing)* provides a reassuring response, however, as an Italian biomedical expert engaged in risk prevention in this field explains.

Paolo Ravazzani, of the IIB-CNR(1) (IT), has specialised in biomedicine of the auditory system for the past 20 years. "From the start, my principal lines of research sought to link the biomedical effects of electromagnetic fields to stimulate the nervous system with applications for the auditory system, such as modelling, signal processing and the optimising of audiological devices. Subsequently, in 1996-97, it was almost natural to find myself at the forefront when it came to looking at the new issues raised by the use of the first cell phones. The search for technological innovation for medical purposes and the new concern regarding the health effects of mobile telephony came together in this field of shared interest."

Direct tests on human volunteers

In 2000, it was Paolo Ravazzani who coordinated the launch and implementation of Guard, one of the first major European biomedical research projects, launched by the EU under the Fifth Framework Programme. French, British, Italian, Greek, Lithuanian, Hungarian and Russian specialists first carried out in-depth tests on animal models. At the same time, sophisticated systems for the recording and verification of measurements were developed so as to be able to carry out direct tests on the auditory systems of human volunteers, looking in particular at the positioning of the devices. One of the subjects studied concerned the central question of localised non-thermal effects that could be caused by the intensive use of GSM devices operating in the 900 to 1 800 megahertz frequency range.

"After three years of research, none of our results permit us to affirm that mobile phones cause the slightest damage to the principal hearing faculties. But Guard does not stop there. We have also defined procedures and accumulated knowledge that open the door to other types of enquiry into potential problems that could still arise in the longer term. For example, we recommend more in-depth research on the effects of mobile phones on the efferent cochlear system."(2)

Tracking technological trends

In the field of hearing, the expertise acquired by virtue of the Guard project will be used to monitor technological developments closely. "We believe that the arrival of the so-called third generation of mobile phones (3G/UMTS(3)), characterised by a higher range of radio frequencies and new modulations for the information transmitted, is reason enough for new research." In December 2004, Paolo Ravazzani therefore took over the coordination of the European EMFnEAR(4) scientific project, a consortium based on the same teams who worked on the Guard project, with the addition of Polish researchers. At the same time, this biomedical specialist who is very much involved in preventing electromagnetic risk – especially the potential dangers of mobile telephone use – is the driving force behind a new coordination and dissemination initiative supported under the Sixth Framework Programme, the EMF-NET network (see above). ■

Studies into long-term effects on the hearing of rats carried out in the laboratory by the Emfnear European project, in co-operation with the Guard project.

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To find out more

- www.guard.polimi.it
- www.emfnear.polimi.it

(1) Istituto di Ingegneria Biomedica – Consiglio Nazionale delle Ricerche

(2) In sensorial neuro-anatomy this term refers to the channels that 'descend' to the sensorial receivers. The latter send messages to the central nervous system through afferent channels and receive messages from the central nervous system through efferent channels.

(3) Universal Mobile Telecommunications System

(4) Exposure to UMTS EMF: Study on potential adverse effects on hearing

Surprising discoveries *in vitro*

In terms of cellular biology, the effects of the electromagnetic fields to which current technologies expose us – ranging from the very low frequencies of electrotechnical applications to telecommunications radio frequencies – have remained unknown territory to date. A pioneer in this field, the European Reflex project recently shed light on some of the mysteries, producing results that raise many questions.

The effects of radiation on DNA *in vitro*. On the left, no change; in the centre, showing breaks in the DNA bonds after exposure to gamma rays; on the right, the breaks are caused by a high-frequency electromagnetic field applied continuously during 24 hours.

Many research studies on cancer have demonstrated the genotoxic methods by which ionising radiation disturbs and destroys the cell universe by breaking the DNA chemical bonds. In this respect, the very recent European project Reflex[1] sought to fill a gap in our fundamental knowledge that had previously kept us totally in the dark about the possible biological effects of standard electromagnetic fields.

The project, pursued by a consortium of 12 laboratories based in seven European countries, sought to take an initial step in verification in this field. Intensive tests were carried out – which sought to be as exhaustive as possible – that involved exposing *in vitro* various isolated human cell systems (fibroblasts, lymphocytes, etc.) to variable ranges of electromagnetic fields. These samples were then examined closely to observe whether or not this radiation had produced any genotoxic or phenotypical effects on the cells of a kind that would normally be susceptible to result in cancerous and/or neurodegenerative pathologies.

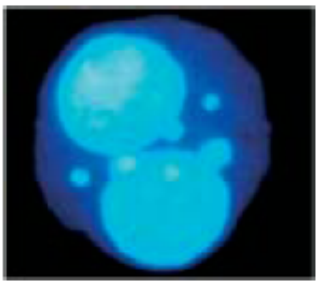
Undeniable breaks in the DNA chain

The surprise effect of the Reflex results, which were obtained during the 2000-2004 period, is in two Reflex laboratories that DNA simple- or double-strand breaks are produced in several cell systems under the effect of the very low frequencies or radio frequencies to which these cell samples were exposed. Furthermore, these genotoxic phenomena are present even when descending below the magnetic flux densities or specific absorption rates that comply with the safety standards in place.

"At this stage, these results – the reliability of which we can guarantee as they originate in a common work platform with several participating laboratories – do not enable us to draw any conclusions in terms of health," stresses Franz Adlkofer of the Verum Foundation in Munich (DE), the project coordinator. "The research we have carried out provides biological indications that clearly concur and constitute an initial knowledge base. Other studies must now investigate the specific points of our results – such as the fact that the genotoxic effect of very-low-frequency electromagnetic fields is only produced on intermittent exposure, not on continuous exposure, and that in the radiofrequency range intermittent exposure generates stronger genotoxic effects than continuous exposure."

The limits of *in vitro*

"To return to the subject of real risks to health, what we obtain from *in vitro* research offers no positive or negative certitude as to what actually happens in a living organism," Dr Adlkofer is careful to point out. "The questions raised by the Reflex results must clearly be an incitement for further research, switching to *in vivo* studies on animal models and on man.



***In vitro* experiment: cell division, revealing several micronuclei, the result of the genotoxic effects of electromagnetic rays.**

To find out more

- Verum Foundation – Stiftung für Verhalten und Umwelt (Munich, DE)
  www.verum-foundation.de/

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(1) Risk evaluation of potential environmental hazards from low-energy electromagnetic field exposure using sensitive in vitro methods