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*for a sustainable future*

## OCCASION

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*for a sustainable future*

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21392

*Final Report*

Contract No.95/206P

Project No.:DP/RLA/92/018

for the Execution of a Course on the

Applications of Biochemical Engineering in

Environmental Biotechnology and Cleaner Production.

Presented by: The Science and Technology Unit of the  
Central American Research Institute for Industry,

(ICAITI)

To: The United Nations Industrial Development  
Organization (UNIDO)**ICAITI****Impulsando el desarrollo  
de la industria centroamericana**

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# *Final Report*

**Contract No.95/206P**

for the Execution of a Course on the Applications of  
Biochemical Engineering in Environmental Biotechnology and  
Cleaner Production.

**Project No.:DP/RLA/92/018**

**Presented by:**

The Science and Technology Unit of the Central American  
Research Institute for Industry,  
(ICAITI)

**To:**

The United Nations Industrial Development Organization  
(UNIDO)

**Date:**

Guatemala, November 14, 1995

## *Abstract*

The Course and its related symposia and workshops, was given on the scheduled date: 18-29th of September 1995.

The report has been organized as follows:

✓ A first section provides information on:

- a) the venue
- b) the teaching staff
- c) the participants
- d) the major topics covered
- e) the different activities in the program
- f) the local attendance to the specialized events
- g) a summary of the important concepts which resulted from the presentations and discussions

✓ This is followed by an **Appendix** in which the following documents have been enclosed:

- a) a copy of the printed Scientific Program which was given to the UNIDO sponsored participants
- b) a detailed list of the teaching staff
- c) a detailed list of the participants
- d) a short written statement on the course by a participating professor
- e) a series of letters received after the course by some professors and participants

✓ Finally, on a separate document a representative sample of the **lectures** has been assembled as a paper hardcopy. Most of the lectures are being edited electronically (using Microsoft Power Point). Some will also be in electronic form but as a full paper in Microsoft Word. A CDROM is being prepared with all the material and will be distributed to all participants in early 1996.

✓ The final financial report is a separate document.

It will be obvious after reading the above documents that the implementation of the course required more funds than those provided by this contract with **UNIDO**.

**ICAITI** was able to get the required funds from many sources. A detailed list will be provided if it is requested on an official letter.

*International Science*

**Biochemical engineering  
applications in environmental  
biotechnology and cleaner  
production**

*1992*

**Biotechnology Regional  
Program for Latin America  
and the Caribbean,  
*UNIDO/UNDP***

*Date:* September 18-29, 1995

*Venues:*

*Casa Santo Domingo*

**Monastery of Santo Domingo,  
founded in 1642**

*Antigua*

*Hotel Del Lago*

*Panajachel*

# antigua

- Antigua was founded March 10th 1543 in the *Pan Can* valley below **Agua** volcano. It was the first urban renaissance design in America. Charles V, King of Spain in 1566, gave the title of **Santiago del Reino de Goathemala**.



# *Panajachel at Lake Atitlan*

**Atitlan means close to  
the water.**

**It is a mountain lake  
formed during a  
gigantic collapse of at  
least two active  
volcanoes.**



*Professors:*

Twenty-six from fifteen  
countries

*Participants:*

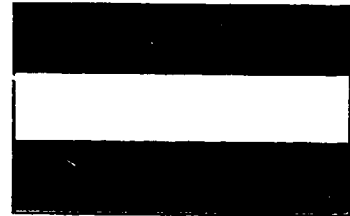
Thirty-three from thirteen  
countries



# Course Professors

## Austria

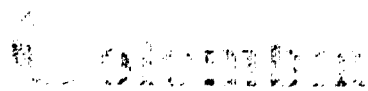
✱ Anton **MOSER**, TU, Graz



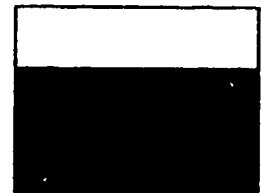
## Brazil

➔ Nelson **DURAN**, CSU, Campinas

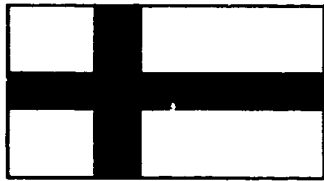
➔ Alex **HAMILTON**, Novo-Nordisk-Brazil



➔ María Consuelo **DIAZ**, IB, Bogotá



# Course Professors

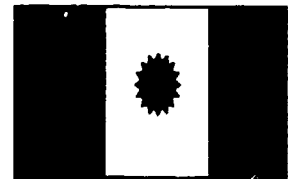


## Finland

• Liisa **VIKARI**, VTT, Espoo

## Guatemala

✓ Carlos E. **ROLZ**, ICAITI



## Israel

➤ Ilan **CHET**, HU, Rehovot

➤ Stefan **ROKEM**, HU, Jerusalem

# Course Professors

## Mexico



- ◆ Agustin **LÓPEZ-MUNGUÍA**, IB, Cuernavaca
- ◆ Oscar **MONROY**, UAM-Ixtapalapa
- ◆ Eugenia **OLGUIN**, EI, Xalapa
- ◆ Rodolfo **QUINTERO**, IB, Cuernavaca
- ◆ Tonatiuh **RAMIREZ**, IB, Cuernavaca
- ◆ Rafael **VÁSQUEZ-DUHALT**, IB, Cuernavaca

## Netherlands



- ◆ Bas **KOTHIUS**, TME, Den Haag
- ◆ Karel **LUYBEN**, TU, Delft

# Course Professors

New Zealand



\* Rhao **BHAMIDIMARRI**, Massey U,  
Palmerston North

Republic of South Africa



\* Eric **SENIOR**, ICWT, Natal

Slovakia



\* Vladimir **BALES**, STU, Bratislava

Spain



\* Joan **MATA-ALVAREZ**, UB, Barcelona

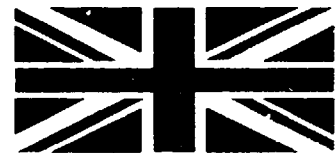
# Course Professors

Switzerland



\*Irving J. **DUNN**, ETH, Zurich

United Kingdom



Alan **BULL**\*, UK, Canterbury

USA



☆Henry **BUNGAY**, RPI, Troy

☆Richard **CLEMENTS**, USEPA,  
Washington

☆Rita **COLWELL**, BI, UM, College Park

☆Ilya **RASKIN**, RU, New Brunswick

# Course Participants

- Cuba (3)

- *Genetic and Biotechnology Engineering Center*

- *Scientific Research National Center*

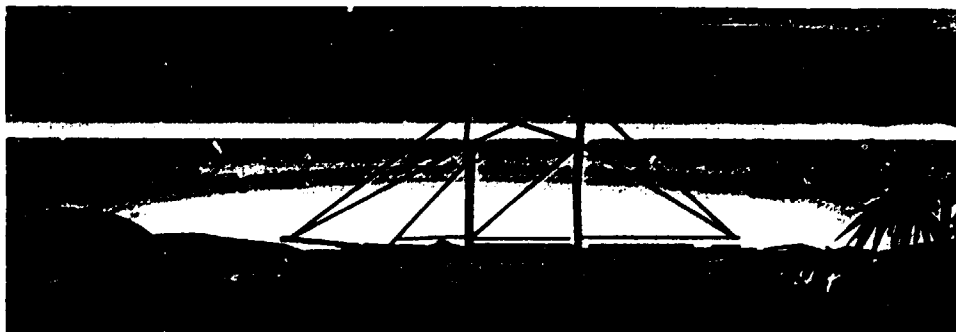
- Dominican Republic (1)

- *Dominican Technological Institute*

- Trinidad & Tobago (2)

- *Food and Biotechnology Division,  
Caribbean Industrial Research  
Institute*

- *Faculty of Engineering,  
University West Indies*



# Course Participants



## Mexico (3)

- *Petroleum Mexican Institute*
- *Biotechnology Institute, Mexican National University*
- *Ecology Institute*



# Course Participants



## **-Costa Rica (4)**

- *Department of Sustainable Development, Chamber of Industry*
- *Faculty of Engineering/Faculty of Chemical Engineering, National University*

## **-El Salvador (5)**

- *School of Engineering, National University*
- *Department of Microbiology, Simeon Cañas University*
- *Salvadorian Coffee Foundation Research*
- *Ministry of Economy*

# Course Participants

## **-Guatemala (3)**

- *Guatemalan Sugar Research Center*
- *Faculty of Chemistry, National University*
- *Pesticides Chemical Factory  
(WESTRADE)*

## **-Honduras (1)**

- *Department of Microbiology,  
National University*

## **Nicaragua (1)**

- *Aquatic Resource Research Centre,  
National University*

## **-Panama (1)**

- *Faculty of Mechanic Engineering,  
Technological University*

# Course Participants

## **-Chile (2)**

- *Department of Microbiology, Technical University*
- *School Biochemical Engineering, Catholic University*

## **-Colombia (3)**

- *Biotechnology Institute, University*
- *Biotechnology Group, Colombian Petroleum Institute, EcoPetrol*
- *Process Engineering, BIOTEC Corporation*

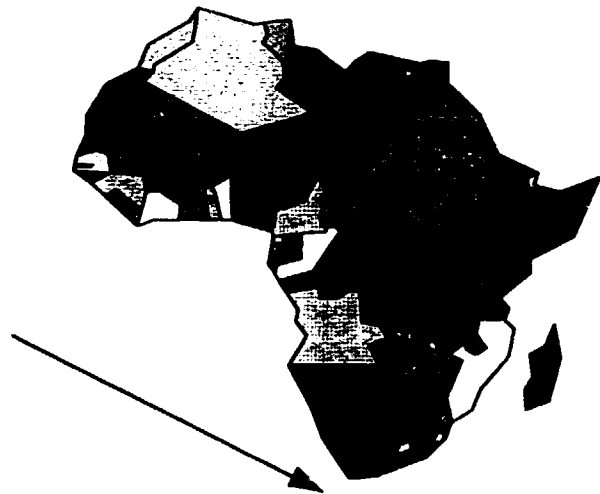


## **-Ecuador (1)**

- *Faculty of Engineering, National Polytechnic School*

# Course Participants

## **-Republic of South Africa (3)**

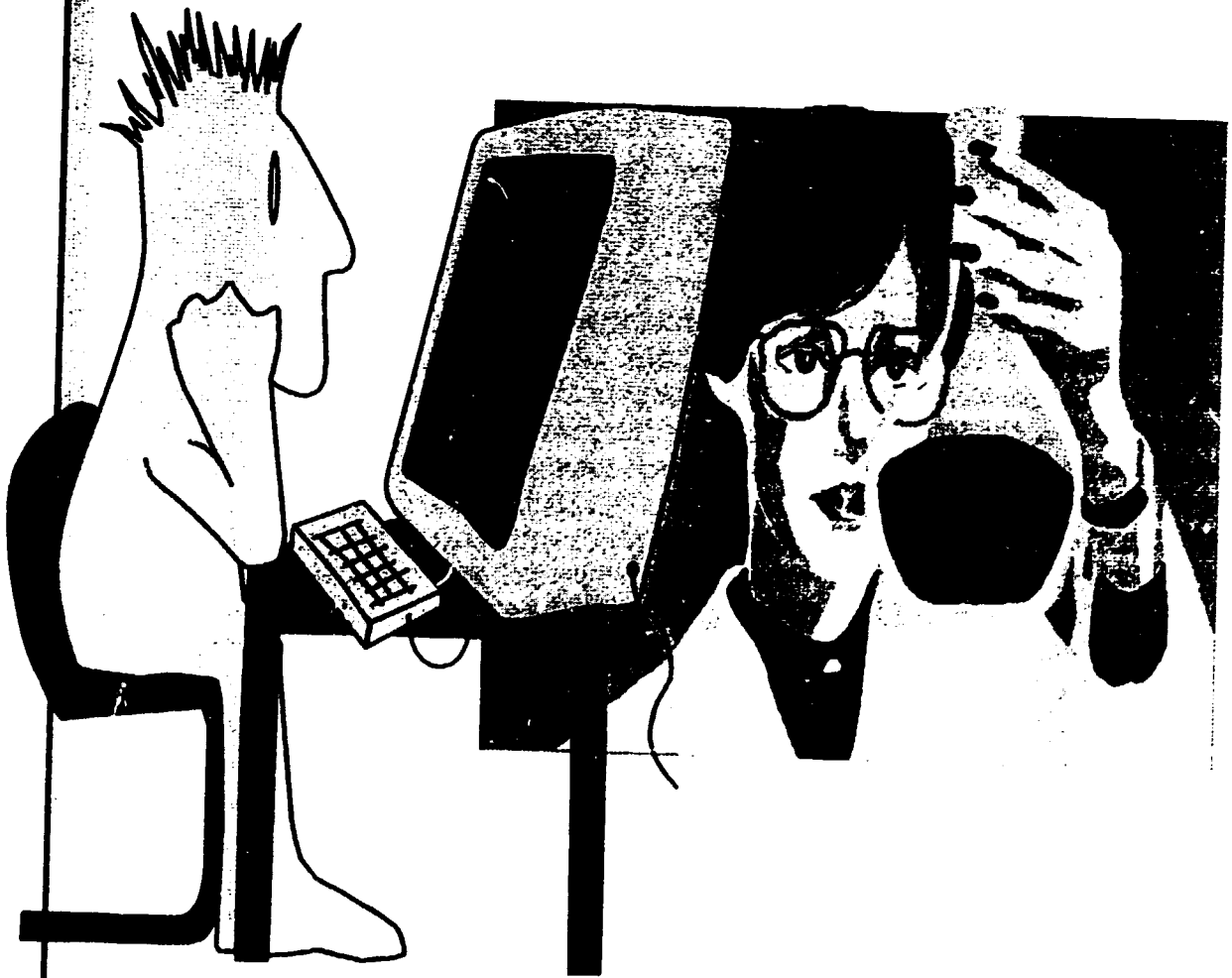


**•*Pollution Research Group,*  
University of Natal, Natal**

**•*Department of Microbiology,*  
University of Orange Free State,  
Bloemfontein**

**•*Department of Chemical  
Engineering , University of Cape  
Town, Cape Town***

*an appropriate  
biotech mix*



*host institution*

40  
years



The Central American Research  
Institute for Industry, ICAITI

*Scientific program coordinated  
by:*

*the Executive Committee of the  
International Organization for  
Biotechnology & Bioengineering  
(IOBB)*

*chaired by Carlos E. Rolz*

- ∞ environmental biology &  
microbiology
- ∞ waste treatment engineering
- ∞ environmental risk  
assessment
- ∞ cleaner production concepts  
and case studies  
(applications of  
biochemical engineering)
- ∞ applied environmental  
economics
- ∞ biotechnology in sustainable  
development



# *activities*



- ☺ lectures 35
- ☺ interactive lectures 1
- ☺ panel (discussion among professors) 1
- ☺ problem solving computer sessions 2 (6 hours)
- ☺ problem solving exercise (discussion of all participants) 1 (5 hours)



# symposia



- ❁ Biodegradability and toxicity of mixtures of xenobiotic compounds: fundamentals & applications

19 lectures

- ❁ Biocatalysis in cleaner production

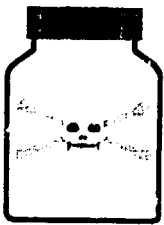
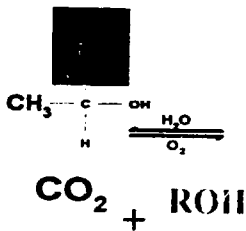


Church of the convent of *Nuestra Señora del Pilar de Zaragoza* &  
*Salón Mayor de la Universidad de San Carlos*

ICAITI  
40 years

# SYMPOSIUM

*Microorganisms*



## Biodegradability and toxicity of mixtures of xenobiotic compounds

THE SCIENCE OF  
BIODEGRADABILITY  
AND TOXICITY OF  
GLASSION  
SCIENCE  
INSTITUTE OF CHEMISTRY

# SYMPOSIUM

Biodegradability and toxicity of mixtures of xenobiotic compounds: *fundamentals*

## INAUGURATION:

Ing. Héctor Centeno, Rector,  
Universidad del Valle de Guatemala

## MODERATOR:

Lic. Roberto de León, ICAITI

## CONFERENCES AND SPEAKERS

### 1. Biodegradation metabolic pathways and enzymology

‡ Biodegradation of recalcitrant chemicals, S. Rokem/Israel

### 2. Biodegradation models

‡ Anaerobic biodegradation, J. Mata-Alvarez/Spain

### 3. Methods for toxicity assessment

‡ Structure activity relationship for estimating toxicity, R. Clemens & J. Vincent Nabholz/USA

‡ Standardization of toxicity tests and acclimatization of organisms, M. C. Díaz-Baes/Colombia

### 4. Methods for biodegradability assessment

‡ Models for estimating biodegradability: a review, C. Rotz/Guatemala

### 5. Special invited conferences

‡ Bioremediation *in situ*, R. Quintero-Ramírez/Mexico

## PLACE

Salón Mayor, Universidad de San Carlos, Antigua  
Wednesday September 20<sup>th</sup>, 1995  
13:30 - 19:00 h

# SYMPOSIUM

Biodegradability and toxicity of mixtures of xenobiotic compounds: *applications*

## MODERATOR:

Lic. Roberto de León, ICAITI

## CONFERENCES AND SPEAKERS

### 1. Process applications

‡ Biodegradation of toxic and inhibitory pollutants,

R. Bhamidimarri/New Zealand

‡ Experimental methodology in complex microorganisms interactions, E. Senior/Republic of South Africa

‡ Modeling biofilter dynamic experiments for mixed ketone removal from air streams, I. Dunn/Switzerland

‡ Application of immobilized cells in waste water treatment, V. Bales/Slovakia

### 2. Use of plant materials

‡ Phytoextraction: the use of plants to remove toxic metals from soil, I. Raskin/USA

‡ Biosorption of heavy metals, O. Monroy/Mexico

Use of microalgae, E. Olguin/Mexico

## PLACE

Iglesia de Nuestra Señora del Pilar de Zaragoza  
(Capuchinas), Antigua  
Thursday September 21, 1995

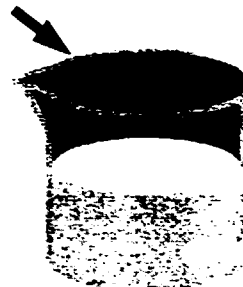
# S

Y M P O S I U M

ICATH  
40 years

## Biocatalysis in cleaner production

enzyme



Salón Mayor, Universidad de San Carlos, Antigua  
Monday September 25, 1995  
14:30-19:00 h

### Moderator:

*Juan Mata-Alvarez*, Barcelona

### Subjects and Panelists:

- Overall view of enzymes for cleaner production,  
*A. Hamilton*/Brasil-Denmark
- Enzymatic extraction of vegetable oils,  
*A. López-Mungia* Mexico
- Enzymatic strategy in the pulp and paper industry,  
*N. Durán*/ Brasil
- Enzymes in bleaching,  
*L. Viikari* Finland

Cultural  
event  
19:00-20:00 h

special conference  
*The Exxon Valdez experience*  
*Rita Colwell*, USA

This event has been organized as part of the *international course: Biochemical engineering applications in environmental biotechnology and cleaner production* (18-22 September 1995), Antigua, Panajachel, Guatemala City. *Coordination: Prof. Carlos Rolz*, Head and Principal Scientist, Science & Technology Unit, Central American Research Institute for Industry (ICATH)

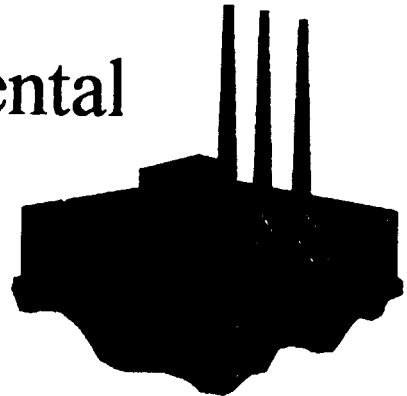
Universities (national and private): **27**

Research institutions: **3**

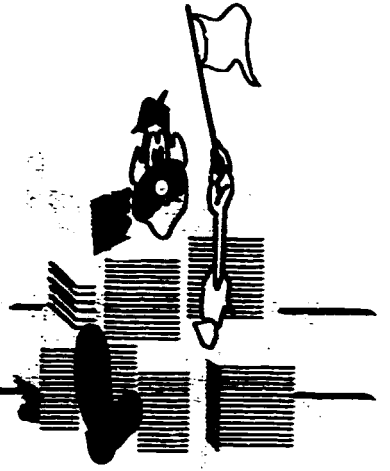


National Environmental Commission: **1**

Private industry: **11**

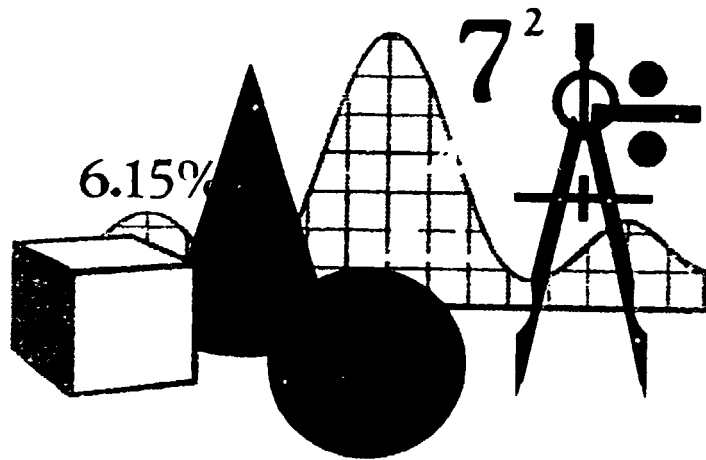


# workshop

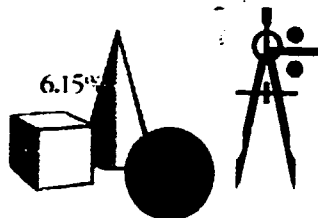


5 Lectures

■ applied  
environmental  
economics



ICAITI  
40 years



**Applied environmental  
economics:  
strategies for corporations  
and governments**

*Inauguration*

*Luis Cifuentes, ICAITI's Director*

*Moderator:*

*Carlos E. Rolz, ICAITI*

*Conferences and Speakers*

**1. Environmental demands and  
policy costs**

✧ Index of sustainability (SI)  
replacing gross national product  
(GNP), A. Moser/Austria

**2. Product improvement through  
life-cycle analysis**

✧ Life cycle analysis (LCA) and Life  
cycle costing (LCC): theory and  
practical experiences,  
B. Kothuis/The Netherlands

✧ Tools for the design of  
ecoproducts, J. Mata-  
Alvarez/Spain

**3. Frontiers**

✧ Environmental technology or the  
WWW of computers, H. Bungay/USA

✧ PIA: computer program for product  
improvement analysis,  
B. Kothuis/The Netherlands

**Iglesia de Nuestra  
Señora del Pilar  
de Zaragoza  
(Capuchinas),  
Antigua,  
Thursday  
September 21,  
1995  
14:30-19:00 h**

**Cultural event  
19:00-20:00 h**

environmental impact, industry and cleaner production

Biotechnical engineering applications

ICAITI



# *special guests*

**Ministers of Economy and  
Industry (or representatives)  
from the five countries of  
Centralamerica: 10**

**Centralamerican common  
market institutions: 10**

# **concepts which resulted from the presentations & discussions**

---

## **Overall concepts**

- 1. Biotechnology has a leading role for achieving sustainability**
- 2. Cleaner production implies a process retrofitting for minimizing wastes. In other words, a much more efficient use of raw materials and energy**
- 3. Wastes are better treated at the source**
- 4. In some cases a situation of zero emissions might be possible, however, a more obtainable goal would be to embed processing into the patterns found in nature's biological cycles. To some, this concept defines ecotechnology**

# concepts which resulted from the presentations & discussions

## regarding products and environmental risk

1. Chemical compounds and products made thereof have been designed to be durable
2. Those that do not degrade within a reasonable time span are persistent in the environment
3. Those that are persistent and show, at the discharge concentration, toxicity towards different organisms present an environmental risk
4. Risk is then the sum of hazard and exposure
5. The environment usually is challenged by mixtures of chemical compounds

## **concepts which resulted from the presentations & discussions**

### **regarding products and environmental risk**

6. Biodegradability can be measured at the lab, although relatively few reliable data has been collected and it is not easy to extrapolate to real world conditions

7. There are mathematical models available for estimating toxicity and biodegradability for pure compounds, mainly based on quantitative structural (molecular) activity relationships (QSARs)

8. Biodegradation pathways are complex, in some cases intermediates are produced which might be more toxic than the parent compound. Also not all pathways end up in biological gases and water

# **concepts which resulted from the presentations & discussions**

## **regarding the actors in biodegradation**

1. Pure chemicals and their mixtures are usually degraded by a consortia of micro and macro organisms
2. Such capability has been acquired through evolutionary biology (genetic engineering in nature)
3. Interactions between micro or macro organisms and their food (chemicals) in a stable consortia are very hard to define experimentally and practically impossible to predict. For example, predator-prey relationships, simultaneous uptake, inhibition conditions.

# concepts which resulted from the presentations & discussions

## regarding the actors in biodegradation

4. There are examples of speciation and bioaccumulation of chemicals within the consortia which influence their environmental fate

5. Complex consortia, constantly challenged by an unusual chemical, might also dynamically change to a more simple and stable ecosystem, in which the fittest survive

6. When solid phases are present ( particles in suspension & wet solids ), chemicals usually interact with surfaces and bioavailability might be hindered

# **concepts which resulted from the presentations & discussions**

## **about bioprocesses**

1. The aerobic liquid waste treatment systems usually need extensive modifications (equipment design and operational practices) for biodegrading unusual chemicals
2. A simple example in case, the removal of nitrogen and phosphorus in activated sludge plants
3. It is almost impossible to predict the fate of any chemical in traditional liquid waste treatment systems.
4. Dilution is an illusion

# concepts which resulted from the presentations & discussions

## about bioprocesses

5. Biofilm reactors look promising for biodegrading chemicals at the source present either in liquid or gaseous phases
6. Sequential use of aerobic and anaerobic systems usually gives a more complete biodegradation
7. Air-lift bioreactors and trickling filters are favorite units for aerobic systems
8. More specialized bioreactors include immobilized microbial cells, enzyme biopackages, aquatic plants and hairy roots



# concepts which resulted from the presentations & discussions

## about bioprocesses

9. Bioprocesses team-up with non-biological unit operations (membranes, ozonation, heat, photolysis) in order to produce efficient systems for the breakdown of chemicals

10. Dumping of chemical waste in the ocean or in soil is a losing proposition

11. Effective bioremediation will be developed for particular cases. The slurry fluidized bed system is compact and lends itself nicely for a bioreactor cascade

12. Land farming and *in-situ* composting might be more suitable for extensive and highly polluted areas

concepts with the following:

The following are the main concepts:

## **on cleaner production**

1. Biotechnology is playing a major role in fostering cleaner production industrial processes
2. Novel uses of enzymes have originated alternative production steps in: pulp & paper, leather and textiles, food and feed, synthesis and biodegradation of chemicals
3. Microbiological processes and plant genetic engineering are striving to develop viable alternatives for reducing the amount of pesticides used in agriculture
4. Cleaner bioprocesses are being developed to manufacture industrial dyes, cellulose and specialty polymers, among many others

concepts which facilitated with

the presentations & discussion

## **on system analysis**

1. In the solution of environmental problems newer methods and techniques are being applied for analyzing both steady-state and process dynamics
2. The ISIM environment provides a useful tool for solving systems of differential equations
3. Interactive spreadsheets allow the use of database tools to calculate, organize and graph information
4. Standard statistical packages permit the user friendly access to multivariate and exploratory data analysis

control system design from  
the process of the system.

## **on system analysis**

5. Neural networks are being employed to model and simulate very complex systems
6. One branch of artificial intelligence called expert systems goes beyond computer logic and substitutes for human thinking
7. In the real world, information is often ambiguous or imprecise. Human reasoning filters and interprets information in order to arrive at conclusions or to dismiss it as inconclusive. An organized method for dealing with imprecise data is called fuzzy logic
8. Expert systems and fuzzy logic provide valuable tools for the redesign of bioprocess to mitigate the need for tight control

**concepts which resulted from  
the presentations & discussions**

---

**on applied environmental  
economics**

1. The desire for product retrofitting in order to generate ecoproducts has pushed the development of specific types of calculations, like life cycle analysis and life cycle costing
2. The index of sustainability (SI), and its many variants, should replace the gross national product (GNP) as the main economic indicator

# appendix

- Scientific Program
- Detailed list of the teaching staff
- Detailed list of the participants
- Report by Prof. Henry Bungay
- Letters received from professors & participants

*International Course:*

**Biochemical engineering  
applications in environmental  
biotechnology and cleaner  
production**

*Scientific Program*

*Sponsored by:*

**Biotechnology Regional Program for Latin America  
and the Caribbean, *UNIDO/UNDP***

**&**

**The Central American Research Institute  
for Industry, *ICAITI***

**40  
YEARS**

**Guatemala, September 18-29, 1995**



**INSTITUTO CENTROAMERICANO DE  
INVESTIGACIÓN Y TECNOLOGÍA INDUSTRIAL  
(ICAITI)**

COSTA RICA  
EL SALVADOR  
GUATEMALA  
HONDURAS  
NICARAGUA  
PANAMA

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***Intensive and Advanced Course:***  
**Biochemical Engineering Applications in Environmental  
Biotechnology and Cleaner Production**  
**(Workshops and Roundtables), 18-29 September 1995**

***Prof. Carlos E. Roly***  
Coordinator-ICAITI

**INVITED PROFESSORS**

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*\*Did not attend due to illness*



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**Intensive and Advanced Course:  
Biochemical Engineering Applications in Environmental  
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(Workshops and Roundtables), 18-29 September 1995**

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## Report by Henry Bungay

*Editor, Journal BINARY*

### **International Course:**

Biochemical engineering applications in environmental biotechnology  
and cleaner production

**Guatemala**, September 18-29, 1995

Over 50 students, mostly from Latin America, and about a dozen teachers supplemented by some additional lecturers met in Guatemala for a course about cleaner and more efficient environmental processing from a chemical engineering viewpoint. Classes lasted far into each day in settings that were spectacular. The main meeting place was in the *Hotel Casa Domingo* in the former capital Antigua. The Spanish ruled from Antigua to escape the heat and to enjoy the mountain beauty. Several volcanoes, one of which still smokes, surround the city. Destruction of Antigua by a severe earthquake in the mid 1700's led to moving the capital to Guatemala City. Restoration of Antigua continues, and the hotel is built on the ruins of a monastery. New walls and roofs on the old foundations create the feeling of living in history while archeology continues as workers sift through the rubble and build on the cleared portions.

The central portion of the course was moved four hours away to the shores of *Lake Atitlan*, considered by many to be the world's most beautiful lake. Formed from the crater of an explosion thought to be 10 times the size of the Krakatoa eruption, the lake is close to three young but inactive volcanoes. Other sessions were held in Antigua in *the museum of*

*the university* and in an old church known as *Capuchinas*. Everywhere one travels in Guatemala there are indians peddling their crafts. Mayan designs and colored patterns dictated by the Spanish rulers are beautiful national symbols. The course included a boat trip across Lake Atitlan, concerts by a string quartet and by a marimba group, folkloric dancing, and receptions.

While most of the lectures were technical, attitudes and philosophy were stressed in talks by **Anton Moser** of the *Technical University of Graz, Austria* with emphasis on sustainability and paradigms for eco-friendly technology. Case histories included improved treatment of piggery wastes in New Zealand, xylanases that reduce the need for chlorine as a bleach during paper manufacturing, trickling biofilters for removal of pollutants from air, enzymatic alternatives to stone washing of jeans, processing of leather, and several methods for treating specific wastes such as dyes and toxic organic compounds. Mixed cultures were discussed by **Stefan Roken**, *Hebrew University Hadassah Medical School, Jerusalem*, and most of the course dealt with microbiological processes. However, **Ilya Raskin**, *Rutgers University*, reported on treatment of various organic wastes and heavy metals

with plants. The plant root system can accumulate these heavy metals with little translocation to the upper structures, and this means that just the roots constitute material for ultimate disposal of toxic metals.

Interspersed with the lectures about specific problems were computer sessions to demonstrate models and programs and tutorials about fundamental concepts. Topics included bioinsecticides, fungal enzymes for protection against plant infections, new feedstocks from transgenic plants, wood protection, process control strategies, simulation models, enzyme reactors, and a variety of computational approaches to solving environmental problems. **Rita Colwell**, *University of Maryland*, lectured on ocean dumping and presented a keynote lecture on the Exxon Valdez spill.

The course was notable for so much biochemical engineering and so little conventional environmental engineering. Mass, energy, and money were constant themes while biochemistry and biology fundamentals were featured. Holding the course away from distractions other than the beauty

of Guatemala was ideal for interactions between the students and the teachers. Already the participants are using *e-mail* for follow up and to reinforce their friendships.

The mechanics of the course deserve some comment. Speakers were urged to use PowerPoint for slides. The layouts were artistic, and the fades and dissolves were great. Unfortunately, some unwise color combinations made many slides unreadable even when the room was pitch dark. Authors should not get carried away by the technology and forget to check on legibility.

Although somewhat overloaded by information, each student found much interesting material. Far better to have too much from which to pick and choose than to have too little. The organizers did remarkably well in assembling a broad spectrum of important environmental topics and in rewarding the participants with valuable training and a memorable adventure.



# programa

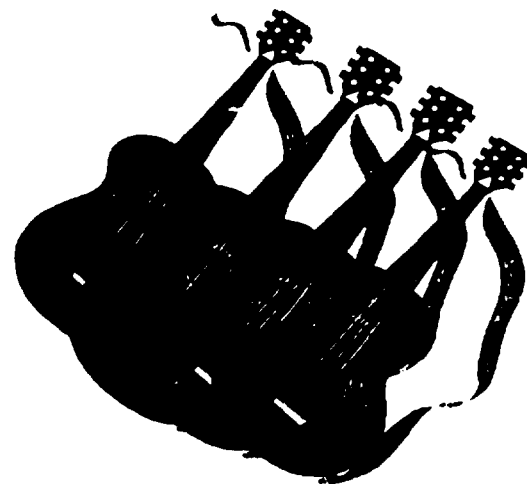
*marimba de concierto  
de Bellas Artes*



Museo de la  
Universidad.  
*Antigua*  
29 de  
septiembre de  
1995.  
19:00 h

Cuarteto Contemporáneo de Guatemala

*Recital en la Iglesia de  
Nuestra Señora del Pilar de  
Zaragoza (Capuchinas)  
21 de septiembre de 1995  
19:00-20:00 h*



September 27, 1995

FAX: 502-2-317470

Professor Carlos A. Rolz  
Ingeniero Químico, Master of Science  
Central American Research Institute for Industry  
Avenida la Reforma 4-47 Zona 10/01010  
Apartado Postal 1552/01901  
Guatemala, Centroamerica

Dear Carlos:

Thank you for a truly memorable trip to Guatemala. The course which you organized was superb. I was very impressed with the quality of the students and, of course, could easily recognize the excellent faculty you brought together for the training.

Each one of your special trips was much appreciated. The trip on Lake Atitlan was beautiful. Please convey to your wife and sons my gratitude for their very kind hospitality.

I did not have a chance to talk with you about our video teleconferencing network which includes Norway, Sweden, Mexico, North Carolina, Baltimore, and will soon include Israel, Singapore, etc. I enclose a list of equipment that will be required if your university/institute wishes to participate. Perhaps this is something we might discuss when you are here in December.

This was a wonderful trip. Many thanks. I will look forward to seeing you in Washington in December.

With all good wishes,

Yours sincerely,

Rita R. Colwell, Ph.D., D. Sc.  
President

University of Maryland Biotechnology Institute  
and Professor of Microbiology  
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RRC:nb0927

Enclosure

cc: Dr. Dan Jacobs  
Mr. Richard Rose

+ 16 OCT. 1995  
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Jerusalem , October 1, 1995

Prof. Carlos Rolz  
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Dear Carlos,

With this letter I want to extend my sincerest and deepest thanks for inviting me to be part of the teaching team at the International Course on "Biochemical Engineering Applications in Environmental Biotechnology and Cleaner Production".

I very much appreciate all your efforts to make an interesting and exciting course and I hope that my contributions were well received by both the other faculty and by the students.

I want to commend you for the fantastic program you put together and the perfect organization and effectuation of all parts of the course, and I mean all parts including the lecturers, that you insisted on use of powerpoint, the choice of venues (Antigua and Panajachel), the hotels, the cultural events, the boat trip, the visit to your house, your always happy face and your continuous care for all of us all the time.

We learnt a lot, all of us, in a very relaxing and pleasant atmosphere enabling continuous discussions both among the faculty and the students. I felt that the group you had gathered left with a much heightened awareness of the importance for cleaner production and hopefully each one of us will contribute to achieve sustainable development, each and everyone within his area, both in their jobs and environment as a whole.

I want you to extend my sincerest thanks and regards to Maria Eugenia and the rest of the staff at ICAITI which made this course possible and I send you my very warmest and sincerest regards.

Yours most sincerely

J. Stefan Rokem, Ph.D.

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Dear Carlos

I am writing to thank you for the opportunity to contribute to your course. I thoroughly enjoyed visiting Guatemala and talking to the students from various Central American countries. I must say I am impressed with your energy and enthusiasm in facilitating such training programmes. On a personal note I thank you for your warmth and hospitality. Professionally I believe we could work together well and it is a pity that it has taken me this long to visit you.

Inadvertently, I forgot to return the key to the Princess Hotel. Could you please ask Maria to mail the attached key. I paid my phone bills and tips to the Princess Hotel as I felt that it was inappropriate either for you or the course to cover for those costs. Could you also please ask Maria to ensure your credit card was not charged for those costs.

I have not managed to get in touch with Horst Doelle as yet. I will write to you again as soon as I manage to contact Horst concerning the possibility of a course in New Zealand next year.

Best regards.

Yours sincerely

Rao Bhamidimarri

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Septiembre 26, 1995

Estimado Carlos:

Esta comunicación tiene el propósito de agradecer las atenciones que tuviste conmigo durante la realización del "Curso Avanzado sobre Aplicaciones de la Ingeniería Bioquímica en la Biotecnología Ambiental y el Procesamiento Limpio".

En mi primera charla mencioné que había tres motivos por los cuales estaba contento y agradecido de estar en Antigua:

1. conocer a nuevos colegas de América Latina y otras regiones interesados en el desarrollo sustentable;
2. poder conversar y compartir experiencias con expertos de prácticamente todo el mundo; y
3. poder volver a la bella ciudad de Antigua y disfrutar su especial ambiente.

Ahora de regreso confirmo mi agradecimiento, pues gracias a tu cordialidad y eficiencia el evento ha resultado un éxito.

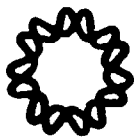
Espero que en noviembre vengas a México (ojalá con Elvira) y tenga la oportunidad de corresponder a tu hospitalidad.

Saludos cordiales

This transmission contains 1 page(s)  
(including this cover sheet)



TELS. (52)(73) 114900, 114990 Y 114700 FAX (52)(73) 172368  
APDO. 810-3, CUERNAVACA, MORELOS 62260, MEXICO



**Instituto de Biotecnología**  
UNIVERSIDAD NACIONAL AUTONOMA DE MEXICO

**DR. CARLOS E. ROLZ**  
CHAIRMAN  
ICAITI  
P. O. BOX 1552  
Guatemala, 01901  
GUATEMALA

INSTITUTO CENTROAMERICANO DE INVESTIGACIONES Y TECNOLOGIA INDUSTRIAL, GUATEMALA	
+ 26 OCT. 1995 +	
No. 2602	Hora

Octubre 2, 1995.

Estimado Carlos:

Por medio de la presente te agradezco ampliamente las atenciones recibidas durante mi estancia en Guatemala, durante el "International Course: Biochemical Engineering Applications in Environmental Biotechnology and Cleaner Production", llevado a cabo del 18 al 29 de septiembre del presente año.

Asimismo quiero felicitarte por el buen nivel académico del curso, el interesante programa científico así como también el excelente programa social organizado.

Espero volver a verte este próximo noviembre durante tu visita a Cuernavaca.

Recibe un afectuoso abrazo

2433

**DR. OCTAVIO TONATIUH RAMÍREZ R.**  
Jefe del Depto. de Bioingeniería

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Date: Fri, 06 Oct 1995 16:32:47 +0300  
To: icaitigt@uvg.edu.gt  
From: Liisa Viikari <liisa.viikari@vtt.fi>  
Subject: thanks

To Carlos Rolz, ICAITI

Dear Carlos,

We happily returned from Guatemala and also recovered from the jet-lag. I will however, never be "recovered" from the beautiful experiences and memories of your country. I want to thank you for arranging such a wonderful course, and especially for creating the warm and creative atmosphere. You did an enormous work when arranging everything so perfectly. The course was an excellent mixture of science and culture. I bought three records, and enjoy my memories with the music, especially the "El paabanc". Professionally, I also enjoyed many of the lectures, and there were several useful discussions, as well as new ideas, generated. I also hope that I can help some of the students on their specific problems. My sister was equally impressed by this journey, and she also wishes to express her warmest thanks for everything. Please, also send our warmest greetings and thanks to your wife, as well as to your right hand, Maria. Best regards, Liisa

\*\*\*\*\*



*Handwritten initials*

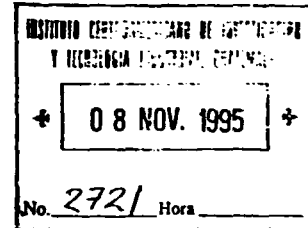
Department of Microbiology and Biochemistry  
Faculty of Science

P.O. Box 339 BLOEMFONTEIN 9300  
TEL. (051) 401-

SOUTH AFRICA  
FAX: (INTERNATIONAL) + 27-51-48-2004  
(NATIONAL) (051) 48-2004  
E-MAIL: @ WWG3.UOVS.AC.ZA

18 October 1995

Prof. Carlos Rolz  
Science and Technology Unit  
Central America Research  
Institute for Industry  
ICAITI - P.O. Box 1552  
GAUTEMALA  
01901



Dear Prof. Rolz

**Biochemical Engineering Applications in Environmental Biotechnology and cleaner production, 18-29 September 1995.**

Hereby I would like to express my sincere gratitude to everybody involved in the organisation of, and participation in the International Course on "Biochemical Engineering Applications in Environmental Biotechnology and cleaner production", which was presented in the most professional manner. With regards to the general standard, choice of research topics, and excellent flow of procedures, accept my congratulations and appreciation. The information gathered at the course was of great value to me and will be in future studies and applications. I trust that I will be able to apply much of the knowledge gained at this course to the South African scenario

My sincere appreciation for the wonderful cultural events and the excursion to lake Atitlán as organised by you and your team. Gautemala is indeed a very beautiful country, which I really enjoyed and I trust that I will be able to return again someday.

Once again, I thank you. All the best wishes for the future.

Yours sincerely,

*Handwritten signature: K-H. Riedel*  
K-H. Riedel





# CAMARA DE INDUSTRIAS DE COSTA RICA

9 de octubre de 1995

Ing. Carlos Rolz  
ICAITI-Guatemala  
S. O.

INSTITUTO CENTROAMERICANO DE INVESTIGACION Y TECNOLOGIA INDUSTRIAL Y COMERCIAL	
+ 08 NOV. 1995 +	
No. 2690	Hora _____

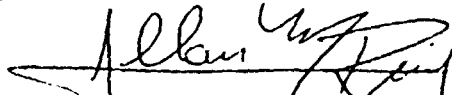
Estimado Ing. Rolz:

Deseo hacerle llegar un efusivo agradecimiento por la oportunidad que me brindó ICAITI, para participar en el Curso Internacional de Aplicación de la Ingeniería Bioquímica en la Biotecnología Ambiental y la Producción Limpia. Esta experiencia ha permitido definir nuevas metas, para el Programa de Asesoría Técnica que desarrolla la Cámara de Industrias de Costa Rica en el sector industrial. Asimismo, debo informarle que ya se han empezado a incorporar los conocimientos adquiridos a dicho Programa y se espera contactar en breve a muchos de los expositores del curso, a fin de ampliar el panorama de alternativas tecnológicas disponibles, para reducir el impacto ambiental de las operaciones productivas en el país.

En lo personal, esta experiencia me ha llevado redefinir mis expectativas de desarrollo profesional, luego de adquirir conocimientos e información cuyo valor considero inestimable.

Deseo asimismo felicitarlo por la excelente organización de la actividad. Sin duda su esfuerzo y dedicación para lograr que ese curso se hiciera realidad, darán valiosos frutos por medio de los profesionales que lo recibimos.

Con toda admiración y respeto, suscribe cordialmente,

  
Ing. Allan Cabalceza Ruiz  
Departamento de Desarrollo  
Sostenible

9599

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HECHO EN  
COSTA RICA

COMPRE CON ORGULLO HECHO EN COSTA RICA

TELEFONO 222-2411 FAX: (506) 222-1007 APARTADO POSTAL 10.003- CODIGO 1.000 SAN JOSE-COSTA RICA



**Ing. Carlos Rolz**  
**Unidad de Ciencia y Tecnología**  
**Instituto Centroamericano de**  
**Investigación y Tecnología Industrial, (ICAITI)**

**Fax: (502-2) 317470**

**Ing. Rolz:**

Con un saludo muy afectuoso desde el INDOTEC, le reitero mis más sentidas gracias por todas las atenciones dispensadas durante el pasado curso sobre Biotecnología Ambiental y el procesamiento Limpio.

Agradezco mucho, no sólo los conocimientos adquiridos, sino también la oportunidad que me brindó de conocer su hermoso país.

Le ruego extender este agradecimiento a la Sra. María Eugenia.

Con sentimientos de consideración,

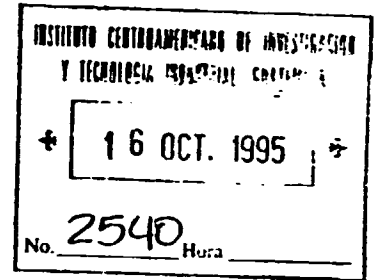
  
**DRA. CARMEN DUVAL**  
**Instituto Dominicano de Tecnología Industrial**  
**INDOTEC**

**CD/Netty R.**

**3 de octubre de 1995**

Nueva San Salvador, 3 de octubre de 1995

Profesor  
Carloz Rolz  
Jefe  
Unidad de Ciencia y  
Tecnología/ICAITI  
Guatemala



Estimado Carlos:

Deseo agradecerle por las atenciones recibidas y por la excelente organización que hicieron más placentera y provechosa mi participación en el reciente curso avanzado sobre biotecnologías y producción más limpia.

Este fue el sentir unánime entre los asistentes con quienes tuve oportunidad de intercambiar impresiones.

Atentamente

  
Gerardo Lardé

2433

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VICENTE  
PEREZ  
ROSALES  
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TECNOLOGICA

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DATE (FECHA) 18 de Octubre

TO(A) : Ing. Carlos Rolz  
NR FAX : 582 2 317470  
FROM(DE) : Verónica Droppelmann  
REF. : Curso Tecnologías Limpias  
PAGINAS : 1

Estimado Carlos:

Quiero agradecerte la posibilidad que tuve de participar en el curso sobre tecnologías limpias, me gustó mucho, fue muy provechoso tanto en lo personal como en lo profesional.

Para nuestra Universidad la temática "Tecnologías Limpias" es de mucho interés, así que lo aprendido será muy bien aprovechado.

Se despide atentamente

*V. Droppelmann*  
Verónica Droppelmann

Por qué se suicidan las hojas cuando se sienten amarillas?

Del libro de las preguntas de Pablo Neruda