



CRI/ICEIT  
NEWSLETTER

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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 EMBARKS ON UNDP-FUNDED HUMAN RESOURCES DEVELOPMENT PROJECT

Development does not always have to occur at the expense of the environment. The key words are sustainable development.

The government-supported Chulabhorn Research Institute (CRI) has recently begun a four-year project to help promote knowledge and skills needed to cope with the rapidly growing amounts of environmentally-destructive industrial waste. It aims at developing human resources in environmental toxicology and biotechnology through scientific and technological research, training and education, and exchanging of information to raise awareness of the problems.

The United Nations Development Programme (UNDP) has provided US\$700,000 to the Government of Thailand for CRI to implement the project. This effort marks the first ever by a country to embark on activities aimed at building the national capacity, since the adoption of Agenda 21 at the United Nations Conference on Environment and Development at Rio de Janeiro in June this year.

Like many other developing countries in the region, Thailand has rapidly grown industrially. Within the last ten years, industrial plants and factories have sprung up in and around Bangkok, releasing tonnes of toxic waste. According to an estimate, Thailand now generates yearly about two million tonnes of hazardous waste, including heavy metals, solvents, oils, and acid and alkaline waste. At an annual



*Mr. Alan Doss, Regional Representative of the United Nations Development Programme (UNDP) in Bangkok, seeks an audience with Her Royal Highness Princess Chulabhorn to present her with UNDP acceptance of the Human Resources Development Project in Environmental Toxicology and Biotechnology to Promote Sustainable Development. Funded by UNDP, the four-year project is to be implemented by the Chulabhorn Research Institute.*

growth rate of 8 per cent, industrial waste is expected to increase to six million tonnes a year by the year 2001.

Unplanned and improperly managed development will constrain future progress and threaten the quality of life of the people. Human resources development is a key strategy for sustainable development. The CRI works to strengthen national capabilities through its International Centre for Environmental and Industrial Toxicology (ICEIT). Toxicology, a study of adverse effects of chemical agents on living organisms, is critical to risk assessments and to the development of health- and environment-protection standards and regulations. Biotechnology helps detoxify chemicals and wastes through the use of microorganisms.

*(Continued on page 2)*

*The Second Princess Chulabhorn Science Congress has attracted over 100 speakers from 21 countries to actively participate in the Congress Program. Highlights of some internationally recognized Plenary Lecturers include:*

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#### **DR. DADE W. MOELLER**

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Dr. Dade W. Moeller is Professor of Engineering in Environmental Health and Associate Dean for Continuing Education at Harvard University's School of Public Health. He served in public health service for 18 years, during which he undertook long-term assignments at the Oak Ridge and Los Alamos National Laboratories of the U.S. Department of Energy and at the Public Health Service headquarters in Washington D.C. He has been a faculty member at Harvard University since 1966.

From 1973 to 1988, Dr. Moeller also served on the Advisory Committee on Reactor Safeguards of the U.S. Nuclear Regulatory Commission (NRC). Currently, he is chairman of the NRC's Advisory Committee on Nuclear Waste.

Dr. Moeller worked as an environmental health consultant for the World Health Organization. From 1978 to 1985, he was appointed the U.S. representative on Committee Four of the International Commission on Radiological Protection. He is also a member of the National Council on Radiation Protection and Measurements.

Dr. Moeller received a Master's degree in environmental engineering from the Georgia Institute of Technology and a doctorate in nuclear engineering from North Carolina State University. He is the author of *Environmental Health*, published in 1992, and has written over 180 scientific papers.

Dr. Moeller will give a plenary lecture on *An Overview of Environmental Health*.

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#### **DR. JOZEF S. SCHELL**

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Dr. Jozef S. Schell is an internationally recognised scholar in molecular biology and genetic engineering of plants. Since 1978, he has been appointed director of the Department of Genetic Principles of Plant Breeding at the Max-Planck-Institut für Züchtungsforschung in Germany. He was chairman of the Evaluation Committee for Biotechnology in Plant Production and Processing of the Dienst Landbouwkundig Onderzoek of the Dutch University of Agriculture, Environment and Fisheries.

Dr. Schell has held several distinguished academic positions at Rijksuniversiteit Gent and the Free University Brussels in Belgium. Currently, he is an

honorary professor at the University of Cologne in Germany. Dr. Schell received many distinguished awards, including the IBM Europe Science and Technology Prize (1987-1988), the Australia Prize from the Australian Academy of Science (1990) and the Feodor Lynen Lecture Medal (1992).

Dr. Schell has been chosen as a member of many distinguished academies, including: the National Academy of Science (U.S.A.); EMBO: the Indian National Science Academy (India); the Academic Europaea (United Kingdom); the Deutsche Akademie der Naturforscher Leopoldina (Germany); the Scientific Council of the Institute of Biotechnology, University of Helsinki (Finland); the Peer Advisory Group for Biotechnology Research at the International Rice Research Institute (the Philippines); and the Scientific Committee on the Application of Science to Agriculture, Forestry and Aquaculture (CASFA). He is also an editorial board member of *Molecular and General Genetics*, *Plant Cell Reports*, *Cell*, and the *EMBO Journal*.

Dr. Schell will give a plenary lecture on *Plant Biotechnology and Sustainable Agriculture*.

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#### **DR. DOUGLAS M. MORTON**

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Dr. Douglas M. Morton is an internationally recognised expert in toxicology. He began his career at Lilly Research Laboratories, a division of the Eli Lilly and Company, as a visiting scientist in 1972. Currently, he is vice president in charge of the company's Pharmacology, Toxicology, Drug Disposition, Clinic Metabolism and Pharmacokinetics divisions.

Dr. Morton received a Ph.D. in drug metabolism from the University of London in the United Kingdom and a post-doctoral fellowship in neuro-chemistry from the National Institutes of Health in the United States. He has been a registered pharmacist, charter chemist and member of the Royal Institute of Chemistry in the United Kingdom. He is a professor of pharmacology and toxicology at the Indiana University's School of Medicine. He is also an accredited toxicology expert in France's Ministry of Health.

Dr. Morton will give a plenary lecture on *The Environmental Toxicity Testing of New Chemicals: an Industrial Viewpoint*.

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## **CRI EMBARKS ON UNDP-FUNDED HUMAN RESOURCES DEVELOPMENT PROJECT**

*(Continued from page 1)*

Under the project, different types of training programmes have been designed, for example, short term intensive training for officials from both the public and private sectors. For environmental toxicology, impact assessment and biotechnology, long-term Post-graduate programmes will be established in both

areas of study. The programme activities are open to the international community, particularly from developing countries. International collaboration and exchange of information will be sought through the establishment of a database on toxic substances in Thailand and through consultations with the world's leading scientists.

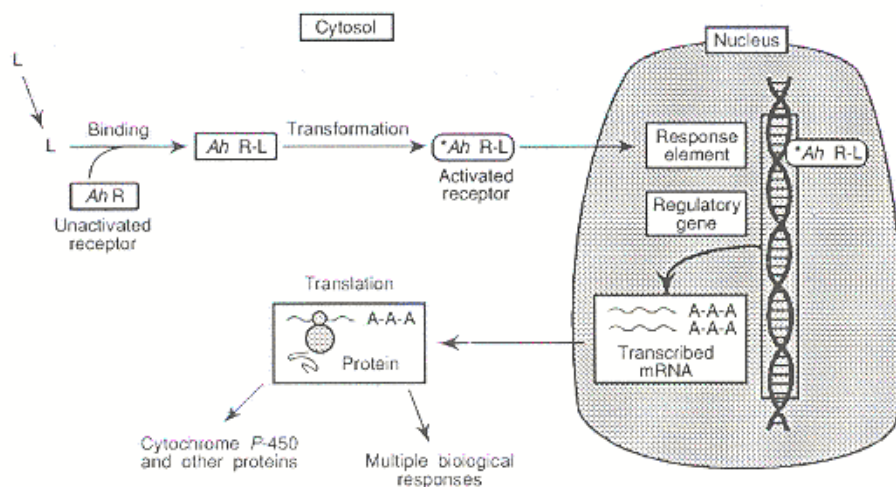
# RE-EVALUATION OF CARCINOGENIC RISK TO HUMAN FROM EXPOSURE TO DIOXIN

There is still much debate over the potential threat to human health from dioxin {2, 3,7, 8-Tetrachlorodibenzodioxin (TCDD)} or better known as Agent Orange. The substance has been linked to cancer.

Many more scientists have now endorsed a receptor-mediated model to determine the extent of the carcinogenic risk on individuals exposed to TCDD. The scientific evidence derived from the model suggests that at low-level exposures, dioxin may not be as harmful as the current stringent regulations have presumed. There are also many scientists who question the wisdom of the scientific evidence; they disagree that the regulations should now be relaxed. Two reports released recently argue in favour of the receptor-mediated model.

One report published in the *Biochemical Journal* (June 1991) indicates that TCDD's toxic effects have been shown to be mediated through reversible binding to a soluble cytosolic protein, known as the Ah (aryl hydrocarbon) receptor. The TCDD-Ah receptor complex translocates into the cell nucleus and binds to DNA recognition sites. The newly expressed proteins then instigate the toxic effects.

"Since toxicity is tied to receptor occupancy, this suggests that the cur-



## Proposed mechanism of action for TCDD and structurally-related chemicals

Ligand (L) passively enters the cell where it encounters and binds to the Ah receptor protein (Ah R). The receptor-ligand complex (Ah R-L) 'transforms' to a DNA-binding form that can enter the nucleus (\*Ah R-L). Interaction with specific genomic sequences (regulatory elements) results in the enhanced transcription of several genes. The transcribed mRNA is translated in the cytosol, resulting in the synthesis of several cytochrome P-450s and a multitude of other biological responses.

Source: *Biochemical Journal*, 276: 273-287, 1991

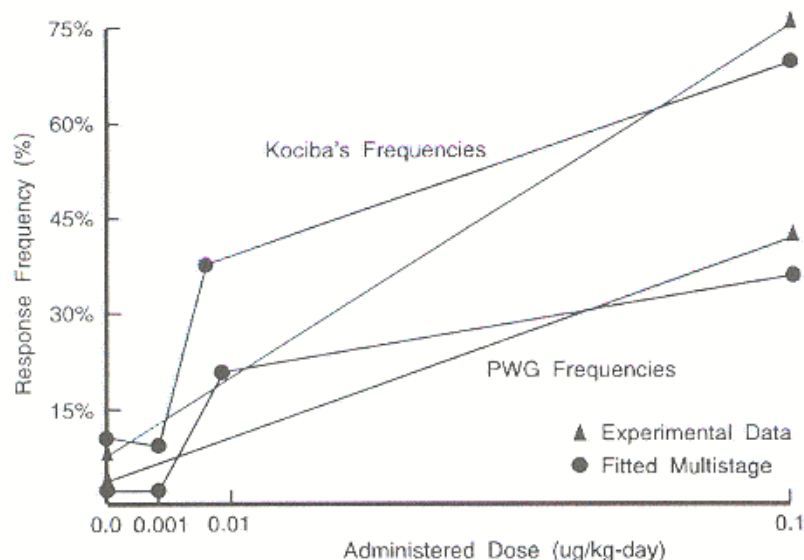
rent environmental levels of dioxin may be too low to cause concern," the report says.

Another report published in *Journal of Toxicology and Environmental Health* (1991) questions the foundations upon which the current dioxin regulations have been based. Having

reviewed the histopathological results of the benchmark study by Kociba *et al.* (1978), the report suggests that the carcinogenic risk to humans from exposure to dioxin is at least 16 times lower than previous estimates.

"In the United States, federal agencies currently use non-threshold dose-response models to extrapolate human exposure levels from the Kociba *et al.* data set at a selected probability of increased cancer risk," the report says. "The use of these models is based on the assumption that there is no threshold for carcinogenesis; that is, any dose, regardless of the quantity, poses some level of risk."

The Environmental Protection Agency (EPA), the Centre for Disease Control (CDC) and the Food and Drug Administration (FDA) each has a different cancer potency estimate for TCDD. The discrepancies among these agencies are the result of differences in the interpretations of the bioassay data of rodents tested, in the models used to estimate the dose-response relationship for low-level human exposures and in the methods used to scale doses between animals and humans.



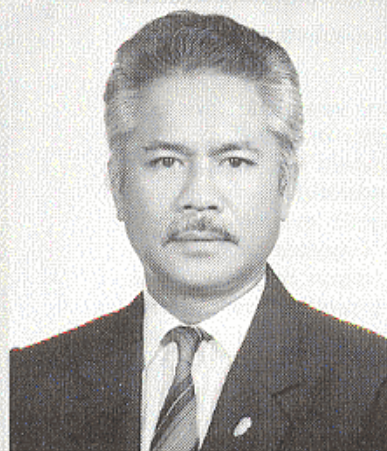
Fitted LMS model to the observed frequencies of hepatocellular "neoplastic nodule" or carcinoma in female Sprague-Dawley rats reported by Kociba *et al.* (1978) and PWG (1990).

Source: *Journal of Toxicology and Environmental Health*, 34: 279-296, 1991

(Continued on page 6)

# Education promotes better understanding among chemical users

The editor of CRI/ICEIT Newsletter talks to Khun Kasem Snidvongs na Ayudhya, Permanent Secretary for the Ministry of Science, Technology and Environment.



**Q:** *The Ministry of Science, Technology and Environment has recently undergone restructuring. What are the reasons for this?*

**Permanent Secretary Kasem:** The restructuring is aimed at strengthening the role of the ministry in the areas of environment and energy. On the environment, originally there was only one department – the Office of National Environment Board (ONEB). Because of the need to expand the scope of our work and because of the growing importance of environmental issues, we abolished the ONEB and established in its place three new departments – the Office of Environment Policy and Planning, the Department of Pollution Control and the Department of Environmental Quality Promotion.

Created more than 17 years ago, the ONEB lacked authority to enforce environmental protection laws, and its role was limited to policy planning and advisory functions. As a result, there were many shortcomings. Requesting one ministry to enforce environmental regulations, for example, was very difficult. When a standard has been set, it is necessary to have an agency with law enforcement capability such as the Police Department to make the official announcement. The procedure can take as long as five years, as was the case in setting standards for carbon monoxide (CO) emission levels.

Another problem is that other government agencies attach low priority to environmental issues. They consider them more to be extra duties than their main responsibilities. Implementing environmental policies is sometimes in conflict with the agencies' main objectives. For example, the Factory Department of the Industry Ministry has the function of issuing permits for the establishment of factories. At the same time, it also has a duty in supervising the environmental aspects of factories. Implementation and setting up standards is not its major function. The Forestry Department of the Agriculture Ministry has a major duty in promoting forestry. Conservation of forests is not its priority.

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**For years, our environmental management has been quite weak.**

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The Government of Prime Minister Anand Panyarachun saw a need to strengthen the ONEB by empowering it with a law enforcement authority. Without a strong implementing agency, environmental problems will persist and our natural resources will be badly abused. This is the underlining reason why the ONEB has been upgraded

from a department to that of a ministry, with the Prime Minister appointed as chairman.

Likewise, the National Energy Agency (NEA) has also been upgraded from a policy planning to that of an implementing body. The Department of Energy Development and Promotion, which has been established to replace the NEA, oversees energy conservation and develop energy sources for use in the agricultural sector.

**Q:** *Since chemicals are now widely used in the agricultural, industrial and public health sectors, how is your ministry working with other government agencies to affect policy changes to regulate the use of chemicals to minimise the adverse impact on the environment?*

**Permanent Secretary Kasem:** Currently, Thailand imports about 700,000 tonnes of chemicals a year. The enforcement of the rules and regulations governing the import of chemical substances is under the jurisdiction of the Ministries of Agriculture and Cooperatives, Industry and Public Health. The now defunct Poison Control Act was limited in scope and failed to cover transportation, storage and spillage. In April 1992, the Government adopted a new law to replace the old one. The Hazardous Control Act classifies dan-

gerous substances into four major categories: those required registration only; those requiring compliance with procedures and regulations; those needing import permission (wastes must be destroyed); and those banned from importation.

Poisonous substances are defined and divided into 10 classes with information on substances provided in each one of them. The ministry has also adopted broad measures to help manage toxic substances to prevent them from harming the environment, to promote their safe handling and to determine their hazardous nature. Today, industry has been expanding rapidly and the amount of industrial waste generated has also increased correspondingly. It is necessary, therefore, to adopt appropriate measures for waste disposal. Our Ministry has coordinated with the Ministry of Industry in developing waste disposal systems in Rajburi and Cholburi provinces.

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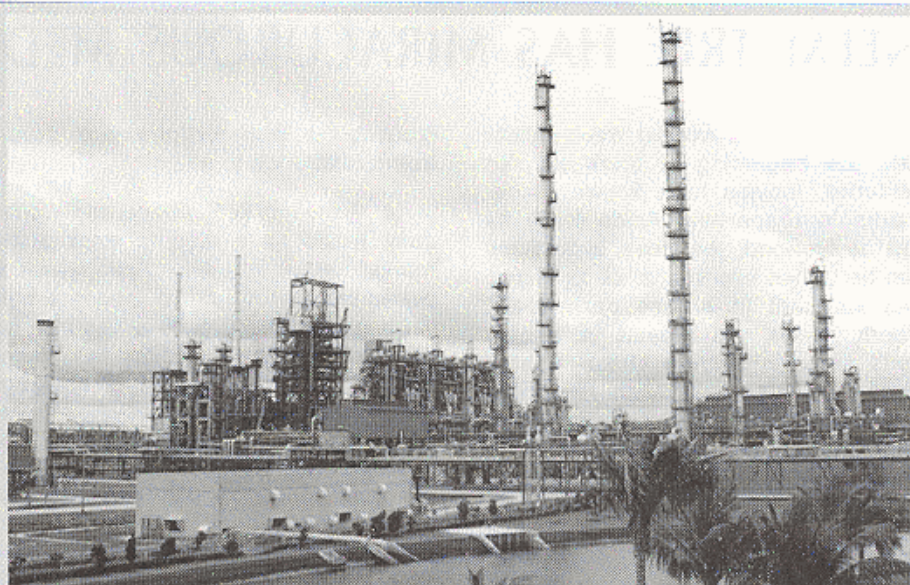
## The public still lacks information on the safe use of hazardous substances.

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**Q:** *Can you identify some of the major environmental problems caused by industrial waste? What are the solutions to these problems?*

**Permanent Secretary Kasem:** In the near future, Thailand will become a NIC (newly industrialized country) with a broader industrial base, mostly comprising pollution-generating industries. Although the Hazardous Control Act contains adequate provisions to regulate the use of chemicals, the public still lacks information on the safe use of hazardous substances. Education will promote better understanding among users. We have to campaign to let farmers know how to handle chemicals safely and what health hazards these substances can impose on them. Lack of public understanding on the safe use of chemicals is a problem not only in the developing countries but also in the developed countries.

Chemical manufacturers play an important role in helping to educate the public. Merchants should provide this essential information to users. But



*In the near future, Thailand will become a NIC (newly industrialized country) with a broader industrial base, mostly comprising pollution-generating industries.*

in most cases, the entrepreneurs are concerned only with selling their products as much as possible.

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## Our educational system has paid little attention to the study of science.

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**Q:** *Capacity building has been stressed at the UNCED as an important factor promoting development. How is Thailand doing in its effort to build national capacity?*

**Permanent Secretary Kasem:** Scientists are most concerned with human resources development. Our educational system has paid little attention to the study of science. Most students tend to ignore science because the subject does not offer them attractive career prospects.

However, the situation has now improved. Currently, there is a higher demand for scientists, particularly chemists, physicists, mathematicians and electronics experts. A large number of scientists have left their poorly-paid civil servant salaries for better job offers in the private sector. Consequently, the Government is now feeling the pinch of the brain drain.

To reverse the situation, the attitude of students has to change. They should be made to realise that scientists will have better job opportunities should Thailand achieve the status of a NIC.

Thailand is an export-led country. To be competitive, it must improve the quality of its products. Scientists will be needed to help us achieve this goal.

The Ministry of Science, Technology and Environment, together with the Ministry of Education, has contributed to the development of the nation's human resources in scientific and technological areas. It provides some 800 scholarships to students, at the high school (mathayomsuksa) to the doctoral level, in three areas of studies – computer and microelectronics, biotechnology, and metal and material technology.

On the environment, the ministry has established a training and research centre to provide in-service training in urgent and essential matters such as the standardisation of analytical methods. The ministry has also proposed that universities adopt curriculum placing a greater emphasis in specialised areas most needed in the job market.

The Ministry will cooperate with national universities and research institutes, in a mutually complementary fashion. For example, the CRI as a centre of excellence can undertake high level teaching and research in environmental sciences, with the Ministry's Centre providing in-service training. The Ministry of Science, Technology and Environment is the body which formulates research policy and technology development in areas that are needed by the country. CRI or the universities can act as the research arms, funded by the research grants made available by the Ministry.

# NEEM TREE HAS MIRACUROUS MEDICINAL PROPERTIES

Is neem a wonder tree? Scientists are beginning to think so. For centuries, Indians have known its remarkable properties. Aside from its use as firewood, the tree's byproducts can be turned into soaps, oil for lamps and lubricant to grease cartwheels. Neem leaves are placed in books, beds or grain bins to chase insects away. The plant also has medicinal power; its extracts can be ingested to treat malaria and applied on skin to heal chicken pox and warts. A U.S. company has recently come out with neem-based pesticides (Bioneem and Margosan-O) strong enough to repel upto 200 different species of insects but too weak to cause environmental damage.

The U.S. National Research Council (NRC) has found that neem contains a chemical substance, "Azadirachtin", resemble to steroids. The substance "repels pests or prevents their larvae from molting into pupae," says *Scientific American* (May 1992, but it "does not commit 'ecocide' in the process". Another positive factor is that the plant's complex chemical makeup of more than 20 compounds

reduces the likelihood of insects developing resistance to neem.

Although W.R. Grace and Company would have liked to expand its market further into selling neem-based pesticides for food crops, neem is not yet commercially attractive. The tree, a relative of mahogany, takes too much time to mature. The cost of bringing the necessary raw materials, from where the trees are being grown in the tropics to the firm's chemical production plant in the United States, is excessively high.

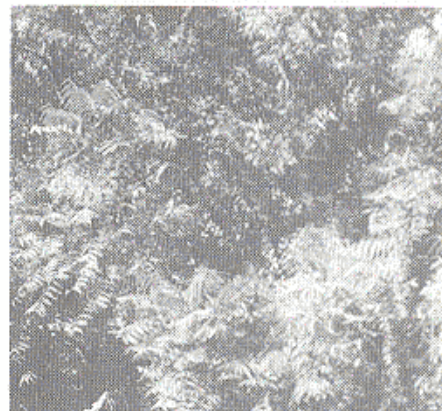
"Neem extract will remain more costly than synthetic pesticides", the article explains. Meanwhile, W.R. Grace will have to be content with selling insect repellents to home gardeners and greenhouses.

In the west, interest in the neem tree began more than 30 years ago, when a German entomologist noticed that the neem trees were not effected by a locust plague in the Sudan. Since then many studies and research followed.

However, the NRC insists that there must be more scientific evidence

to prove that the tree's miraculous properties are not just "anecdotal claims". Africans and South Asians have used neem sticks to brush their teeth and to kill oral bacteria. Some have even gone as far as saying that neem's derivative can be used as a spermicide to prevent pregnancy.

A scientist at the NRC begins to think neem is a "wonder tree". "I've never come across a plant with a breadth of potential the neem has", he says.



Scientists believe that neem is a "wonder tree" with remarkable medicinal properties.

## Re-Evaluation of Carcinogenic Risk to Human from Exposure to Dioxin

(Continued from page 3)

Because of significant new developments in the histopathological criteria for proliferative lesions in the rats' liver, a panel comprising leading pathologists re-evaluated Kociba *et al.* results, using the current classification scheme developed by the National Toxicology Programme. The panel concluded that there are two-thirds fewer cancerous tumors observed in the study than previously reported. "There is a dose-related increase in the incidence and severity of hepatotoxicity among animals in the mid- and high-dose groups compared with controls," it says.

In response to this new histopathology information, a re-examination of the cancer risk to humans using quantitative risk assessment is carried out by researchers from ChemRisk, a division of McLaren/Hart of the United States. These experts assume that the TCDD-Ah receptor complex behaves in a manner directly analogous with that

demonstrated by steroid hormone receptor mechanisms. "Since the use of body-weight scaling best predicts steroid hormone dose when scaling from rodents to humans, this should be appropriate for 2,3,7,8-TCDD," the researchers conclude.

Currently, the EPA has a policy to extrapolate from rats to humans on the basis of relative surface area for all carcinogens. However, both the FDA and the CDC concur that the surface-area scaling is not as appropriate as the body-weight scaling when the active carcinogen is thought to be the administered compound itself and does not have to be metabolised to be carcinogenic.

The implications of the re-examination of the cancer risk to humans using the qualitative risk assessment are far-reaching. "If one accepts the premise that TCDD may be working through an endocrine-sensitive mechanism to yield its toxic effects, a threshold dose for TCDD may well exist", the report explains. The researchers argue against the use of the linearised multi-stage (LMS) or other linear, non-threshold models for extrapolating the risk

associated with low-dose human exposures to TCDD. They recommend that the most appropriate risk-specific dose (RsD) for dioxin is 100 fg/kg/d as oppose to the EPA's 6 fg/kg/d.

U.S. federal agencies have been slow to respond to this latest scientific evidence. The *ad hoc* Dioxin Panel and the Scientific Advisory Board, both belonging to the EPA, recognise that the LMS model is inaccurate for measuring the risk at low-level exposures to TCDD. The two bodies have suggested that a biologically based model or one that accommodates a receptor-mediated mechanism would be more appropriate.

In its report prepared in 1988, an EPA working group has reconfirmed that an RsD of 100 fg/kg/d would be a more accurate upper-bound estimate at a lifetime incremental cancer risk of 1 in 1 million. But the EPA Science Advisory Board disagrees, saying the scientific evidence is insufficient to warrant a change in TCDD's RsD. Nevertheless, EPA Administrator William Riley says his agency will take a second look at the evidence.

# SOME CHEMICALS ARE NOT AS HAZARDOUS AS PEOPLE BELIEVE

Those people who believe that they are doing themselves a favour by switching from chemical-polluted to natural "health" food should think again. They should read this.

Naturally grown broccoli, for example, contains organic substances that are more likely to cause cancer than those vegetables sprayed with insecticides. The U.S. Food and Drug Administration has recently estimated that 98 per cent of carcinogens found in food consists of naturally occurring substances.

However, this is not what most people believe. The public has a false perception of pollution-related personal risk, according to Professor Sev Sternhell of the University of Sydney's Organic Chemistry Department, in an article published in *Engineering World* (February 1992).

"The overwhelming majority believes that there is a difference between 'chemicals' (wicked) and 'substances' (neutral), while in fact there is none", says Professor Sternhell. "Similarly 'natural' substances are considered to be inherently benign while industrial products are at best suspect. These beliefs are factually wrong...."

Based on a test developed by Chemistry Professor Bruce Ames of the University of California, Berkeley, organic substances have been found to be mutagenic, causing toxic and carcinogen hazards twice as great as that of man-made chemicals. To protect their crops, farmers unknowingly increase the carcinogenic risk by choosing the varieties that are richer in naturally occurring insecticides.

What counts most in calculating pollution-related personal risk, Profes-

sor Sternhell says is the substances' molecular structure, not their origin, natural or otherwise. The public does not distinguish between toxicity and toxic hazard. "Toxic hazard involves many additional factors of which the degree of exposure is critical", he says.

Chemical substances can be tested to determine their toxic hazard levels. At present, an index, called HERP (Human exposure dose/rodent potency dose), is the best possible risk measurement of the carcinogenic hazard of any substance. An index can be arrived at by combining exposure data with animal (rat) experiments. Through this measurement method, substances such as pesticide residues, dioxins, polychlorobiphenyls (PCB) and asbestos, which are perceived to be highly carcinogenic, are found to be relatively harmless unless individuals are excessively exposed to them. However, cumulative poisons from heavy ions such as mercury, cadmium and petroleum additive tetra-ethyllead present real health risks to the general public.

The public's distorted view, fuelled by miscalculation of risk, fear of the unknown and sheer ignorance, has resulted not only in widespread neurotic fear but also in the adoption of unnecessary and costly regulations. Professor Sternhell blames politicians for "a waste of resources on a truly astonishing scale" to affect inappropriate regulation action. Politicians "have demonstrated a combination of cowardice, ignorance and shallow opportunism on all environmental matters involving personal risks...", he says.

A concerted effort by journalists, business enterprises, environmentalists and politicians is necessary to help public overcome its ignorance.

## SAFETY VIOLATIONS FOUND AT TOXIC WASTE INCINERATORS IN U.S.

A Joint government task force has uncovered gross violations of safety and environmental regulations at hazardous waste incinerators in the United States.

The task force, comprising the Occupational Safety and Health Administration and the Environmental Protection Agency, made unannounced inspections at 29 out of 140 incinerators sites to evaluate compliance, and found nearly 400 cases of infringements.

According to *Chemistry & Industry* (17 June 1991), most violations involved failure to provide adequate training and information for employees, and non-compliance with emergency response and contingency plan requirements. However, there was no evidence of workers being overexposed to toxic chemicals.

The inspections also found certain safety devices had been frequently used at some facilities, indicating that there might be operational problems.

Meanwhile, Greenpeace has released a report calling for a ten-year moratorium on new capacity of incinerator, an immediate ban on burning of wastes containing metals, chlorine or other halogens, and a mandatory pollution prevention programme.

Burning of hazardous waste releases heavy metals, unburned wastes and products of incomplete combustion, the environmental group says.

A pollution prevention programme is needed because methods for monitoring and controlling emissions are inadequate and because no large-scale combustion system that routinely burns hazardous waste has ever been fully evaluated.

The installation of "inexpensive, liability-free" incinerators discourages industry to enforce waste minimisation measures, Greenpeace says.

## NEW REFRIGERANT HFC-32 CHOSEN OVER OTHER CFC ALTERNATIVES

United States' ICI has decided to invest in HFC-32 as a new, safer replacement for other chlorofluorocarbon (CFC) refrigerants, according to *Chemistry & Industry* (18 November 1991).

A company spokesman says the U.S. Environmental Protection

Agency has been keen to promote HFC-32, a chlorine-free molecule, because of its low content of greenhouse gas. The new product has a warming potential of 0.1 while another candidate for replacing CFC refrigerants, HFC-125, for example, has at least 0.6.

(Continued on page 8)

# SOUND ENVIRONMENTAL MANAGEMENT IS GOOD FOR BUSINESS

A new understanding of the impact of human activities on the environment is challenging industry and commerce to stop "business as usual". As they do, companies are finding that sound environmental management can also be good for business.

Industry and business activities are the engine of the world economy. They are also a major cause of environmental degradation. Oil refineries, chemical factories, nuclear power and weapons plants, metal mining operations, plastics producers and other manufacturing companies spew hundreds of millions of tonnes of toxins into the air, land and water every year, contributing to global warming, air and water pollution, acid rain, ozone depletion, and toxic and hazardous waste.

Business and industry have traditionally regarded the environment as an almost limitless source of energy and raw materials, with the environmental costs of doing business shifted to society at large or future generations. This thinking originated with the industrial revolution and achieved its fullest realisation in the decades of unprecedented growth following World War II, when innovation produced such high-tech items as computer chips and satellites; new and quicker modes of transport; the agricultural "green revo-

lution"; life-prolonging medical advances; household conveniences; and a wealth of other benefits. However, this only served to reinforce a belief in the virtues of unbridled industrial development, even at the expense of the environment.

As the decisions of yesterday play havoc with the global environment of today, the idea that there should be little or no environmental constraints on business and industry has been rendered obsolete. "In one area after another, environmental degradation is eroding the potential for development", the World Commission on Environment and Development reported in 1987. Long-term environmental health is now seen as essential for the future vitality of business and industry.

These new facts need not be a cause for alarm. The Commission found that "experience in the industrialised nations has proved that anti-pollution technology...has made many industries more profitable by making them more resource-efficient. While economic growth has continued, the consumption of raw materials has held steady or even declined, and new technologies offer further efficiency." In other words, sound environmental practices are sound business practices, inseparable and mutually reinforcing.

France's chemical industry, for example, has halved pollution levels over the past 10 years while raising production by 25 per cent. Japan has lowered pollution levels since 1975 while simultaneously reducing some 40 per cent the energy required to produce a unit of Gross Domestic Product (GDP) and effecting a similar reduction in raw materials use. A Swedish pharmaceutical-maker has cut its toxic waste in half by substituting water for some solvents, thus reducing pollution and saving the considerable expense of disposal.

A decisive shift is under way from "end of pipe" solutions to making sure that what goes into the pipe is clean in the first place. Many industries are convinced that it pays to prevent pollution rather than clean it up, and that concern for the environment leads to financial savings and increased competitiveness. Progress and protection have become two sides of the same coin.

*\* This article is adapted from Earth Summit in Focus, No.8, the United Nations Department of Public Information (DPI/1206-92286-March 1992-15M).*

## New Refrigerant HFC-32 Chosen Over Other CFC Alternatives

*(Continued from page 7)*

HFC-32 will eventually replace CFC-502 and HCFC-22 in refrigeration applications and is expected to be made commercially available before 1997, when CFC production must stop under European Community law, the spokesman says.

In a related story, Germany has banned the production of HCFC-22 by the year 2000. The decision drew heavy criticisms from CFC producers who argue that HCFC-22 will be needed until a range of chlorine-free CFC substitutes is available. Earlier, the government has set 1995 as the deadline for phasing out CFCs.

HCFC-22, a partially chlorinated compound with an ozone depletion potential of about 5 per cent that of the major CFCs, is already widely used as a refrigerant and foam-blowing agent. The European Community Commission has not yet imposed a ban on HCFCs.

The ban on HCFC-22 will have an adverse impact on the country's effort to eliminate the use of CFCs. A representative of a major German CFC maker, Solvay's Kali Chemie, says that suppliers of refrigeration plants would now have difficulties in phasing out CFCs by 1995.

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