CRI/ICEIT
NEWSLETTER

VOL. 4 NO. 2 – April 1994
ISSN 0858-2793
BANGKOK, THAILAND

Chulabhorn Research Institute

INTERNATIONAL CENTRE FOR ENVIRONMENTAL AND INDUSTRIAL TOXICOLOGY (ICEIT)

CRI's ICEIT has been designated as a
"UNEP Centre of Excellence for Environmental and Industrial Toxicology".

CRI and Asian Institute of Technology (AIT) to launch a post-graduate training program in environmental toxicology and management of toxic chemicals

From left to right: Dr. Mathuros Ruchirawat, Vice-President for Research, Chulabhorn Research Institute; Professor Alistair North, President of Asian Institute of Technology and Professor Chongrak Polprasert, AEON Group Professor discussing the joint post-graduate training program.

In January 1996, the Chulabhorn Research Institute (CRI) and the Asian Institute of Technology (AIT) will launch a post-graduate training program at M.Sc. and Ph.D. levels with an innovative curriculum that has been developed over the past three years by an expert committee of internationally recognized toxicologists.

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ARSENIC CONTAMINATION IN SOUTHERN PROVINCES OF THAILAND

A recent report entitled "Arsenic Contamination in Southern Provinces of Thailand", published by the Prince of Songkla University provides evidence of arsenic contamination in the food chain in Ron Phibun, a tin mining village in the province of Nakhon Si Thammarat in Southern Thailand.

A further study carried out by the National Health Foundation's Health Research Institute identified the source of the problem as a liquid mixture of sulphuric acid, xanthate and turpentine used by large mining companies in tin extraction 20 years ago. This solution helps extract pure tin from arsenopyrite when applied to tin ore. Water used in the extraction process acidifies and this leads to the easy dissolution of arsenic.

Small independent miners have obtained the solution from mining companies because it facilitates the extraction of tin ore. After extraction, the tin ore still mixed with arsenopyrite is washed in streams. The arsenic dissolves in the water and is carried down stream.

Arsenic is now found in most water sources in Ron Phibun and has also managed to enter the food chain. Random tests conducted in 1987 by the Skin Diseases Institute found 44 per cent of the 131 children tested had excessive amounts of arsenic in their hair and 78 per cent had excessive arsenic in their nails.

ARSENIC IN DRINKING WATER

A study carried out over a number of years by epidemiologist Chen Chien-Jen of National Taiwan University in Taipei has found a strong dose-response relationship between the arsenic concentration in well water and the mortality for bladder, lung, liver and kidney cancer.

The levels of arsenic in drinking water on the southwest coast of Taiwan ranged from 170 to 800 micrograms per liter (µg/1), compared to the current Taiwan and EPA standards of 50 µg/1.

The Deputy Director of Taiwan's EPA, Lin Ta Hsuing, said that the agency's policy is to provide tap water to communities with excessive arsenic in well water in south-western Taiwan, and nearly all urban residents now receive tap water, although 15-20% of rural residents still use potentially contaminated well water.

Source: Environmental Health Perspectives, Vol. 102, No. 2, February 1994.

HAIR DYE AND RISK OF CANCER

The potential for hair dyes to act as mutagens *in vivo* and as carcinogens in animal models has, for many years, caused concern that use of these agents may increase risk of cancer.

However, the results from a study carried out by the American Cancer Society on a cohort of over half a million women in the United States, followed for more than six years, offers reassuring evidence that the use of permanent hair dyes does not increase risk of cancer mortality. The study found no relationship between use of permanent hair dyes and fatal cancers of the mouth, breast, lung, bladder, or cervix – areas that were of interest as a result of earlier studies. Women using permanent hair dyes are not generally at higher risk of fatal cancer. Although women with prolonged use of dark, particularly black, hair dyes may have increased risk of fatal non-Hodgkin's lymphoma and multiple myeloma, these women represent a small percentage of hair dye users. Nonetheless, the removal of carcinogens from hair dyes and appropriate labelling of hair colouring products would help reduce this potential risk.

Source: Journal of National Cancer Institute, Vol. 86, No. 3, February 2, 1994.

CRI and Asian Institute of Technology (AIT) to launch a post-graduate training program in environmental toxicology and management of toxic chemicals

(Continued from page 1)

The concept of this program has evolved from highly successful short term training courses that have been organized by CRI since 1988, and later joined by AIT in 1991.

The curriculum for the post-graduate program will consist of core and elective courses, the former being taken by every registered student while the choice of electives will be determined by the interests and possible research requirements of the student.

Students entering the post-graduate training program are expected to have already taken prerequisite courses in biochemistry, statistics and biology or life sciences, in preparation for the intensive content of the new curriculum. However, a course entitled "Integrated Life Science" has been proposed for students without sufficient background in biology or life sciences so as to develop baseline knowledge for the didactic portion of the post-graduate program. Original research will be an integral part of the program at both M.Sc. and Ph.D. levels. Research projects will be conducted on practical problems specific to the different countries of origin of the students.

Each student carrying out a research project based in his own country would have a local supervisor as well as a faculty supervisor within CRI or AIT, or a research director in a third country, depending on the nature of the research and the availability of expertise in the area.

With the submission of the research thesis and its successful defence, AIT will be the degree-granting institution since CRI is a research institute independent of university affiliation.

THE BENZENE CONTROVERSY

Benzene has been a focus of concern of occupational health scientists for very many years. It is an industrial chemical which has been recognized as a human carcinogen, with studies showing that high-levels of exposure cause leukemia in workers. Of even greater concern are the recent studies that indicate that low levels of benzene may also pose a threat to health; and the focus of much current research is directed at understanding the risks of low level exposures in both the workplace and the environment. Important questions are whether low levels of benzene cause leukemia, the mechanism by which the chemical causes cancer, and whether the mechanism at high doses is relevant at low levels of exposure. Also, more work needs to be done to determine which blood-related cancers other than leukemia are definitely related to benzene exposure.

Benzene undergoes many changes when it is inhaled. For example, many different metabolites are formed by the liver via several metabolic pathways involving different enzyme systems. More research is needed to identify with certainty which of the many metabolites of benzene may be toxic, or whether there is only one toxic metabolite.

Several types of biomarkers, including muconic acid in urine, are being evaluated as possible biological markers of benzene exposure for both occupationally exposed workers and the general population. Previously, simple blood counts have been used as markers of adverse effects to benzene, but more sophisticated cytogenetic tests are now being evaluated.

The Health Effects Institute of Cambridge, Massachusetts held a series of workshops on "Research Priorities for Mobile Air Toxics" in 1992-93 and the report that issued from these workshops contains a series of research recommendations on benzene, one of which is for studies to characterize the mixture of metabolites delivered from the liver to the bone narrow, with particular attention to the relationship between metabolite concentration and cell damage.

The report also gives high priority to research to develop a better understanding of benzene's mechanisms and research on the link between chromosomal changes and leukemia. Such research needs multidisciplinary teams of researchers including epidemiologists, mathematicians, molecular biologists and toxicologists in order to fill knowledge gaps that create uncertainty in current risk assessments for benzene.

Source: Environmental Health Perspectives, Vol. 102, No. 3, March 1994.

Results of Epidemiologic Studies: The Need for Caution

In 1993, the Journal of the National Cancer Institute published findings of a study by Dr. Mary Wolff of Mount Sinai Hospital, New York, which indicated that breast cancer was four times more common among women with the highest blood levels of the pesticide chemical DDE, a breakdown product of DDT, than among women with the lowest levels.

However, the latest issue of the same journal has published a report of a new study linking breast cancer and pesticides, undertaken by a group led by Dr. Nancy Krieger of the Kaiser Foundation Research Institute in Oakland, California. This study, based on blood samples taken before the 1972 DDT ban, when women in the United States were exposed to far higher levels than they are today, finds no connection between the pesticide and cancer. In an editorial accompanying the publication of the Kaiser study, Professor Brian MacMahon, professor emeritus of epidemiology at the Harvard School of Public Health, wrote that the study provided another reminder of the caution with which the results of a single epidemiological study should be regarded. In explaining the opposed findings of the New York study and the Kaiser study he states, "The spectrum of man's diseases is complex and his environment labyrinthine". He adds, "We must expect many tentative positive findings not to be confirmed."

Neither he nor the researchers think that the Kaiser study is definitive with regard to the possible link between pesticide and breast cancer.

In the view of Dr. Krieger, the proper scientific response to the findings of her study is to pursue the question by doing more research, not by dismissing the hypothesis.

Source: Science, Vol. 264, 22 April 1994.

THE ROLE OF BETA-CAROTENE IN CANCER PREVENTION

A study published in New England Journal of Medicine (April 1994) reports that supplements of the antioxidant beta-carotene markedly increased the incidence of lung cancer among heavy cigarette smokers in Finland, in a large, randomized clinical trial.

This finding goes against the accepted belief that high doses of antioxidant vitamins will afford some protection against cancer, and also against all the previously available evidence, since over a hundred epidemiological studies have indicated that people who have high levels of beta-carotene in their diet and in their blood have lower risks of cancer.

The data analyzed at the end of the Finnish trial revealed that the incidence of lung cancer was 18% higher among the 14,500 smokers who took beta-carotene supplements than among the 14,500 who did not. The probability that the increase was due to chance is less than one in one hundred.

However, experts on clinical trials agree that it is important to wait for results from other ongoing trials of beta-carotene before making a judgment on whether the antioxidant is beneficial or harmful.

Charles Hennekens of Harvard University, the principal investigator of the Physicians' Health Study, one of the large scale ongoing trials, says that the results of the Finnish study provide support for skepticism.

Source: Science, Vol. 264, 22 April 1994.

Low Frequency Electromagnetic Fields

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The possible link between exposure to low level a.c. magnetic fields and cancer is proving to be a most divisive issue. Experts agree that the levels of energy to which people are exposed from the great variety of electrical equipment present in everyday life in industrialized countries are extremely small. Studies released by the Electrical Power Research Institute, a California-based alliance supported by the electrical power industry, indicate many sources of exposure to environmental electromagnetic fields and show that, surprisingly, the most common fields to which most people are exposed are generated via "earth" or "ground" loops in main supplies. Domestic equipment such as hairdriers and motors produce shorter-term, though more intense, exposures. Overhead supply lines provide additional exposure levels. Work-related exposures predictably vary greatly according to the nature of employment but sources include computer monitors and other office equipment, making electromagnetism a "white collar" issue. It can be concluded that sources of exposure are far more prevalent in the general population than the overhead electrical lines that were the original cause for concern.

Despite this prevalence of low-level exposure sources, there is currently no known mechanism within living cells that would seem to be capable of responding to the typical field strengths to which humans are exposed. Nevertheless, since the pioneering epidemiological study by Wertheimer and Leeper first associated childhood leukemia with the configurations of electrical wiring (1), other studies have shown similar correlations (2-5) and leukemia incidence has also been found to be higher for workers in jobs associated with the exposure to low frequency magnetic fields (6,7). Several other epidemiological surveys seem to support these findings. Such studies stimulated laboratory investigations into the effects of electromagnetic fields on cultured cells and other biological models. Amongst several responses reported to low-level fields, heat shock proteins were produced by cultured

cells following exposure (8), and changes in gene expression occured (9).

Despite these epidemiological and biological reports, some prominent researchers argue against the possibility of low frequency bioelectromagnetic effects on the grounds that the densities of energy that could be coupled into cells from environmental fields are far smaller than the energy perturbations constantly produced by thermal noise at ambient temperatures. They claim that such noise, whose most familiar manifestation is "Brownian motion", would mask any detectable effects of electromagnetic fields in the environment. Nevertheless, there have been occasions in the past when experts have claimed that something is biologically impossible only to discover that nature has developed some very sensitive structures over the course of a billion years or so of evolution.

It was surprising, then, to see the intensity of emotions that were expressed at the recent 38th Annual Meeting of the Biophysical Society in New Orleans when proponents and opponents of low-frequency electromagnetic field effects met at a special session. Scientists biased against the existence of such effects expressed strong opinions against the epidemiological and biological work without offering any substantive objections to the studies. Those open to the possible existence of bioelectromagnetic effects also acted emotionally. While public figures with political objectives might be expected to express emotional biases in public forum, it was sad to see such subjectivity expressed at a professional meeting of the scientific community.

With such disagreement among even the experts, what should be done about electrical fields in the environment? Certainly, the intensity of most sources could be lowered significantly by careful layout of electrical wiring configurations and by the shielding of equipment. But is the evidence for damaging effects good enough to justify the huge expense of such a massive re-engineering effort? And without dose-response information, how can appropriate exposure codes upon which to base this re-engineering be developed? The US Environmental Protection Agency has determined that sufficient evidence exists in published studies for the possibility of damaging effects of low frequency magnetic fields to be taken seriously and to request more research efforts but finds insufficient evidence to initiate any regulatory action or to recommend any exposure guidelines. The US National Institute for Environmental Health has responded to the call for more research by issuing two recent Requests for Applications. A primary requirement of these is that each funded project must repeat at least one of the previous studies in the literature that reports biological effects of low frequency fields utilising a consistent field-exposure protocol. After these new investigations are completed one hopes that the scientific fog will clear somewhat. The emotional fog is a far more complex issue.

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SOURCES OF LEAD EXPOSURE IN MEXICO CITY

Mexico City ranks high among those capital cities of the world where high levels of airborne lead resulting from combustion of leaded gasolene are a major cause of environmental pollution in metropolitan areas, causing chronic human health problems due to low level lead poisoning.

However, other sources and pathways of lead exposure among the Mexican population may also contribute to a largely unrecognized epidemic of low-level lead poisoning. They include lead-glazed ceramics, leaded paint and lead in canned foods and beverages.

Mexico is the world's sixth largest lead producing country with an annual production of 170,200 tons (1988 figures). While 60% of this production is exported, 40% is used within the country in industrial processes which include pigments, leaded pipes, batteries, and tetraethyl lead.

In a recent study to determine the sources of lead exposure in the Mexican population, information was collected and analysis performed on different types of samples randomly selected from products readily available to local communities: coloured pencils, ceramics, cans, and cigarettes. Water samples were obtained from randomly selected households, the first flush from the tap being collected to sample water that was standing over night.

To determine the impact of potential sources on the blood lead levels of schoolchildren, private and public schools in different areas of Mexico City were selected. Information on potential lead exposure was obtained through a detailed questionnaire. Blood lead samples were drawn at school, and analysis was conducted by laboratories using atomic absorption spectrophotometry.

Airborne Lead

One-fourth (20 million) of the Mexican population lives in the metropolitan area of Mexico City. It has been estimated that 14 million liters of leaded gasolene and 4 million liters of diesel fuel are consumed every day in Mexico City and that 1500 metric tons of lead are deposited annually in the environment from combustion of leaded gasolene. Despite measures taken by the Mexican government to decrease the use of tetraethyllead in gasolene, consumption of leaded gasolene is still high in Mexico City. Other sources of airborne lead within the valley of Mexico City include lead smelters, battery manufacturing plants, battery repair shops and paint factories. Data collected in the study suggest that leaded fuel could play an important role in determining the blood lead levels among children living in Mexico City.

Lead in Paint

In Mexico, where lead-based paint is frequently used, the proportion of lead can be as high as 50% for exterior lead-based paint such as that used on sidewalks and bridges. Lead from this paint can be released into the environment by contact with acid rain and drainage water. Lead pigments are also used in children's toys and pencils.

Although there are, at present, no data on the impact of paint on blood levels in Mexican children, a research study has indicated that among the important determinants of blood lead levels was the habit of biting coloured pencils and crayons. Children in the study who frequently bit their pencils (41%) had a blood lead level of 21 µg/dl, as compared to 18 µg/ dl among children who did not have this habit.

Other important predictors of blood lead levels were the use of lead-glazed ceramics and the volume of traffic in the vicinity of the child's home.

Lead in Cans and Canned Food

Lead-soldered cans are still used in Mexico and food processed in such cans, particularly foods high in acid substances like chilli, tomatoes and lemon juice, are more likely to be contaminated. Measurements taken by the National Laboratory of Public Health on a random sample of 300 cans with different types of solder showed that 33% had a lead content exceeding 0.30 ppm, the recommended guideline of the Mixed Commission of FAO/OMS. Among the cans that were over this level, 61% were lead-soldered.

Food may also be contaminated before processing, and high lead content has been found in food grown in urban gardens, if there is a high lead concentration in the soil or in the air or the water used for irrigation.

Lead in Drinking Water

Lead in drinking water may be the result of contamination at source, or it may come from the water treatment and distribution system.

Lead levels in drinking water can be high when soft or acidic water flows through lead pipes, which could potentially contaminate the water. However, measurements of lead in drinking water in different households in Mexico City revealed lead levels close to 0.1 ppb. This is below the WHO guideline for drinking water of 0.01 ppm. The fact that the water in Mexico City is alkaline may explain the low lead levels.

In June 1991, the Mexican government signed the Agreement for Joint Actions for the integral solution of problems related to lead products that pose a risk to human health and the ecosystem. In addition, a national consultant committee for the establishment of regulations to prevent the use of lead has been set up under the coordination of the Health Ministry. As a result, several measures to decrease lead exposure have been implemented and a decreasing trend in blood lead levels among some groups of the population of Mexico City has been observed. There is, however, still a need for more extensive screening of the population to obtain a more precise estimate of the magnitude of the problem.

Source: Environmental Health Perspectives, Volume 102, No. 4, April 1994

Asia and Pacific Parliamentarians' Conference on Environment and Development

The Second East Asia and Pacific Parliamentarians' Conference on Environment and Development (EAPPCED II) took place in Phuket, Thailand from 20-23 April 1994. The conference served as a forum for environmentalists from a number of international organisations and parliamentarians from countries in the Pacific Rim to exchange views on the future of the global environment and the ways in which it can be preserved and protected.

Among the guest speakers at the conference were Anand Panyarachun, former Prime Minister of Thailand, Prof. Bert Bolin of the Intergovernmental Panel on Climate Change, and Scott Vaughan of the United Nations Environment Programme.

The conference discussed four critical environmental themes: biodivesity, climate change, trade,and environmental law.

In explaining the link between trade and the environment, UNEP's Programme Officer Scott Vaughan gave the example of a government trying to stop timber exports from a developing country to promote sustainable use of forests by imposing trade sanctions. Following strong protest, the developed country withdrew its sanction.

However, trade is an essential contributor to environmental protection and economic growth, and countries that manage their resources effectively show higher income.

Former Prime Minister of Thailand and Chairman of the Council of Trustees of the Thailand Environment Institute, Anan Panyarachun, reminded the conference: "International harmonization may be a desirable goal. But we must keep in mind the national, and sometimes regional, differences in ecological carrying capacities, climate conditions, natural resources endowments and environmental priorities, which are all sources of a country's, or a region's, competitive advantage and which we may be loath to relinquish without proper safeguards."

(UNEP News Release)

ADB Representative Visits CRI

Mr. J. Warren Evans, Senior Environment Specialist of the Asian Development Bank on a visit to Chulabhorn Research Institute's laboratories, Laksi on March 29, 1994. With Mr. Evans are Dr. Mathuros Ruchirawat, Vice-President for Research and Dr. Jutamaad Satayavivad, Associate Vice-President for Scientific Affairs observing a demonstration of the use of the UNEP/IRPTCPC Databank System to call up information on chemical substances.

Global Ban on Toxic Waste Exports

At a meeting of the 64 member states to the Basel Convention on toxic waste held in Geneva in March, negotiators agreed to impose a worldwide ban on the export of toxic waste to Third World states from 1998. The decision imposes an immediate ban on all cross-border movement of dangerous waste from developed to developing countries for final disposal. This decision further strengthens the controls imposed by the convention in December1992.

However, the Group of 77 Third World states saw the decision made on 25 March 1994 as a compromise; the Group had pressed for the ban to take effect from 30 June 1996. The Group's negotiator, Senegal's environment director Bakary Kante, said the agreed formula was a firm condition of the industrial countries for accepting the cut-off date. This compromise text was the logical consequence of multilateral negotiation.

The decision means that all countries which did not previously have laws forbidding imports of toxic waste and which intend to allow trade until the 31 December 1997 deadline, should supply the Convention with trade details including quantities, processing methods and final destination of the waste residues.

THE INTERACTION OF HUMAN LUNGS WITH ENVIRONMENTAL TOXINS

Because they are open to the environment, the lungs' airways continuously take in the atmosphere and process its contents through the bronchi and alveolar air sacs. The effect of pollution on the lungs is of critical importance for determining acceptable air quality in industrial and urban areas.

One institution, the Center for Extrapolation Modeling at Duke University Medical Center, is making progress in understanding how human lungs interact with environmental toxins.

Using data on lung structure and organization from a variety of different types of pathologic analyses, the center is slowly and steadily deriving a computer-based, three-dimensional model of both animal and human lungs that can be used to help predict where different doses of a particular pollutant will cause damage.

The center's researchers are using the only data available to them, namely the known effects of air pollution in studies of animal lungs. Then, using mathematical modeling, the researchers derive experimental correlations that can provide input for extrapolation from acute and chronic lung desease in animals to humans.

Scientists at the center are conducting toxicology studies of cells of the alveolar regions and small airways of animals exposed to varying doses of different airborne pollutants. These data are gathered by techniques such as immunocytochemistry, *in situ* hybridization, electron microscopy,and magnetic resonance microscopy. Researchers at the center are also leading the field in gathering microdosimetry data , the calculation of pollution dose at specific cells in each of the different regions of the lungs using labeled gases and particles in combination with microscopy, autoradiography, or positron emission tomography.

Source: Environmental Health Perspectives, Vol. 102, No. 3, March 1994.

Urban Improvement Campaign

In April 1994, the Chulabhorn Research Institute, in co-operation with non-government organisations, the armed forces, and the Bangkok Municipal Authority launched a campaign aimed at urban rehabilitation by means of improved waste disposal and maintenance of urban greenery.

The first phase of the campaign concentrates on waste disposal procedures currently employed in barracks and other residential and administrative offices occupied by members of all branches of the armed forces. Improved procedures carried out in a controlled setting are to be applied in private residential and business areas. One experiment in the early stages of the programme is to reduce the number of garbage collections in military establishments so that garbage collection vehicles can be redeployed in other areas.

Other experiments involve the sorting of waste for recycling and the construction of green mounds of waste after recycling. These mounds are lined with plastic to prevent seepage of toxic materials and will be planted with trees and other greenery.

A public cooperation programme will aim to encourage urban residents to look after trees and plants in their own residential areas. In the campaign, particular emphasis is placed on the recycling of waste, starting with recycling of paper from government offices and using waste materials from construction sites in military zones for land refill and road repair, and also for the construction of the green mounds.

After implemention in Bangkok, the campaign will be introduced in other large urban areas in Thailand such as Chiangmai, Pattaya, Phuket, Korat and Kanchanaburi.

The ICEIT NEWSLETTER is published quarterly by the International Centre for Environmental and Industrial Toxicology of the Chulabhorn Research Institute, supported in part by the Asian Development Bank. It is intended to be a source of information to create awareness of the problems caused by chemicals. However, the contents and views expressed in this newsletter do not necessarily represent the policies of ICEIT.

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ENVIRONMENTAL AND ECONOMIC BENEFITS OF TREES IN URBAN AREAS

A study measuring the environmental and economic benefits of trees in metropolitan Chicago quantitated how much trees improve air quality and reduce energy costs.

The three year study by the United States Forest Service estimates that planting 95,000 trees in Cook and DuPage counties would result in a net benefit of US$38 million over the next 30 years.

As part of their investigation, the researchers made a detailed examination of the role of vegetation in an urban-suburban ecosystem. The report estimated that in 1991, the value of the removal of pollutants such as carbon monoxide, sulphur dioxide, ozone and particulate matter from the air by trees in the study area amounted to US$9.2 million.

Trees also provide shade in urban areas. Street trees, which account for 10 percent of Chicago's trees and 24 percent total leafsurface area, were found to be a major source of building shade. The researchers calculated that the shade of a large tree situated to the west of a brick residence can reduce the use of airconditioning energy by 2 to 7 percent.

Source: USDA Forest Service.