# CURRICULUM STRUCTURE
## TIME TO STUDY
## TIME TO THINK

**Symposium on Excellence in Higher Education**

Luiz Bevilacqua
January 2014

# THE THREE FOCUS OF THE PRESENTATION

**THE CULTURAL FRAMEWORK**

**THREE BASIC PRINCIPLES FOR THE CURRICULUM STRUCTURE**

**THE ULTIMATE AIM OF THE CURRICULUM: EDUCATION**

# THE CULTURAL FRAMEWORK

## 1. CULTURAL SHOCK

# SURFING IS THE PROPER WAY TO MOVE ALONG A SHOCK WAVE

**SURFING IS NOT A NEW SWIMMING STYLE BUT REQUIRES NEW SKILLS.**

**A BOARD IS NECESSARY**

# THE CULTURAL FRAMEWORK

## 2. INTERDISCIPLINARITY

# E. Shrödinger

## The first statement about the interdisciplinary option of the modern times.

*“ …. But the spread, both in width and depth, of the multifarious branches of knowledge during the last hundred odd years has confronted us with a queer dilemma. We feel clearly that we are only now beginning to acquire reliable material for welding together the sum-total of what is known into a whole; but, on the other hand, it has become next to impossible for a single mind fully to command more than a small specialized portion of it. I can see no other escape from this dilemma (lest our true aim be lost for ever) than that some of us should venture to embark on a synthesis of facts and theories, albeit with second-hand and incomplete knowledge of some of them, and at the risk of making fools of themselves. So much for my apologize”*

# THE CHALLENGES OF THE NEW ERA

- **There is no unique solution** for the best curriculum. Excellence in Higher Education requires freedom to explore new avenues
- Excellence in Higher Education requires to exercise the ability to hear, **to be open-minded towards new ideas** and accept that good proposal may come from unexpected sectors of society
- Particularly in **very large countries**, both in space and population, **centralization may cause more harm** than benefits
- Excellence in Higher Education requires nowadays more than ever **exchanging experiences, not searching for a uniform, universal educational system**
- In any case the **traditional university organization is hopeless**

# THE THREE FOCUS

THE CULTURAL FRAMEWORK

1. The presence of the cultural shock. there is no unique solution
2. The entanglement of different knowledge fields. interdisciplinarity

# THREE BASIC PRINCIPLES

## 1. LEARN RATHER THAN TEACH

# THE NEW UNIVERSITY
## *Learn rather than Teach*

| Nome | Créditos | C.H.G. Teórica/Prática | |
|---|---|---|---|
| Resistencia dos Materiais I | 4.0 | 45 | 15 |
| Geomecânica - A. | 2.0 | 15 | 30 |
| Sistemas Prediais I | 2.0 | 30 | 0 |
| Mat de Construção I - A. | 2.0 | 30 | 0 |
| Lab Mat de Construção I - A. | 1.0 | 0 | 15 |
| Eletricidade I | 4.0 | 45 | 30 |
| Economia A | 4.0 | 45 | 15 |
| Topografia | 4.0 | 45 | 30 |
| | 23 | 255 | 135 |

With 1 hour of individual study for each hour in class this gives about 8 hours of intellectual work 6 days a week!!! (**Advisable 12-15 credits per term** )
A proof that the basic assumption is that students learn mainly because they here not because they think

# THE NEW UNIVERSITY
## *Learn rather than Teach*

- The University must be  a place intended primary to learn rather than teach
- Students should be stimulated to make their own choices, to take risks, and to contribute to the academic project. **Admission must be to the University not to a specific field**.
- Students should learn to think autonomously, to build up their self confidence and to think independently

# THREE BASIC PRINCIPLES

## 2. DO NOT POUR NEW WINE IN OLD BOTTLES

# THE NEW UNIVERSITY

## *Do not pour new wine in old bottles*

1950
Calculus I, II, III, IV
Physics I, II, III, IV
Chemistry I, II
Biology I, II, III, IV

AFTER 63 YEARS

2013
Calculus I, II, III, IV
Physics I, II, III, IV
Chemistry I, II
Biology I, II, III, IV

# THE NEW UNIVERSITY

## *Do not pour new wine in old bottles*

Reorganize the contents of knowledge according to more adequate guide-lines

- **Structure of matter**
- **Energy**
- **Transformation processes**
- **Communication and Information**

- Different forms of knowledge: rational. emotional, transcendental
- History of Civilization
- Driving forces of the cultural evolution
- Life on earth: from elementary building blocks to complex organisms

HELMHOLTZ | GEMEINSCHAFT

# HELMHOLTZ INSTITUT

## RESEARCH FIELDS

- ENERGY
- THE EARTH AND THE UNIVERSE
- HEALTH
- AERO-ASTRO AND TRANSPORTATION
- KEY TECHNOLOGIES
- STRUCTURE OF MATTER

# THE NEW UNIVERSITY
## *Do not pour new wine in old bottles*

- **Selected courses**, presenting more questions than consolidated knowledge:

*Evolution of life on earth, Cosmology, Different forms of knowledge, The Amazon forest: a complex thermodynamic process, God: belief and myth, Religion in the modern world, Sports and politics, The universe: dark matter and dark energy*

- Research is not an advanced phase of the university education, it must be embedded in the course program

# THREE BASIC PRINCIPLES

## 3. FIRST DISCOVER THAN PUBLISH

# THE NEW UNIVERSITY

## *First discover then publish*

A necessary although not sufficient condition to make sure that you have a valuable contribution to the advancement of science is to have your paper peremptory refused for publication, at least once, in the most prestigious scientific journals.

# THE THREE FOCUS

THE CULTURAL FRAMEWORK

1. The presence of the cultural shock. there is no unique solution
2. The entanglement of different knowledge fields. interdisciplinarity

THE THREE BASIC PRINCIPLES

1. Learn rather than Teach
2. Do not pour new wine in old bottles
3. First discover then publish

# THE ULTIMATE AIM EDUCATING THE NEW GENERATION

1. THE ENLIGHTENMENT OF THE HUMAN SPIRIT

# THE ULTIMATE AIM EDUCATING THE NEW GENERATION

2. STUDENTS SHOULD MAKE THEIR OWN CHOICES, TO TAKE RISKS, TO ACCEPT CHALLENGES AND TO THINK CREATIVELY.

# EDUCATION

- Fostering creativity – More individual work and less classes – Think.
- Building self-confidence – To dare and to reduce aversion to risk.
- Learning to take decisions and to take initiaves – Less complaints and more solutions.

# THE THREE FOCUS

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THE THREE BASIC PRINCIPLES

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THE ULTIMATE AIM OF THE CURRICULUM: EDUCATION

1. The enlightenment of the human spirit
2. Students should make their own choices, to take risks, to accept challenges and to think creatively.

# FINAL CONSIDERATION

- As matter of fact as you can see, after all, the curriculum has no uniform, unique, or almost unique arrangement.
- It is build up with several hands, competences, expectations, and dreams.
- It is a dynamical process and as all dynamical process may be stable or unstable, may approach regular attractors (classical education) or strange attractors (non-classical education)
- This is the new university controversy the challenge of the new education.

# BERNARD SHAW

"Reasonable people adapt themselves to the world. Unreasonable people attempt to adapt the world to themselves. All progress, therefore, depends on unreasonable people."

# REFERENCES

**A formação do engenheiro inovador: uma visão Internacional**, Marcos Azevedo da Silveira – Rio de Janeiro, PUC-Rio, Sistema Maxwell, 2005.

**Subsídios para a Reforma do Ensino Superior,** Luiz Davidovich (ed), Academia Brasileira de Ciências, 2006.

O documento foi uma contribuição ao debate sobre o tema, desenvolvido por solicitação do Ministério da Educação (MEC). O grupo de trabalho da ABC, coordenado por Luiz Davidovich (UFRJ), contou com a participação dos seguintes Acadêmicos:


THANKS FOR YOUR ATTENTION
LET US SURF
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# EDUCATION IN A DIVERSIFIED CULTURAL ENVIRONMENT

- There is no unique solution for the best curriculum. Excellence in Higher Education requires freedom to explore new avenues
- Excellence in Higher Education requires to exercise the ability to hear, to be open-minded towards new ideas and accept that good proposal may come from unexpected sectors of society
- Particularly in **very large countries**, both in space and population, centralization may cause more harm than benefits
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# THE CHALLENGES OF THE NEW ERA

THE TRADITIONAL UNIVESITY ORGANIZATION IS HOPELESS

THERE IS NO MUCH TIME TO THINK AND TO TAKE DECISIONS

IT IS NECEESARY TO UNDERTAKE RISKS

IT IS NECESSARY TO CHALLENGE TRADICIONAL RULES AND FIGHT FOR NEW AND MORE FLEXIBLE STATUTES ADEQUATED TO THE PRESENT TIMES

IT IS NECESSARY TO FIND A SUITABLE BOARD

ANYWAY IT IS NECESSARY TO BE PREPARED TO FALL DOWN AND GET ON YOUR FEET AGAIN

# EDUCATING FOR THE FUTURE

- **Professional mobility:** New professions and jobs that do not fit the traditional standards.
- **New professional demands not yet regulated:** New professions are popping up that do not fit the traditional regulations.
- **Professional specialization:** Some industries and service companies are becoming highly specialized and prefer to offer in-job professional training.
- **Education with emphasis on less obsolescent matters:** Basic science, history of human knowledge
- **Encourage the students to think creatively:** to invent, to discover and to criticize

# EDUCATING FOR THE FUTURE

**Professional education** should also be of concern. But courses dealing with professional topics should be taught by highly **qualified professionals** not as full time professors but as collaborators.

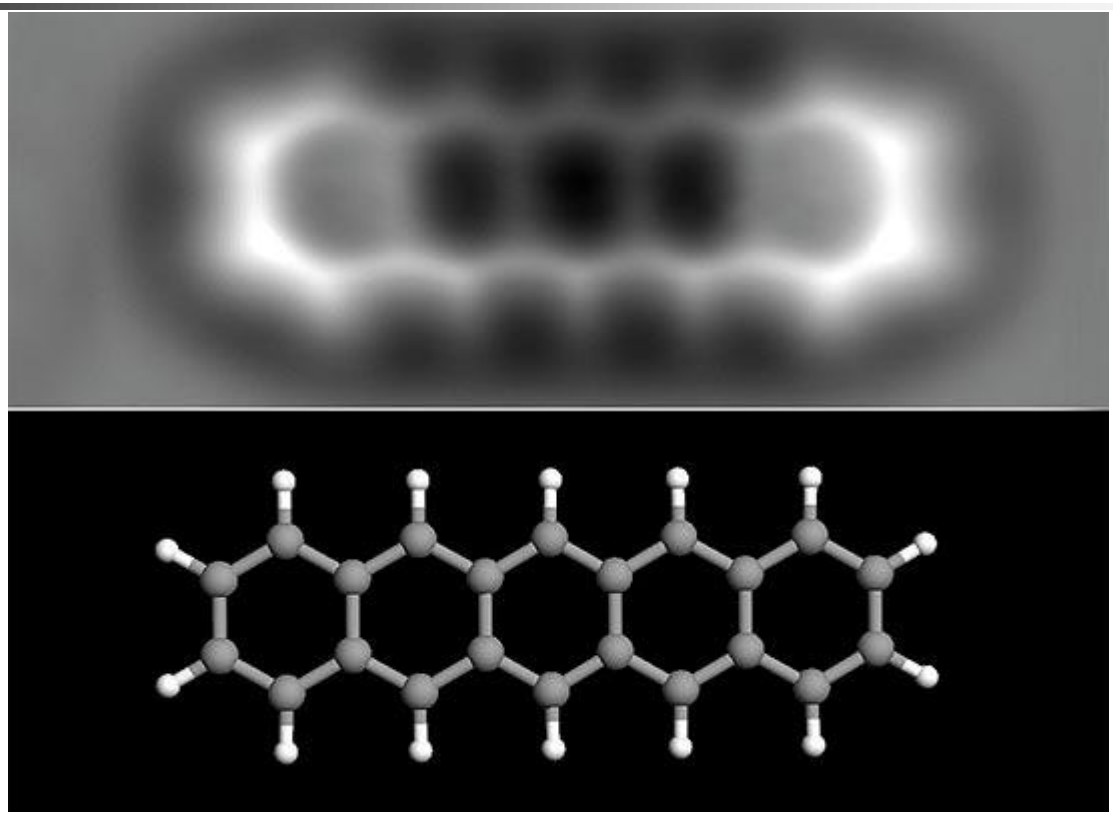
# EDUCATING FOR THE FUTURE

Classical organization that breaks up the so called hard sciences into **physics, chemistry, biology, computer science and mathematics should be reviewed**. The creation of courses following a new profile would help the **interaction of people with different backgrounds and would enforce collaborative and interdisciplinary research**.

# THE CORNERSTONE OF THE KNOWLEDGE BOOM

- Ability to make scientific observations and experiments
  - Macrocosm (*deep universe, new galaxies, high energy cosmic rays, black holes, cosmology*)
  - Microcosm (*molecular biology, nano-science, MEMS*)
- Computational capability
  - Applied mathematics
  - Modeling
  - Complex systems

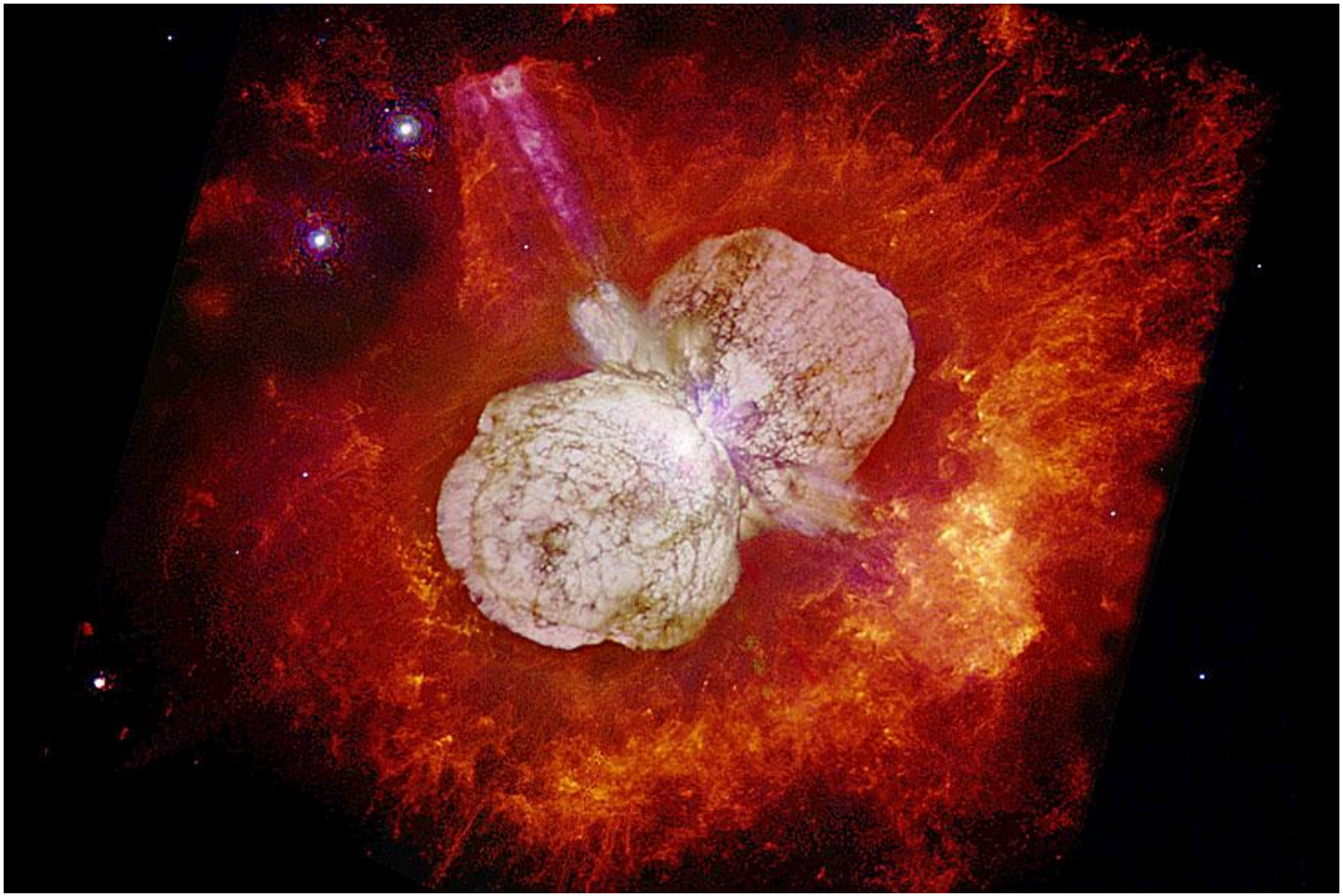
# PENTACENE



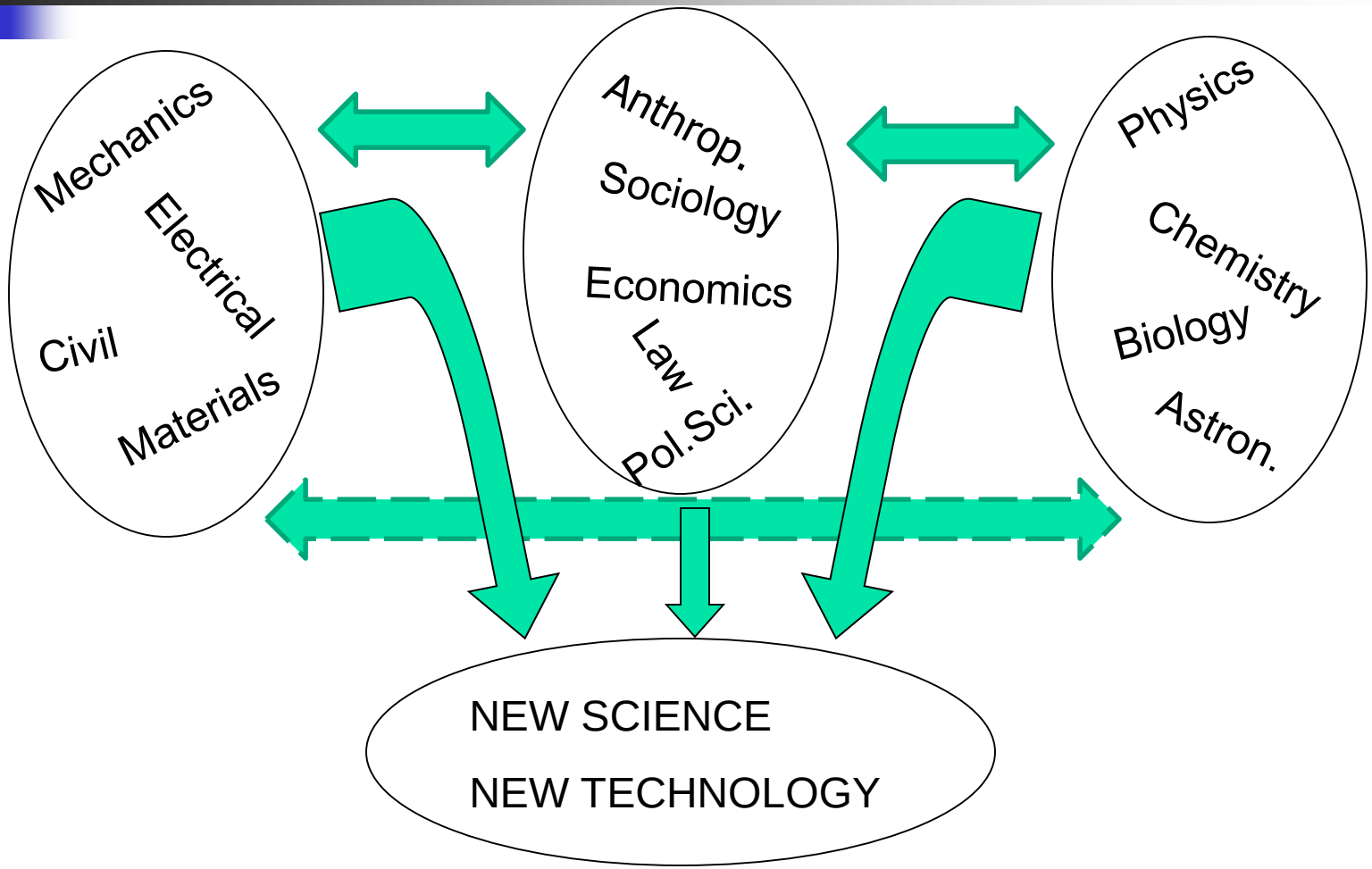
IBM

Researchers at IBM have used an atomic-force microscope to resolve the chemical structure of pentacene.

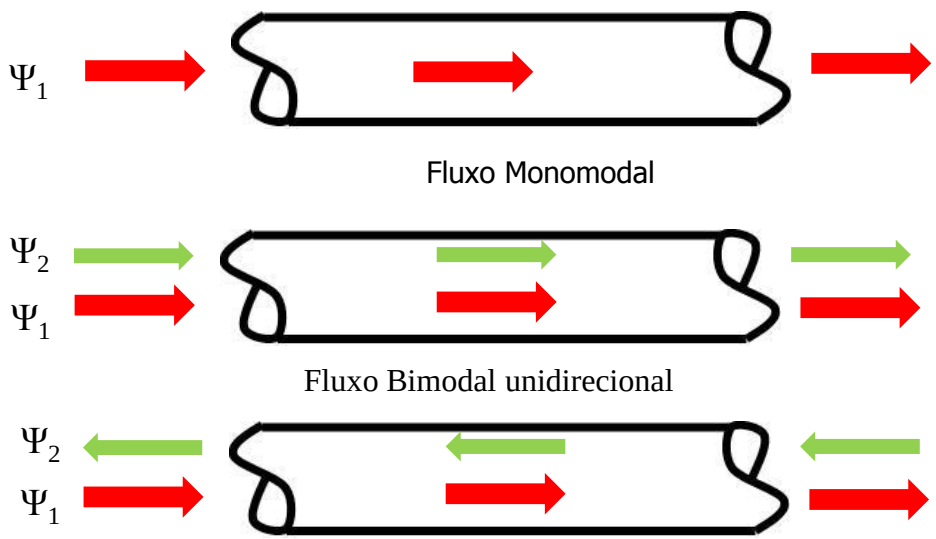
# ETA KARINA



# BARRIERS HAVE COLLAPSED



# CAPITAL FLOW



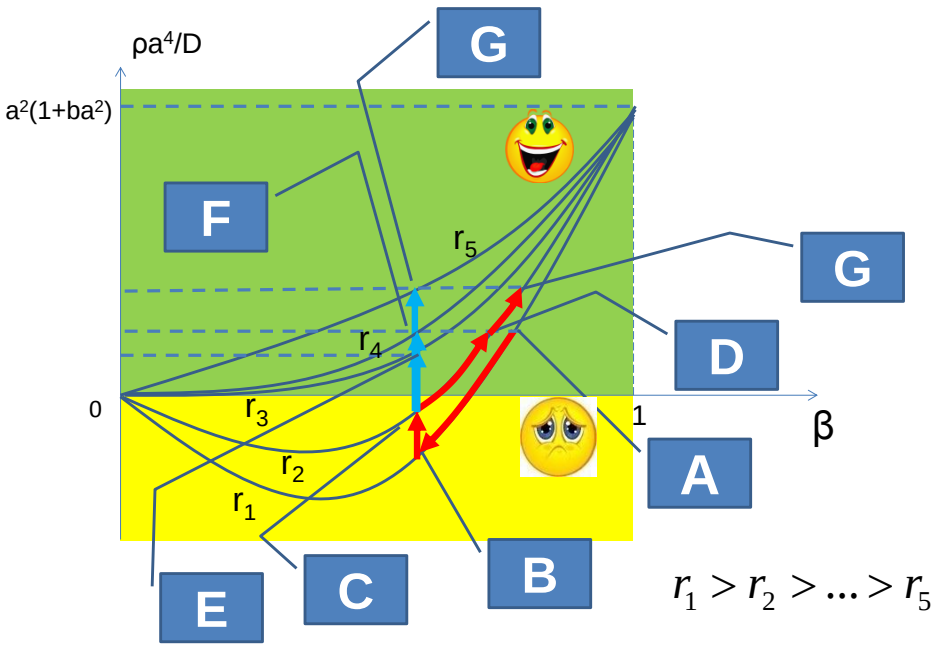

Black and Scholes

$$\frac{\partial V}{\partial t}+\frac{1}{2}\sigma^2 S^2\frac{\partial^2 V}{\partial S^2}+rS\frac{\partial V}{\partial S}-rV=0$$

Bi-Modal Model

$$\frac{\partial p}{\partial t}-\beta D\frac{\partial^2 p}{\partial x^2}+\beta(1-\beta)R\frac{\partial^4 p}{\partial x^4}-\beta Bp=0$$

# INTERDISCIPLINARY APPLICATIONS




MACROECONOMICS

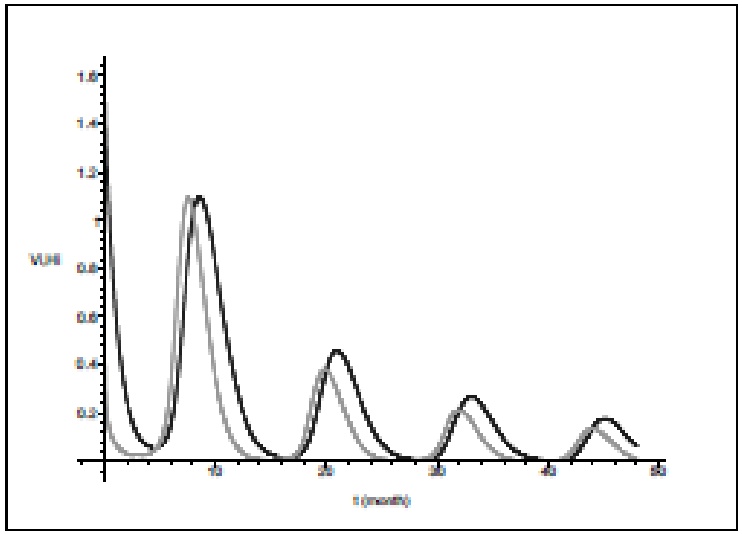


Fig. 2. Population of infected humans (dark line) and infected mosquitoes (light line) employing $p_1 = 0.75$, $p_2 = 0.20$, $p_3 = 0.05$ and $T = 25°C$.

EPIDEMIOLOGY-MALARIA

# A TRUE SHOCK WAVE


PAST SQUEEZE INTO THE FUTURE

# THE UFABC PROJECT

- **Abolition of the departmental organization**
- **New framework for the scientific knowledge**
- Challenging new topics offered in courses under the supervision of the Undergraduate Studies Division
- Competence prevailing over diploma
- More freedom to select courses and professional options
- Students are admitted to the University not to a specific course

# THE SCHOOLS

- School of Natural Sciences and Humanities. Discovery.
- School of Mathematics, Computation and Cognition. Logic.
- School of Engineering and Applied Social Sciences. Invention.

# AFTER SIX YEARS

**YES IT WAS POSSIBLE and IT WORKS**

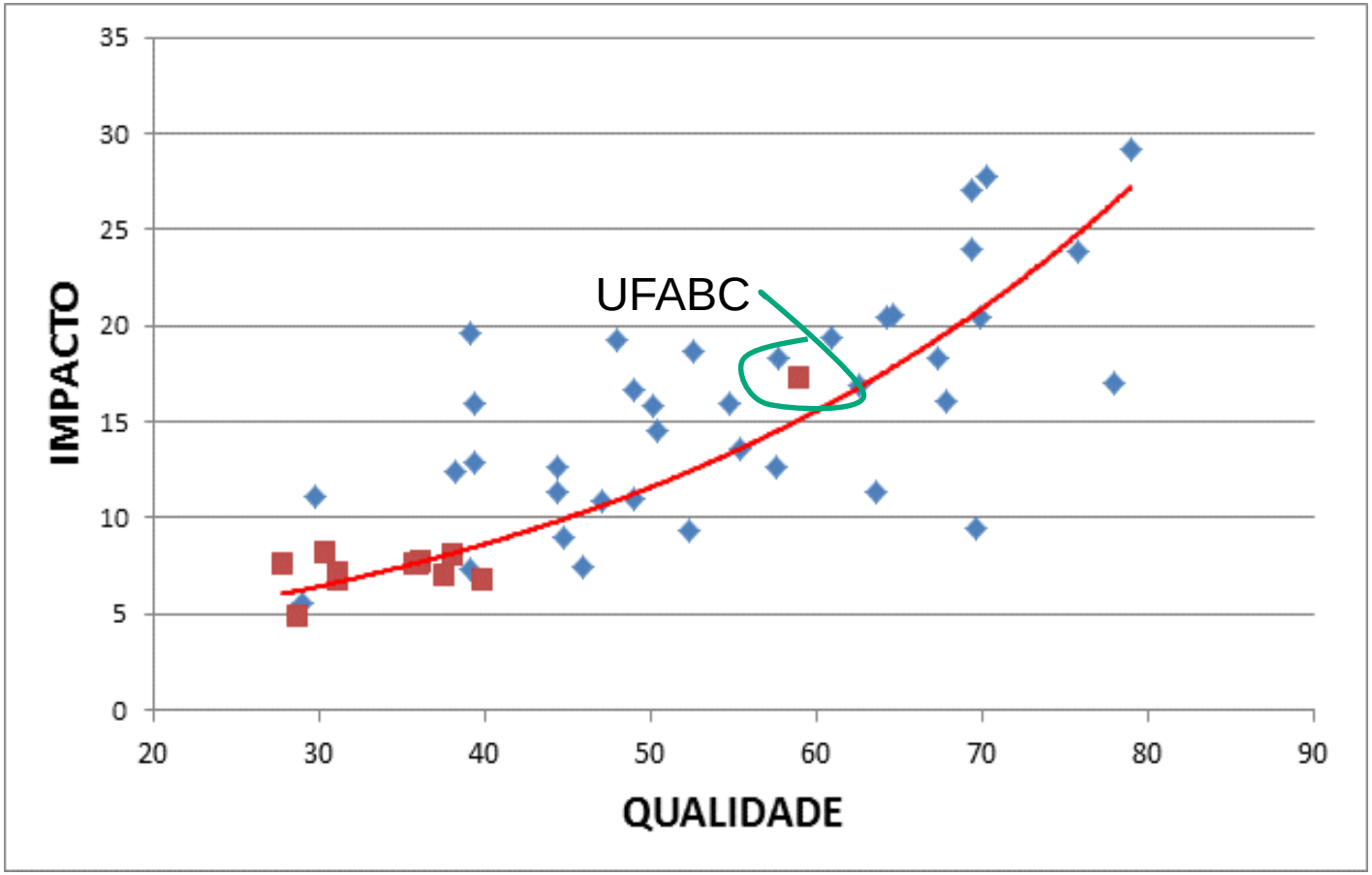
# EDUCATION
## MEC-ENADE EVALUATION

Ranked second best among 200 universities regarding the performance in education –Undergraduate and Graduate courses. First place undergraduate course. The only University in Brazil with mark above 4 (5 is the maximum)

Four courses were evaluated as best among all Brazilian Universities: Materials Engineering, Environmental Engineering, BSc in Chemistry and BSc in Mathematics
Among the three best courses in Brazilian Universities are: BSc in Biology, Production Engineering, "Licenciatura" in Physics

# RESEARCH PERFORMANCE

## SIR World Report 2012



# THE NEW SCIENTIFIC FRAMEWORK

- Structure of Matter
- Energy
- Transformation Processes
  - Mechanically and physically driven
  - Life sciences
- Communication and Information
- Representation and Simulation (Mathematics)
- Humanities and Social Sciences