Ionizing and non-ionizing radiation are separated on the electromagnetic spectrum by visible light – a frequency of roughly 500 trillion cycles a second. Above that frequency is ionizing radiation which contains enough energy to physically alter the atoms it strikes, changing them into charged particles called ions. Below visible light the low frequency waves are non-ionizing – they do not possess enough energy to charge atoms. Ionizing radiation, such as nuclear radiation and X-rays, have long been known to be harmful. However, the question of the health effects of electromagnetic radiation, which is non-ionizing is a controversial one.

Some of the first warnings came in 1972 when scientists in the Soviet Union reported strange health effects in switchyard workers who were routinely exposed to high levels of electromagnetic fields. The workers experienced increased heart disease, nervous disorders, blood pressure changes, recurring headaches, fatigue, stress and chronic depression.

Although concerns had been raised earlier, one of the first epidemiological studies to indicate a health risk was a 1979 University of Colorado study by Dr. Nancy Wertheimer and Ed Leeper which reported a two to three-fold increase in cancer deaths among children living near high current power lines in Denver, Colorado.

In November 1986 Dr. David Savitz, of the University of North Carolina, reported the results of a study done as part of the New York Power Lines Project which confirmed Wertheimer and Leeper's findings. The study found increased incidences of childhood cancer and leukemia associated with EMF exposures above 2.5 mG. Dr. Savitz's final report to the New York State Health Department stated: "The degree of confidence placed in these findings is open to varying interpretation, but the tentative conclusion that the study is supportive of an association of electromagnetic fields (EMFs) and cancer risk is warranted."

Dr. David Carpenter, the Executive Secretary of the New York Power Lines Project, in response to statements that the Project "revealed no evidence that magnetic fields pose a health hazard" stated: "Any logical person cannot conclude that there are no effects." He said "It's just wrong to imply that there are no hazards." A second New York Power Lines Project was soon planned.

The findings of the Wertheimer and Leeper and Savitz studies were confirmed by a 1991 study by S.J. London et al., published in the American Journal of Epidemiology.

A University of Southern California study undertaken by John Peters and colleagues and published in the American Journal of Epidemiology in November 1991 also confirmed these findings. Public Power Weekly reported on January 28, 1992 that: "The most comprehensive study to date of childhood leukemia and exposure to electromagnetic fields offers additional evidence that proximity to power lines may increase leukemia risk."

When wire codes were used to measure exposure, the risk of leukemia among children with the highest exposure to magnetic fields was about two times greater than the risk of leukemia among children with the least risk.

There was no clear association shown when direct measurements of magnetic fields in the children's residences were used as an indication of exposure. However the discrepancy between results based on measurements and those using wire codes may mean that wire codes are a more accurate predictor of magnetic fields, according to the researchers. They stated: "Although magnetic fields are imperfectly approximated by wiring configuration, the wiring configuration is determined with little error, is unlikely to change over time within a residence, and therefore, may actually be a superior indication of long-time field exposure than the measurements taken."
measurements were longer than measurements made in previous studies, they're still just snapshots”, said Peters. "The estimates based on wiring configuration may better reflect the long-term exposure."

These findings were further confirmed by a 1992 Swedish study by Maria Feychting and Anders Ahlbom which reported a higher relative risk of 2.7 times for childhood leukemia and 1.7 times for leukemia in adults for subjects exposed to higher magnetic field levels compared with the control group in the study.

Christine Gorman in the October 26, 1992 issue of Time, stated: "One of the most telling results was that the cancer risk grew in proportion to the strength of the electromagnetic field." She reported that children with constant exposures to the weakest fields (less than 1 mG) had the lowest incidence of cancer. Those exposed to 2 mG had a threefold increase in risk and those exposed to 3 mG had a fourfold increase in the risk of leukemia. As Gorman stated: "Such a clear progression makes it difficult to argue that factors other than exposure to the electromagnetic field were responsible for the extra cases of leukemia."

As well a 1992 Danish study conducted by Dr. Jorgen H. Olsen found a five-fold increase in the risk of childhood leukemia, lymphomas and brain tumours where children living near power lines were exposed to 4 mG.

A more recent study published in the February 1998 Journal of Occupational and Environmental Medicine and reported in the March/April 1998 issue of Microwave News found an elevated risk of leukemia among children living near high-voltage transmission lines in metropolitan Taipei, Taiwan. The study drew on data from Taiwan's National Cancer Registry for the years from 1987 to 1992.

Children living in areas within 100 meters of a transmission line had a leukemia rate 2.7 times higher than did children in the nation as a whole, a significant increase. Their cancer risk was 2.4 times higher than that of other children in the same neighborhoods, a finding just short of statistical significance.

On June 15, 1999, a team at the University of Toronto and the Hospital for Sick Children, both in Canada, released results of an epidemiological study that provides perhaps the strongest evidence to date for the existence of an EMF-cancer link among children. Children with the highest exposures to power frequency EMFs were found to have a risk of leukemia 4.5 times higher, after adjusting for various known risk factors, than did children with the lowest exposures. The increase in risk is statistically significant.

The Canadian researchers, led by Dr. Lois Green of the University of Toronto, report their findings in two papers: in the International Journal of Cancer and in Cancer Causes and Control. The study was funded in part by Ontario Hydro, an electric utility, and by the Canadian Electrical Association.

Children are not the only ones at risk. Microwave News reported in March/April 1990 that "there are now at least 12 studies pointing to an EMF-brain tumour risk". Researcher Dr. Samuel Milham Jr. stated: "There are far too many positive studies to dismiss an EMF-brain tumour connection".

As well, Microwave News reported in July/August 1990 that epidemiologists at the Fred Hutchinson Cancer Research Center in Seattle, WA, had uncovered new evidence for an association between occupational exposures to electromagnetic fields (EMFs) and the development of male breast cancer. The study supports the preliminary findings of a Johns Hopkins University (JHU) study, reported last year, showing an increased risk of male breast cancer among young New York telephone workers.
Paul Demers, working with Dr. David Thomas's research group at the Hutchinson center, has found that telephone linemen, electricians and electric power workers have six times the expected rate of male breast cancer – a statistically significant increase. For radio and communications workers, the risk was almost tripled. Overall there was a doubling of the cancer risk for all EMF-exposed workers. A further Norwegian study found twice the expected rate of breast cancer in men in occupations which involved exposure to electromagnetic fields.

As well, a study by University of North Carolina researcher Dana Loomis published in the June 15, 1994 issue of the Journal of the National Cancer Institute, found that women in electrical occupations are 38% more likely to die of breast cancer than other working women. The study found the breast cancer death rate was more than twice as high among female telephone installers, repairers and line workers, compared with women in non-electrical occupations. The results support four previous studies that found elevated breast cancer rates among male electrical workers.

Another study, conducted by Dr. Tora Tynes of the Cancer Registry of Norway, found that in a sampling of over 2,000 female licensed ship radio operators born between 1934 and 1969, the risk of developing breast cancer was almost twice that of other Norwegian women.

A third epidemiological study has linked EMFs to female breast cancer. The study by Dr. Patricia Coogan and coworkers at Boston University School of Public Health was reported in the September 1996 issue of Epidemiology. It found a 43% increase in breast cancer among women with a high potential for occupational exposures to magnetic fields, notably those working with main-frame computers.

Cindy Sage, in a report on the First World Congress on Breast Cancer, printed in the Fall 1997 issue of Network News, states that evidence from over 100 epidemiological studies has shown an association between occupational and residential EMF exposure and various types of cancer and that evidence from half a dozen studies supports an association between EMF exposure and breast cancer. Environmental risk factors for breast cancer, including EMFs, were featured at the conference held in Kingston, Ontario, Canada in July 1997.

Among the recommendations of the conference was that conclusive scientific evidence should not be required to establish reasonable policies for prudent avoidance concerning EMF exposure and that the consensus of industry scientists should not be a prerequisite for action in determining when a causal linkage between EMF and breast cancer has been achieved.

Another occupational study, funded by Hydro-Quebec, Ontario Hydro and Electricite de France, was released at the end of March 1994. It found a link between the magnetic fields generated by electrical currents and an increased incidence of leukemia among utility workers. These findings confirm the results of a 1991 study by Genevieve Matanoski that found telephone workers employed by AT&T with higher EMF exposures had 2.5 times the rate of leukemia as employees with lower exposures.

"We believe our results speak for an association between occupational exposure to magnetic fields and at least one type of leukemia" conclude the authors, led by Dr. Gilles Theriault of Montreal's McGill University.

They found that workers with above-average exposure to magnetic fields were three times more likely to develop acute myeloid leukemia than less-exposed workers. Acute myeloid leukemia is one of the most common types of leukemia among adults.

A University of North Carolina School of Public Health study conducted by Dr. David Savitz and Dr.
Dana P. Loomis published in January 1995 in the American Journal of Epidemiology found that utility workers have a greater chance of dying of brain cancer. The results demonstrated that workers with the highest EMF exposures had more than a two-and-a-half times greater chance of dying of brain cancer than the least exposed workers. The researchers also observed a strong exposure-response relationship for brain tumours.

A 1996 study of cancer among hydro workers by researchers at the University of Toronto suggests that exposure to electric fields could be carcinogenic. Previous studies have focused on the magnetic fields. The study was led by Dr. Anthony Miller, chair of preventive medicine and biostatistics at University of Toronto.

In the study, covering more than 30,000 current, former and retired Ontario Hydro workers, Miller and colleagues found an increased risk of leukemia in association with increased exposure to both electric and magnetic fields. However the risk was highest in relation to electric fields and the researchers concluded that the electric field effect is dominant.

The study found that the risk of leukemia in the highest electric field exposure level was four times that of the lowest. In certain subcategories where workers had high exposure to magnetic and electric fields, researchers found leukemia rates 11 times greater than rates among the general worker population.

The other major finding of the study is a suggestion of increased risk for lung cancer. Miller said that although the increased risk was not statistically significant it is important and needs to be examined further. Over 40 occupational studies have shown that adults who were routinely exposed to high EMFs in their work environment had a significantly increased chance of dying of cancer when compared to other workers.

In The Great Power-Line Cover-Up, published in 1993, Paul Brodeur cites a review of 51 epidemiological studies of electromagnetic field exposure and cancer risk published in a California Department of Health Services handbook. It found that 28 studies (55%) reported a statistically significant risk, 15 studies (29%) reported elevated but non-statistically significant risk, and 8 studies (16%) reported no association.

In the same book Brodeur also refers to remarks made by Dr. David Carpenter, the Executive Secretary of the New York Power Lines Project, in the keynote speech at a conference on electromagnetic fields in Meriden, Connecticut on July 28, 1992. Dr. Carpenter was responding to a June 1992 report of the Connecticut Academy of Science and Engineering which stated that there was not enough evidence to support a conclusion that electromagnetic fields could cause cancer. Brodeur states:

"Pointing to the consistency of results between several childhood cancer studies and more than two dozen occupational studies, he declared that the weight of the evidence clearly showed that people exposed to power-line frequency fields at home and at work were experiencing an increased risk of developing leukemia and brain cancer. He said that recent studies showing increased breast cancer in men who were occupationally exposed to power-frequency fields were particularly worrisome, and he warned that if breast cancer and other reproductive cancers in women were also found to be associated with magnetic field exposure, the nation would be facing a major public health hazard.... He added that to do nothing about the problem was unacceptable because `we are where we were with cigarette smoking twenty five years ago".  

In 1994 three new epidemiological reports were released. One indicated a tie between occupational
exposure to EMFs and Alzheimer's disease, another indicated a link with Sudden Infant Death Syndrome (SIDS), and another indicated a tie with Amyotrophic Lateral Sclerosis.

In a 1994 case-control study of 387 Alzheimer's patients and 475 controls, Dr. Eugene Sobel of the University of Southern California School of Medicine and colleagues found an association between occupational exposure to electromagnetic fields (EMFs) and Alzheimer's disease. The study was made up of two Finnish groups and one American group of subjects. Researchers found that the overall odds ratio of subjects occupationally exposed to "high" and "medium" levels of EMFs developing Alzheimer's was 3.0 compared to subjects exposed to "low" levels of EMFs.

Another study done by Dr. Sobel which collaborates those findings is reported in the December 18, 1996 Los Angeles Times.

"The results, published in the journal Neurology, indicate that people who are exposed to high EMF levels on the job – seamstresses in particular – have, on average, three to five times the normal risk of contracting the devastating disease of aging.

"The results, from a study at Rancho Los Amigos Medical Center in Downey, follow on the heels of a September report from the Centers for Disease Control and Prevention indicating that a broad variety of neurodegenerative diseases, including Alzheimer's, are more common among workers exposed to EMF on the job.

"The greatest risk was for people who operate sewing machines. 'Seamstresses are highly overrepresented among Alzheimer's cases, and their exposure is the highest for all occupations,' Sobel said. The exposure is high because they work so close to the electrical motor in the machine.'

A researcher at Coghill Research Labs in England recently (1994) reported the results of a study on the relationship between Sudden Infant Death Syndrome (SIDS) and EMFs. This study examined the location of all SIDS cases in Inner North London between January 1986 and July 1988 in relation to obvious sources of EMFs. The researcher found that not only were SIDS infants living significantly nearer to EMF sources than controls, but the nearer the EMF sources, the younger in age did the infants die. The author concluded that there is a correlation between chronic EM field exposure and SIDS.

An article in the May 12, 1997 New Zealand Herald reports that New Zealand researchers have linked high-tension power lines – already associated with higher rates of leukemia among children – to asthma and depression in adults. The groundbreaking research suggests that people living within 20m of high-voltage lines are three times as likely to suffer from asthma and twice as likely to have major depression. The study also indicates that these people have a higher incidence of diabetes and are twice as likely to suffer from immune-related illnesses such as allergies and dermatitis.

A New Zealand study, presented at the Second World Conference on Electricity and Magnetism in Biology and Medicine, Bologna, Italy, in June 1997, found significantly increased risks for asthma, arthritis, type-2 diabetes and combined chronic health problems in adults living near transmission lines. As part of a larger cross-sectional study, in Auckland, New Zealand, 560 adults living near 5Hz 110kV transmission lines completed questionnaires about their residential location and existing health problems.

The study, titled: Chronic Health Problems in Adults Living Near High-Voltage Transmission Lines: Evidence for a Dose-Response Relationship with Magnetic Field Exposure, was conducted by Ivan L. Beale, Department of Psychology, University of Auckland, Roger J. Booth, Department of Molecular
Significantly elevated adjusted risk ratios were found for asthma, arthritis, type-2 diabetes and combined chronic health problems. The results are consistent with the hypothesis that 50-Hz environmental magnetic fields may affect human immune function.

The July/August 1998 issue of Microwave News reports on a recent French study that found that workers exposed to EMFs from nearby transformers and power lines were more prone to fatigue and immunological disorders. The study's results are "evidence that chronic human exposure to environmental low frequency EMFs... can cause neurovegetative, hematological and immunological disorders," wrote Dr. Laurence Bonhomme-Faivre and colleagues at Paul Brouse Hospital in Paris. Their report appeared in the March/April 1998 issue of Archives of Environmental Health.

Heart disease has also been implicated, according to a report in the July/August issue of Microwave News. EMF exposure can alter heart rhythms and may lead to elevated cardiac risks, according to Dr. Antonio Sastre of the Midwest Research Institute in Kansas city, Missouri.

In recent clinical studies of EMF effects, Sastre observed changes in heart rhythms that have been linked to increased risks of heart disease. This led him to predict that utility workers would have a higher rate of two specific types of heart disease. He then collaborated with Dr. David Savitz on a new epidemiological study to test his hypothesis. The epidemiological results supported Sastre's prediction. Based on these findings, Sastre proposed that workers with high EMF exposure could show increased mortality from two types of cardiovascular conditions – arrhythmia and heart attacks.

The recent proliferation of wireless communications and cellular phones and towers has raised new concerns that are addressed by Dr. Marjorie Lundquist in the article "Cellular Phones: The Brain Cancer connection" published in the Spring 1996 issue of Network News. Dr. Lundquist cited EMF researcher and medical doctor William Ross Adey's testimony before a Senate subcommittee where he warned of a brain cancer epidemic from the use of cellular telephones. (Emphasis added in bold)

Dr. Lundquist recommends not using cellular phones with the antenna connected to the handset. If you must use such a phone use it only for emergencies a few times a year and keep the calls short. If you need to use a cellular phone on a regular basis use one with a separate transmitter and headset and keep the transmitter several feet away from anyone.

In April of 1997 Australian researchers published the strongest evidence yet of a possible link between the use of mobile telephones and the development of cancer. The study led by Dr. Michael Repacholi of the Royal Adelaide Hospital is published in the American Journal Radiation Research. It involved 100 mice carrying cancer-causing genes that made them prone to develop lymphoma, cancer of the immune system. The incidence of lymphoma doubled from the spontaneous rate of 22% to 43% when the mice had prolonged exposure to electromagnetic fields of the kind emitted by digital mobile phones. For more information see the article by Stewart Fist. Reuters also issued two reports on the subject in January, 1998: "Cancer Jump Mirrors Mobile Phone Use" and "British Scientists Demand Cellphone Warnings".

The Express Newspapers reported on May 24, 1999 that evidence of the potentially harmful effects of mobile phones is being covered up.

Two of the world's leading radiation experts told The Express that multinational companies tried to influence the results of their research.
Professor Ross Adey, a biologist, had his funding withdrawn by Motorola before completing research which showed that mobiles affected the number of brain tumours in animals. Dr Henry Lai, who has been studying the biological effects of electromagnetic fields for 20 years, was asked three times to change findings on how they caused DNA breaks in rats.

Their claims come as two new studies reveal links between mobile phones and brain tumours. Swedish cancer specialist Dr. Lennart Hardell found the risk of getting brain tumours was two and a half times higher for people using mobile phones. And Dr. George Carlo, heading a multi-million pound research project in the U.S., says that users have an increased risk of getting a rare type of brain tumour.

The Express also reported on October 16, 1999 that a scientist who was paid millions by mobile phone companies to investigate health risks has bitterly criticised them for failing to act on his findings.

Dr. George Carlo found that the rate of death from brain cancer is higher among mobile phone users and the risk of contracting a rare tumour on the outside of the brain is more than double.

In an astonishing attack on the industry for which he once acted as a spokesman, he accused firms of not taking safety seriously. "The companies are now spending millions trying to discredit me because, basically, they didn't like what I told them", he revealed to The Express. "I feel angry and let down". His research body, which was handpicked by the industry was given £15 million to carry out a six-year study into the health effects of mobile phones. But after presenting its results to the phone companies in February, he claims they failed to take the "appropriate steps to protect consumers". Dr. Carlo, a leading public health scientist based in Washington, said: "They have shown total disregard for mobile phone users".

The Herald Sun in Melbourne Australia reported on October 12, 1999 the results of a study that found that children absorb up to 50 per cent more radiation from using mobile phones than adults.

The younger the child, the more radiation their brain soaks up. Scientists have found the thin skulls and smaller heads of children offer less protection against microwaves sent out by the phones. As a result, they may stand a far greater risk of damage to brain cells.

The study was carried out by Professor Om Gandhi, head of electrical engineering at the University of Utah in Salt Lake City. He found 10-year-olds absorbed 10 per cent more radiation than adults when making a call, and 5-year-olds 50 per cent more. "The handsets are logically closer to the brain and the brain cells than with adults," he said.

Sunday Age, Australia, reports that using a hand-held mobile phone for as little as two minutes could put people at risk of developing disorders such as Alzheimer's disease, multiple sclerosis and Parkinson's disease, according to a new study from the University of Lund.

Swedish researchers found that microwaves from mobile phones disabled a safety mechanism in the body that protects the brain from toxic substances in the blood. Once the toxins were released, there was a high chance of developing brain illness.

The Sunday Mirror (United Kingdom) reports that the world's biggest study into suspected links between mobile phones and cancer will take place in 2000. Nearly 9,000 cancer sufferers in 14 countries – including the UK and USA – will be interviewed by scientists in a £5.5 million study funded by the European Commission.

Researchers want to establish once and for all if there is a link between mobile phones and brain...
tumours and other cancers. France-based Dr. Elisabeth Cardis, who is leading the project, hopes to interview 7,000 brain tumour sufferers, 1,000 acoustic nerve cancer sufferers and 800 people with cancer of the saliva gland. The brain, saliva gland and acoustic nerve centre in the ear are vulnerable to high doses of radiation from mobile phones.

The mobile phone industry and medical research funds are helping pay for the study. Results from it should be available by 2003 or 2004.

Dr. David Carpenter, former Executive Secretary of the New York Power Lines Project and later Dean of the State of New York School of Public Health, states: "In my view, it is totally irresponsible to position a cellular antenna near a site where children spend significant periods of time. While I am not saying that the association between these exposures and childhood cancer is proven beyond any shadow of a doubt, I do see evidence to be suggestive. When children's health is concerned, I strongly feel that our society must be cautious so as not to increase the chances of their developing cancer or other health effects."

A recent study carried out in Sydney, Australia found that children who lived near television broadcast towers had more than twice the rate of leukemia than those living further away from the antennas. The radiofrequency and microwave radiation exposures in the study are similar to those emitted by cellular facilities. As well childhood leukemia clusters have been found near many similar wireless communications facilities as reported in the Spring 1996 issue of Network News.

A 1997 United Kingdom study conducted by Dr. Helen Dolk and colleagues at the London School of Hygiene and Tropical Medicine found that rates of adult leukemia were nearly twice those expected within two kilometres of a TV and FM tower operated by the British Broadcasting Corporation.

On May 16, 1999, The Sunday Times (London, United Kingdom) reported that analysis conducted by Professor Gordon Stewart, one of Britain's leading epidemiologists, shows there may be a significant increase in the risk of cancers, including leukaemia, associated with television transmitters. The study revealed an increased incidence of cancer within up to 7km of masts. Subsequent inquiries have unearthed possible clusters in London, Bedfordshire, south Wales and the Midlands.

Stewart, emeritus professor at Glasgow University's public health department and a former consultant on epidemiology to the World Health Organisation, was commissioned to analyse detailed geographical data on cancer rates and has concluded there are grounds for concern. He said: "I would say the leukaemia question is sufficiently suspicious to merit further investigation." He wants the government, which has denied any risk, to commission new research.

Previous studies have also linked health risks to radiofrequency radiation. In 1982, Dr. William Morton of the Oregon Health Sciences University found higher rates of leukemia and breast cancer near broadcast towers in Portland. In 1987, Dr. Bruce Anderson and Alden Henderson of the Hawaii Health Department reported significantly higher leukemia rates in areas with broadcast towers in Honolulu.

Laboratory studies have also shown health effects from electromagnetic radiation. Cass Peterson, writing in the Washington Post, states: "Similarly, numerous animal studies have demonstrated neurological or reproductive effects from low frequency electromagnetic fields. Chick embryos show a higher rate of abnormalities when exposed to low-frequency fields, mice suffer a higher rate of abortion and abnormal fetuses when exposed to slightly higher frequencies, approximating those emitted by video display terminals." Peterson further stated: "In separate experiments, scientists at the Cancer Therapy and Research Centre in San Antonio discovered human cancer cells exposed to
60 Hz fields (the frequency of a high-voltage line) grew as much as 24 times as fast as unexposed cells and showed "greatly increased resistance to destruction by the cells of the body's defense system."

While doing research for the New York State Power Lines Project Dr. Jerry Phillips and Dr. Wendell Winters discovered that human cancer cells proliferated like crazy when exposed to magnetic fields. As well, the exposed cells became increasingly resistant to the body's immune system. Drs. Phillips and Winters stated that their observations led them to believe that it was possible that magnetic fields stimulate the rate of cancer cell growth, or act as a cancer promoter.

Research into how magnetic fields are linked to cancer is also being undertaken. For example, Dr. Russell Reiter believes that a variety of different cancers may be promoted by magnetic fields. In a paper presented in November 1993 at a United States Department of Energy meeting, he explained that "the suppression of melatonin by magnetic fields could result in a higher incidence of cancer in any tissue." This effect could clear up "one of the mysteries of the magnetic field/cancer issue," that is, "the large number of different types that have reportedly increased," he suggested. A leaked United States National Council on Radiation Protection report (discussed later in this article) supports this theory.

The melatonin hypothesis got a boost when Cancer Research featured researcher Richard Stevens on its July 15, 1996 cover with a diagram explaining the melatonin/EMF/cancer hypothesis. The results of a major epidemiological study by Dr. Stevens and Dr. Scott Davis of the Fred Hutchinson Cancer research Centre, that tests the theory, will be released in the spring of 1997.

A number of other studies relating to EMFs and melatonin are cited and described in the August-December 1996 and Autumn 1997 issues of Electromagnetics Forum. A June 1997 article by Electromagnetics Forum editor Don Maisch examines "Breast Cancer & EMFs – The Melatonin Connection".

The July/August 1998 issue of Microwave News reports that a team at the Pacific Northwest Labs in Richland, WA, has found that a 12 mG magnetic field can block the protective action of melatonin against the growth of cancer cells. Batelle is now the fourth lab to observe this effect. Human breast cancer (MCF-7) cells whose proliferation had been inhibited by melatonin resumed growing in the 12 mG 60 Hz field. A 2 mG magnetic field did not affect the melatonin-stabilized cells.

Batelle is the latest lab to repeat the EMF-melatonin experiment, which was first reported by Dr. Robert Liburdy in 1992 and published in the Journal of Pineal Research in 1993. In 1996, Dr. Carl Blackman of the Environmental Protection Agency and later Dr. Richard Luben of the University of California each reported replication of Liburdy's experiment.

Liburdy and his collaborator, Dr. Joan Harland, both of the Berkely National Lab have also found that 12 mG magnetic fields can block the growth inhibition of tamoxifen, a drug used to control breast cancer. The Battelle group confirmed this finding, too.

A recent study suggests another possible cause. A British study conducted by Denis Henshaw and colleagues at the University of Bristol, published in the International Journal of Radiation Biology on February 14, 1996, found that power lines attract particles from radon gas, a known carcinogen. They have found evidence that the harmful concentrations of radon products may be present around overhead power lines. The electromagnetic fields associated with the lines can therefore concentrate a cocktail of potential carcinogens.

On November 28, 1999, The Sunday Times reported on a new study by Professor Henshaw to be
published in the International Journal of Radiation Biology. The study confirms that people living near them are exposed to radiation levels dozens of times greater than the legal limit.

The research firmly links the power lines with childhood leukaemia and other forms of cancer. The levels recorded in some areas were two times higher than the legal maximum allowed for adult nuclear power workers – the group permitted maximum radiation exposure.

Its most serious implication is that more than 23,000 homes built under or near power lines are unsafe, especially for children. The effect of the fields can extend more than 100 yards either side of the lines.

Henshaw is understood to have shown that in some areas children living near power lines could receive doses of 95 millisieverts of radiation a year, compared with the maximum for homes of one millisievert. Nuclear workers are allowed a maximum dose of 50, soon to be reduced to 20.

Science News (February 21, 1998) reports on studies done by pediatric oncologist Fatih M. Uckun of the Wayne Hughes Institute in St. Paul, Minnesota, which indicate a possible mechanism for EMF health effects.

His latest test tube studies show that magnetic fields with a frequency of 60 hertz and a strength of 1 gauss on the high end of exposures that might be encountered in the home or workplace trigger a cascade of enzyme-driven cell-signaling events. These short-distance communications serve as a means by which cells can relay operational directions to their DNA.

A year ago, Uckun and his team reported that ionizing radiation could prompt cell membranes to initiate a similar signaling cascade. Those data, he says, suggested that events triggered by the enzyme tyrosine kinase are responsible for the final DNA damage that ionizing radiation induces. Out of curiosity, the team decided to look at EMFs, expecting that they would prove ineffective. Instead, the EMFs activated a tyrosine kinase dangling from the inner surface of the cell membrane. By alternately removing and inserting the gene that makes the enzyme, Uckun and his colleagues report in the February 13 Journal of Biological Chemistry they showed that cells exhibit a response to EMFs only when the kinase is present.

This suggests that activation of the enzyme represents the initial manifestation of EMFs biological influence, Uckun says.

In a second report, slated to appear in the journal in April, the team details the cascade of events triggered by EMFs activation of that enzyme. It includes the turning on of a second tyrosine kinase, known as BTK. Studies in people have shown that excessive activation of BTK can lead to leukemia, lymphomas, and other cancers, Uckun observes. Because you don't have any hormone production without activation of tyrosine kinases, Uckun says, the new findings may also explain provocative hormonal perturbations linked to EMF exposures.

We only have room here to cite a sampling of the hundreds of laboratory studies that have shown a link between EMFs and health effects.

The utility industry's latest strategy is to argue that we cannot prove that there is a health risk from electromagnetic fields until we know exactly how magnetic fields cause cancer, leukemia or other diseases. This is a false argument as Paul Brodeur clearly points out in his 1993 book The Great Power-Line Cover-Up. He states:

"What industry spokespeople conveniently overlooked, of course, was that thirty years after definitive epidemiology had been conducted to show that asbestos was a potent cancer-producing agent,
scientists still do not know the mechanism by which an inhaled asbestos fibre reacts in lung tissue to cause cancer. Nor do they understand the mechanism by which cigarette smoke reacts in lung tissue to cause cancer. Or how the chemical pesticide DDT operates in breast tissue to cause breast cancer. Suffice it to say, if public health authorities had been required to wait for the cancer-producing mechanisms of these agents to be fully understood, regulations governing asbestos exposure would not have been implemented; warnings on cigarette smoking would not have been issued; and the twenty-year old ban on DDT would not have been imposed."

In the United States several courts have ruled on the health risk issue.

In late 1985, after parents brought suit, a Texas court ruled that Houston Lighting & Power had shown "callous disregard" of their children's health by siting a 345 kV line within 200 feet of a school and playground. The court ordered the utility to relocate the line.

In June 1989 a Florida judge ruled that children may not play in a Boca Raton school yard which borders on high voltage power lines. The suit was brought by three local parents who sought to close the Sandpiper Shores school because of potential electromagnetic field health hazards.

The judge noted that children have "no choice" about going to school and therefore EMF exposure at school is an involuntary risk: He stated that "a 1% chance that there is substantial danger is unacceptable".

Official recognition of the health hazards of electromagnetic radiation is slowly coming. In a report issued June 19, 1989 the United States Congressional Office of Technology Assessment stated: "Electric and magnetic fields produced by electric power systems may pose public health hazards." The report states that a growing amount of evidence now indicates that, under certain circumstances, even relatively weak extremely low frequency (ELF) fields can cause biological changes and that, although the implications are still unclear, "there are legitimate reasons for concern".

Among the report's proposals is a strategy of "prudent avoidance": attempting to route new transmission lines so that they avoid people; widening transmission line rights-of-way; developing designs for distribution systems – including new grounding procedures – which would reduce the associated fields; and redesigning appliances to minimize or eliminate fields.

Further official recognition comes from a United States Environmental Protection Agency draft report which, according to the New York Times (May 23, 1990), says that there is a possible link between cancer and the electromagnetic fields generated by power lines. In particular, the agency's survey of existing human health studies found that children exposed to such radiation seemed to face a higher than normal risk of developing leukemia.

The findings on the possible health effects of exposure to radiation from electromagnetic fields generally agree with those in the report issued previously by Congress's Office of Technology Assessment.

Of the EPA report, Time magazine reported, on July 30, 1990, that Louis Slesin of Microwave News, has printed what may be his greatest scoop: the key paragraph of a two-year Environmental Protection Agency study recommending that so-called extremely low-frequency fields be classified as "probable human carcinogens" alongside such notorious chemical toxins as PCBs, formaldehyde and dioxin. The recommendation, which could have set off a costly chain of regulatory actions, was deleted from the final draft after review by the White House Office of Policy Development. "The EPA thing is a stunner," says Paul Brodeur, a writer for the New Yorker. "It's a clear case of suppression and politicization of a major health issue by the White House."
Paul Brodeur wrote of the EPA report in the New Yorker: "In spite of the deletion, the summary-and-conclusions section of the draft EPA report contained a persuasive indictment of power-line magnetic fields as a cancer-producing agent. Its authors stated that five of the six case-control studies published in the peer-reviewed medical literature showed that children who lived near power lines giving off strong magnetic fields were developing cancer more readily than children who did not live near power lines."

Martin Halper, a director of the EPA, said in a December 1990 Fortune magazine article: "In all my years of looking at chemicals, I have never seen a set of epidemiological studies that remotely approached the weight of evidence that we're seeing with ELF electromagnetic fields. Clearly there is something here."

Further official recognition came on June 29, 1994 when Washington State's Department of Labor and Industries ruled that a former smelter employee of Kaiser Aluminum and Chemical Corporation in Tacoma was entitled to worker's compensation for cancer he claims was caused by exposure to electromagnetic fields (EMFs) on the job. This is the first ruling by a U.S. government body acknowledging a link between EMF exposure and cancer. The complaint filed by James Brewer pointed out that eight Kaiser employees out of the 90 who worked with him in the smelter's "pot room" had developed lymphoma or leukemia and died. Aluminum smelting requires unusually high levels of electrical power and consequently workers are exposed to high magnetic field levels during the manufacturing process. In the pot room Brewer was also frequently exposed to intense heat and noxious chemicals including benzene and polycyclic aromatic hydrocarbons.

Mr. Brewer's physician, Dr. Samuel Milham, has asserted a link between EMF and cancer in aluminum smelters in his research. Dr. Milham studied Kaiser's aluminum plant during the 1980s and found "way too many cases" of leukemia and non-Hodgkin's lymphoma among workers there. The high incidence of cancer in the Kaiser workers coincides with similar findings in other aluminum plants.

In a Canadian case, a World War II veteran, John D. Evans, has had his malignant melanoma recognized as having been related to his Royal Canadian Air Force service as a Wireless/Radar Mechanic by the Veterans Review and Appeal Board in 1997. Mr. Evans credits information he was able to obtain via the EMF-L mailing list, including contacts with two eminent medical doctors, as contributing to his victory.

After citing the statements made by the two medical doctors, here is what was said: "The Board, after having analysed all the evidence submitted, has come to the conclusion that there was a reasonable doubt that Mr. Evans' relevant condition [metastatic malignant melanoma] was attributable, in part, to his Active Force Service."

The latest official recognition of the health risk comes in a leaked United States National Council on Radiation Protection report funded by the Environmental Protection Agency and written by eleven leading American experts in EMFs. Bob Edwards, in the October 7, 1995 issue of New Scientist, writes that the report recommends an EMF safety limit of 2 mG (0.2 microteslas). He writes:

"EPA officials say the report is the most comprehensive study ever on the health effects of low-frequency EMFs. Its findings represent a fundamental challenge to the electricity industry. The authors say that their recommendations, if accepted, could force 'complex and costly' changes in society's use of electricity.

"The committee's chairman, Ross Adey, a neurologist from the Veterans Affairs Medical Centre in Loma Linda, California, says there is now a 'powerful body of impressive evidence' to suggest that
very low exposure to EMFs has subtle, long-term effects on human health. 'The sensitivity of the brain and its mechanisms to these fields is the key to understanding this issue,' he told New Scientist.

"The report recommends that future developments adopt a safety limit of 0.2 microteslas. This is a very weak magnetic field, and stronger fields are common around electricity pylons and close to electrical appliances. New nurseries, schools and houses should not be built where EMF exposures breach that guideline, says the report, and power lines should be kept away from residential areas. Offices should be designed to keep workers' exposure from computers, photocopiers and printers below 0.2 microteslas."

The final report is expected to be released to the public in late 1996 or 1997.

A similar drastic reduction in exposure guidelines has also been proposed in 1995 for Italy by the Physics Laboratory, National Institute of Health. They proposed a reduction to 1 mG for residential and 5 mG for occupational exposure.

To quote from their report, titled, High Voltage Power Lines in Italy: Quantitation of Exposure and Health Risk Evaluation: "New regulations have recently been proposed in Italy, both at national and regional level, aimed at preventing possible long-term health effects of magnetic fields from power lines. Based on some indications from the epidemiological literature, the proposed standards require the exposure limits to be reduced to values that are three orders of magnitude lower than recommended by IRPA/INIRC guidelines."

More recognition of the EMF health risk came in June of 1998 when a panel of the National Institute of Environmental Health Sciences recommended that EMFs be classified as a possible human carcinogen.

The new report comes from a National Institutes of Health panel convened to review scientific research on the topic. The group, completing 10 days of discussions in Brooklyn Park, Minn., voted 19-9 Wednesday to accept the position that electromagnetic fields should be regarded a "possible human carcinogen."

On June 15, 1999, the National Institute of Environmental Health Sciences (NIEHS) in Research Triangle Park, NC, released its final report to Congress on the RAPID research program on possible health effects of power frequency EMFs. In a letter accompanying the report, NIEHS Director Dr. Kenneth Olden concludes that evidence of any health risk from exposures to EMFs is "weak."

Epidemiological data provide the strongest evidence for health effects, NIEHS' Olden states, and show associations between EMF exposures and increased risk of childhood leukemia and of acute lymphocytic leukemia in adults. According to Olden, these data show "a fairly consistent pattern of a small, increased risk with increasing exposure." Animal and in vitro research, in contrast, do not demonstrate "any consistent pattern across studies," Olden concludes, although "sporadic findings of biological effects have been reported."

While the evidence is "insufficient to warrant aggressive regulatory concern," according to Olden, he concludes that, "Inexpensive and safe reductions in exposures should be encouraged." Olden "encourages" U.S. electric utilities to measure fields in customers' homes and help them identify sources of high fields. In addition, Olden "suggests that the power industry continue its current practice of siting power lines to reduce exposures."

The full text of the NIEHS press release appears below and the full text of the report to Congress is available now on the Internet at www.niehs.nih.gov/emfrapid.
Public health officials are now beginning to take a position on the EMF issue.

Patti Miller, who is in charge of the Washington State Department of Health EMF Task Force, is quoted by Ellen Sugarman in Warning: The Electricity Around You May Be Hazardous to Your Health as stating: "In the Department of Health, we've been answering questions about the dangers by telling people to avoid fields at the level of 3 mG. The utilities recently complained to the governor's office about it and the governor has tried to make us stop saying this when people call. But we feel strongly that we can't just pass the buck the way they do. After all, we're responsible for the public health."

Dr. David Carpenter, former Executive Secretary of the New York Power Lines Project and now Dean of the State of New York School of Public Health, is quoted by Ellen Sugarman as stating:

"I am now convinced that EMFs pose a health hazard. There is a statistical association between magnetic fields and cancer that goes beyond the shadow of reasonable doubt. I think there is clear evidence that exposure to EMFs increases the risk for cancer. This is most clear with leukemia and brain tumours, but in the residential studies, statistical significance increased for all kinds of cancer. And we're just beginning to have a whole body of evidence that reproductive cancers are increased by exposure."

The World Health Organization has, in early 1996, initiated a 5 year $3.33 million project to assess the health and environmental effects of exposure to electric and magnetic fields. An International Advisory Committee will oversee the project.

Perhaps the most significant new factor concerning the EMF health factor is the increasing public awareness. The January 1-3, 1993 issue of USA Weekend, a Sunday supplement magazine with a readership of thirty-three and a half million, contained a poll that asked readers to select what they considered to be the United States number one environmental health priority. The results were announced in the February 19-21, 1993 issue of the magazine. Electromagnetic fields were selected as the number one priority by 35% of the readers; 17% chose chemicals in food; 12% chose indoor air quality, and 36% listed other environmental concerns.

The Bridlewood Residents Hydro Line maintains a Bibliography on Electromagnetic Radiation and Health which currently contains over 1,000 entries consisting of scientific reports and journal articles, government and official reports, newspaper and magazine articles, books, and non-print media such as videotapes and TV programs.

From: Bridlewood Electromagnetic Fields (EMFs) Information Service

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