Universidade Federal do Rio de Janeiro

Simposio Internacional
Inflamación crónica. Avances y perspectivas terapéuticas.

Facultad de Ciencias – Universidad de la República
Balmoral Plaza Hotel, Montevideo - UY

Investigación y desarrollo de fármacos radical o incremental

Junio 21, 2015

Eliezer J. Barreiro

Profesor

Universidade Federal do Rio de Janeiro

Laboratório de Avaliação e Síntese de Substâncias Bioativas

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INCT Instituto Nacional de Ciência e Tecnologia de Fármacos e Medicamentos

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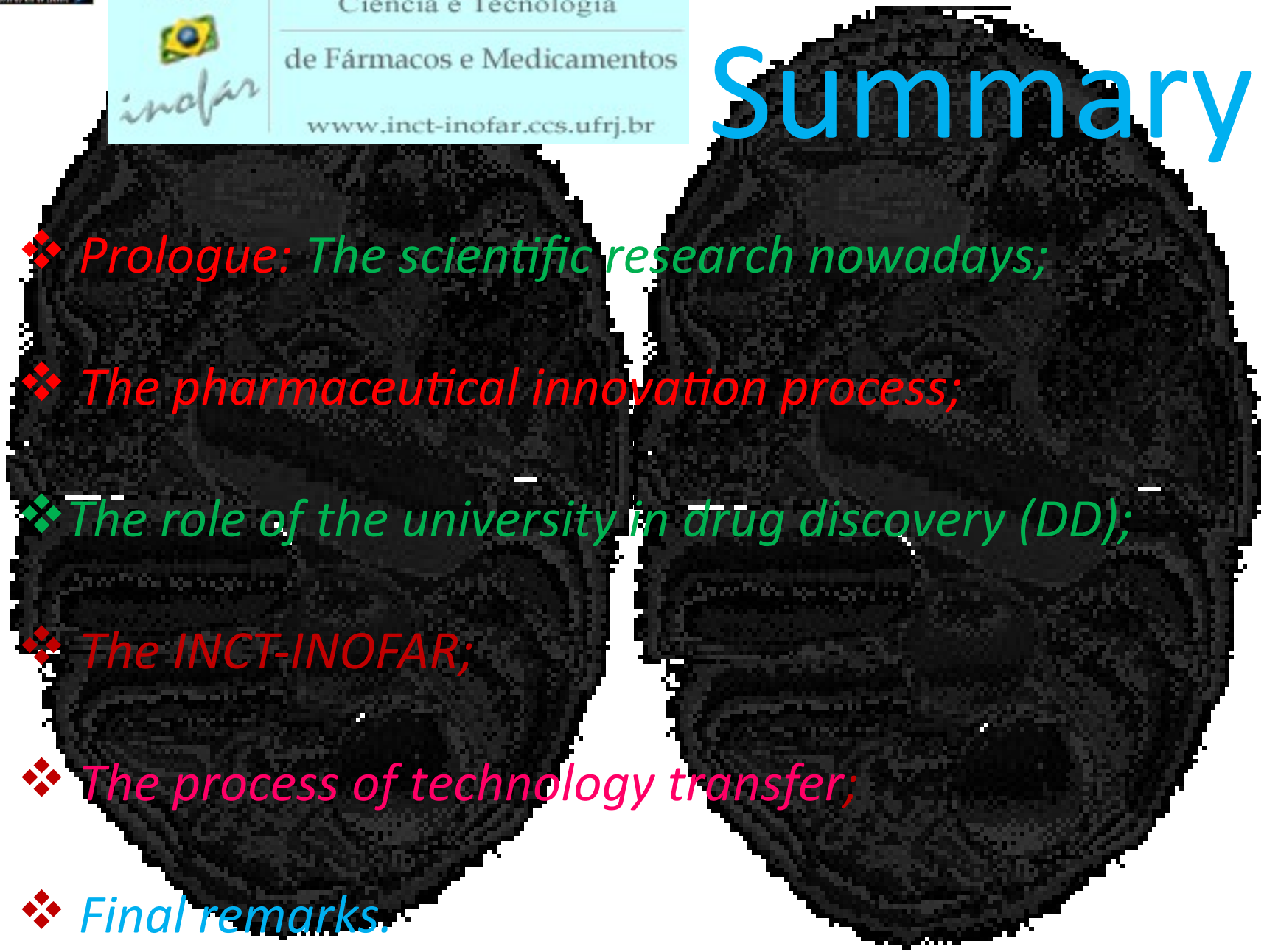
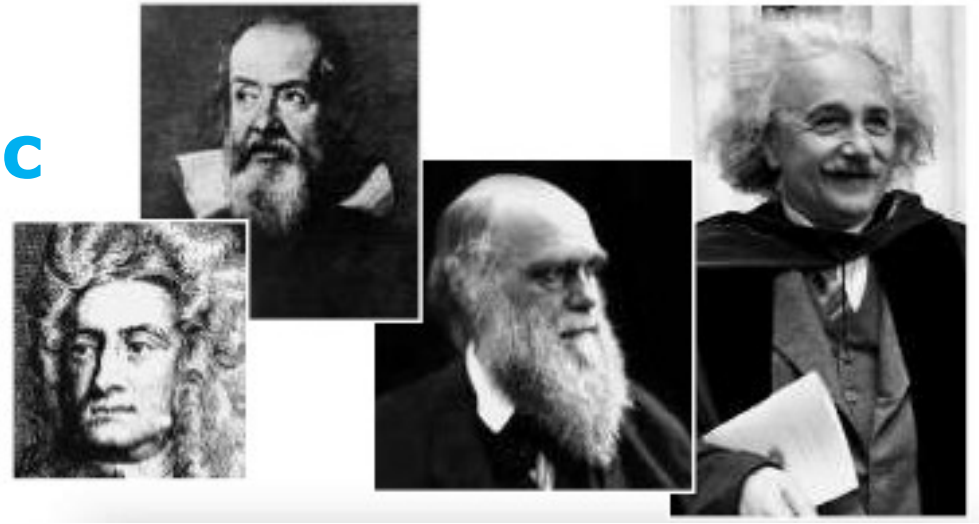
Summary

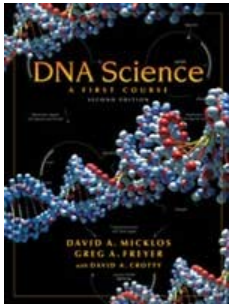


- *Prologue: The scientific research nowadays;*
- *The pharmaceutical innovation process;*
- *The role of the university in drug discovery (DD);*
- *The INCT-INOFAR;*
- *The process of technology transfer;*
- *Final remarks.*

The scientific research through the ages...



Galileo, Newton, Darwin, & Einstein



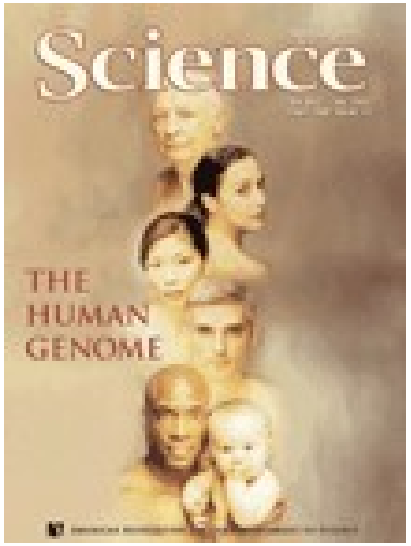
The physical Crick & the biologist Watson

JD Watson & FHC Crick, A Structure for Deoxyribose Nucleic Acid, *Nature* **1953**, *171*, 737–738 .

The human genome team

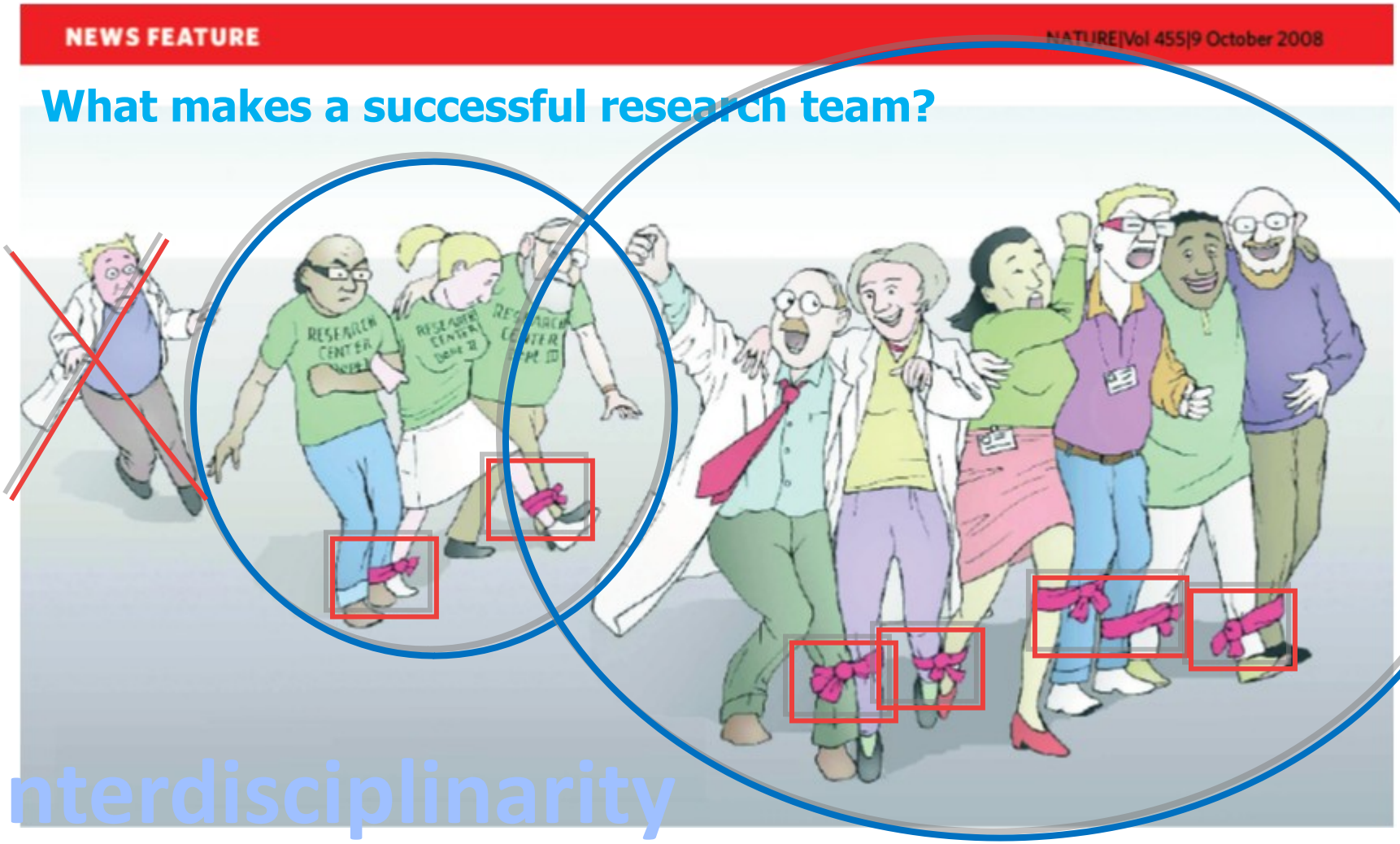
The Sequence of the Human Genome

J. Craig Venter, Mark D. Adams, Eugene W. Myers, Peter W. Li, Richard J. Mural, Granger G. Sutton, Hamilton O. Smith, Mark Yandell, Cheryl A. Evans, Robert A. Holt, Jeannine D. Gocayne, Peter Amanatides, Richard M. Ballew, Daniel H. Huson, Jennifer Russo Wortman, Qing Zhang, Chinnappa D. Kodira, Xiangqun H. Zheng, Lin Chen, Marian Skupski, Gangadharan Subramanian, Paul D. Thomas, Jinghui Zhang, George L. Gabor Miklos, Catherine Nelson, Samuel Broder, Andrew G. Clark, Joe Nadeau, Victor A. McKusick, Norton Zinder, Arnold J. Levine, Richard J. Roberts, Mel Simon, Carolyn Slayman, Michael Hunkapiller, Randall Bolanos, Arthur Delcher, Ian Dew, Daniel Fasulo, Michael Flanigan, Liliana Florea, Aaron Halpern, Sridhar Hannenhalli, Saul Kravitz, Samuel Levy, Clark Mobarry, Knut Reinert, Karin Remington, Jane Abu-Threideh, Ellen Beasley, Kendra Biddick, Vivien Bonazzi, Rhonda Brandon, Michele Cargill, Ishwar Chandramouliswaran, Rosane Charlab, Kabir Chaturvedi, Zuoming Deng, Valentina Di Francesco, Patrick Dunn, Karen Eilbeck, Carlos Evangelista, Andrei E. Gabrielian, Weiniu Gan, Wangmao Ge, Fangcheng Gong, Zhiping Gu, Ping Guan, Thomas J. Heiman, Maureen E. Higgins, Rui-Ru Ji, Zhaoxi Ke, Karen A. Ketchum, Zhongwu Lai, Yiding Lei, Zhenya Li, Jiayin Li, Yong Liang, Xiaoying Lin, Fu Lu, Gennady V. Merkulov, Natalia Milshina, Helen M. Moore, Ashwinikumar K Naik, Vaibhav A. Narayan, Beena Neelam, Deborah Nusskern, Douglas B. Rusch, Steven Salzberg, Wei Shao, Bixiong Shue, Jingtao Sun, Zhen Yuan Wang, Aihui Wang, Xin Wang, Jian Wang, Ming-Hui Wei, Ron Wides, Chunlin Xiao, Chunhua Yan, Alison Yao, Jane Ye, Ming Zhan, Weiqing Zhang, Hongyu Zhang, Qi Zhao, Liansheng Zheng, Fei Zhong, Wenyan Zhong, Shiaoping C. Zhu, Shaying Zhao, Dennis Gilbert, Suzanna Baumhueter, Gene Spier, Christine Carter, Anibal Cravchik, Trevor Woodage, Feroze Ali, Huijin An, Aderonke Awe, Danita Baldwin, Holly Baden, Mary Barnstead, Ian Barrow, Karen Beeson, Dana Busam, Amy Carver, Angela Center, Ming Lai Cheng, Liz Curry, Steve Danaher, Lionel Davenport, Raymond Desilets, Susanne Dietz, Kristina Dodson, Lisa Doup, Steven Ferriera, Neha Garg, Andres Gluecksmann, Brit Hart, Jason Haynes, Charles Haynes, Cheryl Heiner, Suzanne Hladun, Damon Hostin, Jarrett Houck, Timothy Howland, Chinyere Ibegwam, Jeffery Johnson, Francis Kalush, Lesley Kline, Shashani Koduru, Amy Love, Felecia Mann, David May, Steven McCawley, Tina McIntosh, Ivy McMullen, Mee Moy, Linda Moy, Brian Murphy, Keith Nelson, Cynthia Pfannkoch, Eric Pratts, Vinita Puri, Hina Qureshi, Matthew Reardon, Robert Rodriguez, Yu-Hui Rogers, Deanna Romblad, Bob Ruhfel, Richard Scott, Cynthia Sitter, Michelle Smallwood, Erin Stewart, Renee Strong, Ellen Suh, Reginald Thomas, Ni Ni Tint, Sukyee Tse, Claire Vech, Gary Wang, Jeremy Wetter, Sherita Williams, Monica Williams, Sandra Windsor, Emily Winn-Deen, Keriellen Wolfe, Jayshree Zaveri, Karena Zaveri, Josep F. Abril, Roderic Guigó, Michael J. Campbell, Kimmen V. Sjolander, Brian Karlak, Anish Kejariwal, Huaiyu Mi, Betty Lazareva, Thomas Hatton, Apurva Narechania, Karen Diemer, Anushya Muruganujan, Nan Guo, Shinji Sato, Vineet Bafna, Sorin Istrail, Ross Lippert, Russell Schwartz, Brian Walenz, Shibu Yooseph, David Allen, Anand Basu, James Baxendale, Louis Blick, Marcelo Caminha, John Carnes-Stine, Parris Caulk, Yen-Hui Chiang, My Coyne, Carl Dahlke, Anne Deslattes Mays, Maria Dombroski, Michael Donnelly, Dale Ely, Shiva Esparham, Carl Fosler, Harold Gire, Stephen Glanowski, Kenneth Glasser, Anna Glodek, Mark Gorokhov, Ken Graham, Barry Gropman, Michael Harris, Jeremy Heil, Scott Henderson, Jeffrey Hoover, Donald Jennings, Catherine Jordan, James Jordan, John Kasha, Leonid Kagan, Cheryl Kraft, Alexander Levitsky, Mark Lewis, Xiangjun Liu, John Lopez, Daniel Ma, William Majoros, Joe McDaniel, Sean Murphy, Matthew Newman, Trung Nguyen, Ngoc Nguyen, Marc Nodell, Sue Pan, Jim Peck, Marshall Peterson, William Rowe, Robert Sanders, John Scott, Michael Simpson, Thomas Smith, Arlan Sprague, Timothy Stockwell, Russell Turner, Eli Venter, Mei Wang, Meiyuan Wen, David Wu, Mitchell Wu, Ashley Xia, Ali Zandieh, and Xiaohong Zhu



Science **2001** *291*, 1304-1351 [DOI: 10.1126/science.1058040]

J. Whitfield, *Nature* **2008**, *455*, 720

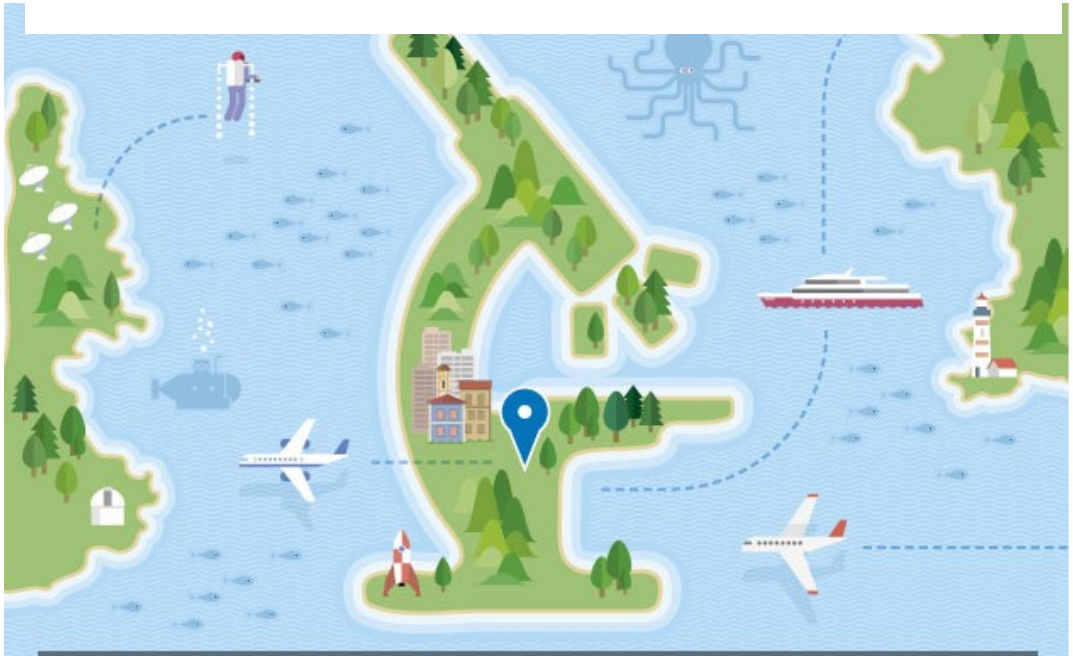


W Masona, D J Watts, Collaborative learning in networks, *PNAS* **2012**, *109*, 764; M Williams, Productivity Shortfalls in Drug Discovery: Contributions from the Preclinical Sciences?, *JPET* **2011**, *336*, 3; R Guimera, B Uzzi, J Spiro, L A N Amaral, Team Assembly Mechanisms Determine Collaboration Network Structure and Team Performance, *Science* **2005**, *308*, 697.

Bright lines in this map of scientific collaborations between 2005 and 2009 show many joint publications.

The rise of research networks

New collaboration patterns are changing the global balance of science. Established superpowers need to keep up or be left behind, says **Jonathan Adams**.

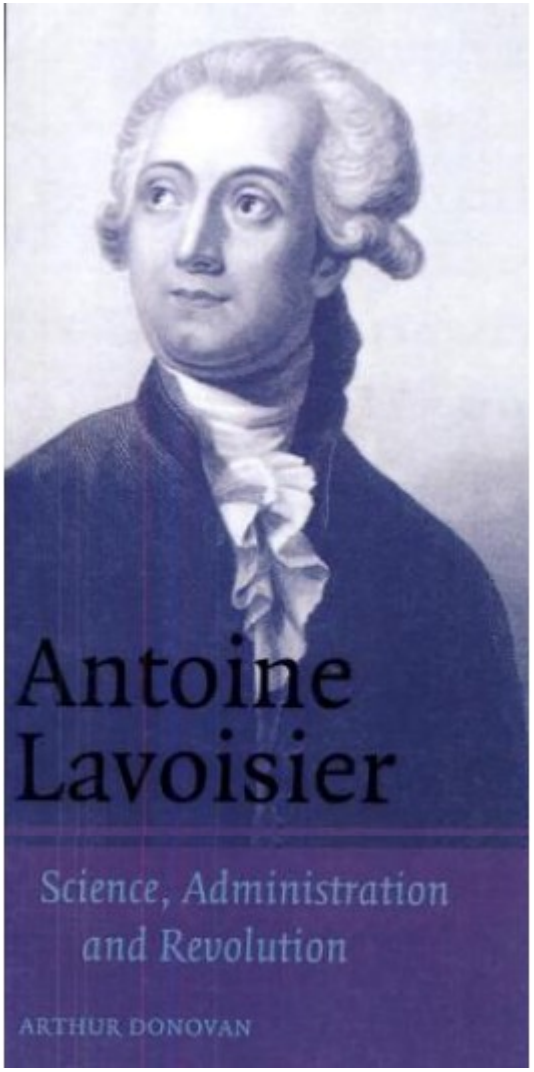


THE NEW MAP OF SCIENCE

Today more nations – from China and India to Singapore, Brazil and South Korea – are taking their place at the high table of research alongside the traditional science superpowers. At the same time national boundaries are being transcended through collaboration networks and 'brain circulation'. In this special issue *Nature* examines how the movement of people and ideas will change how science is done, how it is funded and the questions that it addresses.

Image credit: Jasiek Krzysztofiak

J Adams, Collaborations: The rise of research network, *Nature* **2012**, *490*, 335



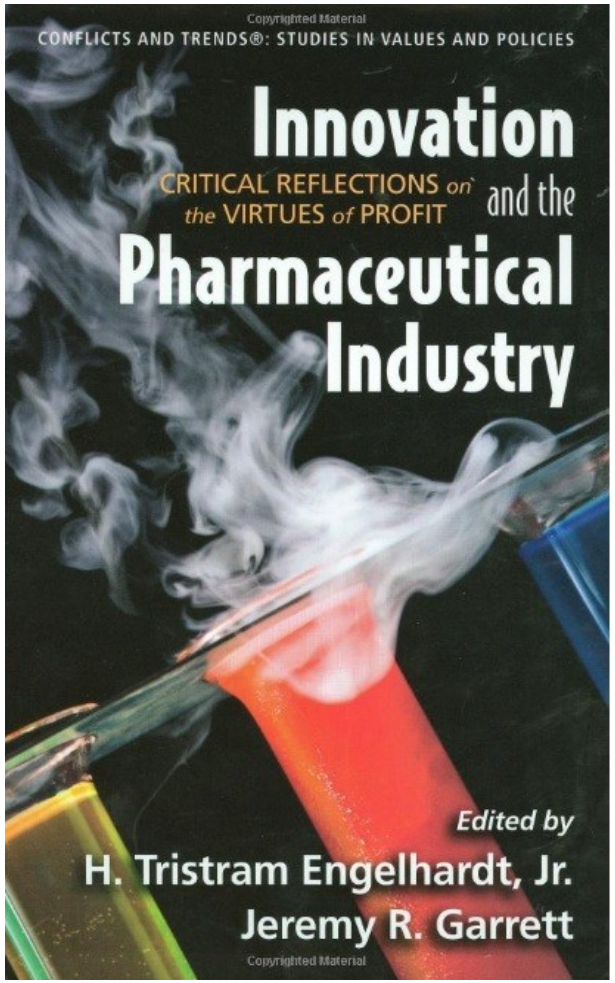
"Most of the work still to be done in science and the useful arts is precisely that which **needs knowledge and cooperation of many scientists and disciplines**.

That is why **it is necessary for scientists and technologists in different disciplines to meet and work together, even those in branches of knowledge which seem to have least relation and connection with one another**."

Interdisciplinarity

Antoine Lavoisier, 1793


The pharmaceutical innovation process...

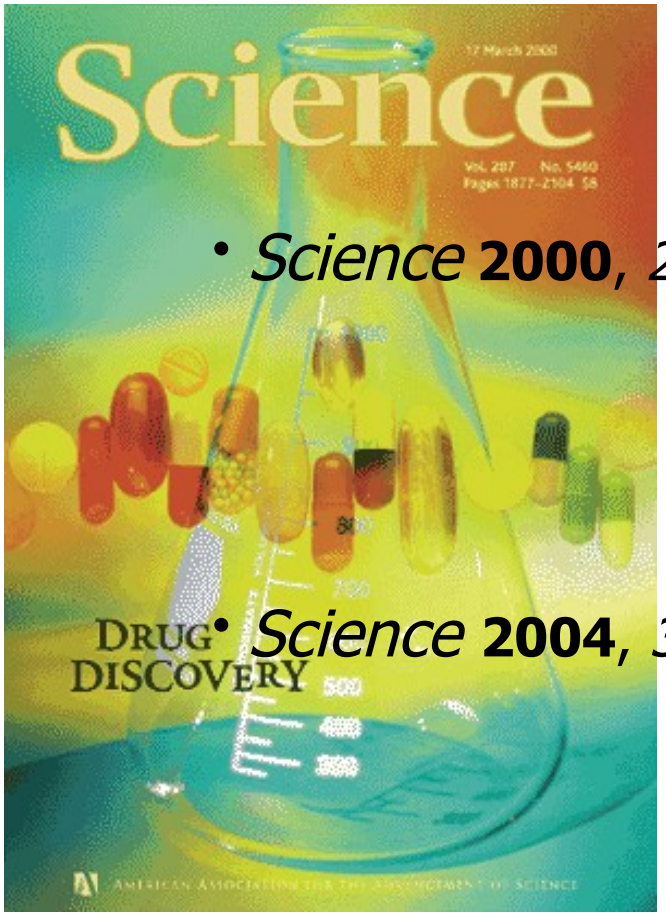


Technological innovation is a process mostly dynamic in industrial activity.

This dynamism is accentuated in pharmaceutical innovation which, more than any other, depend on the effective and productive interaction between

Science & Technology.

The drug discovery...



- *Science* **2000**, *287*, 1951 (J. Uppenbrink,J.Mervis)

- *Science* **2004**, *303*, 1713 (D. Kennedy)

...is science-based process!

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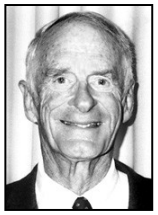
The Nobel & drugs

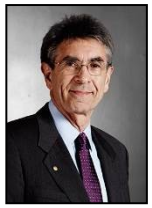
- ***165*** **researchers won the Nobel Prize in Chemistry from 1901 to 2013**


1990 - E. J. Corey

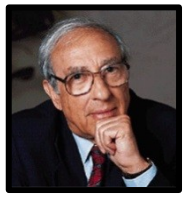

2001-R. Noyori

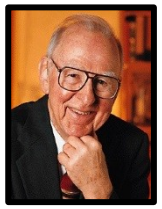

2001-W.S.Knowles

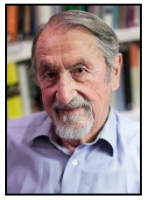

2001-K.B.Sharpless


2012-R.J. Lefkowitz


2012-B.K. Kobilka


1992 –E.H. Fischer


1992 - E.G. Krebs


2013- M. Karplus


2013- M. Levitt


2013- A. Warshel


http://nobelprize.org

"for their discoveries of important principles for drug treatment"

- ***204*** **researchers won the Nobel Prize in Medicine from 1901 to 2013**


1982 – S.B.Bergstöm

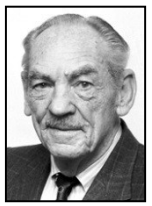

1982 – B.I.Samuelsson


1982 – J.R. Vane

R Ganellin, W Duncan, Obituary James Black (1924-2010*), Nature* **2010**, *464*, 1292; CP Page, J Schaffhausen, NP Shankley, The scientific legacy of Sir James W. Black, *TiPS* **2011**, *32*, 181.


1988 - J.W. Black


1988 - G.B. Elion


1988 - G.H. Hitchings

inter-alia:
2013–M. Karplus
M. Levitt
A.Warshel
2012- R.J. Lefkowitz
B. K. Kobilka
2009-V Ramakrishnan
T. A. Steitz
A. E. Yonath
2002-J.B.Fenn
K.Tanaka
K.Hüthrich
1997-P.D.Boyler
J.E.Walker
J.C.Skou
1987 –D.J. Cram
J-M Lehn
C.J. Pedersen
1979 - H. C. Brown
G. Wittig

***inter-alia*:**
AAS
Propranolol
Cimetidine
Acyclovir

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The role of the university in D2

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ACS Medicinal Chemistry Letters

medicinal chemistry

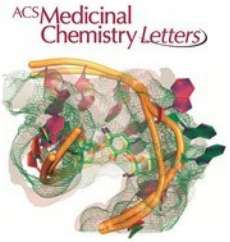
Viewpoint

pubs.acs.org/acsmedchemlett

Drug Discovery in an Academic Setting: Playing to the Strengths

Donna M. Huryn*

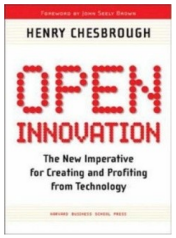
Department of Pharmaceutical Sciences, University of Pittsburgh, 712 Salk Hall, 3501 Terrace Street, Pittsburgh, Pennsylvania 1526
United States



Inter-alia: CJ Tralau-Stewart et al., UK academic drug discovery, *Nature Rev. Drug Discov*. **2014**, *13*,15; M Alvim-Gaston et al. Open Innovation Drug Discovery (OIDD): A Potential Path to Novel Therapeutic Chemical Space, *Curr Top Med Chem* **2014**, *14*, 294; SP Forster et al. Virtual pharmaceutical companies: collaborating flexibly in pharmaceutical development, *Drug Discov. Today* **2014**, *19*, 348; BS Slusher et al., Bringing together the academic drug discovery community, *Nature Rev. Drug Discov.* **2013**, *12*, 811; H Wild, C Huwe, M Lessl, Collaborative Innovation — Regaining the Edge in Drug Discovery, *Angew. Chem. Int. Ed*. **2013**, *52*, 2684; W L Jorgensen, Challenges for Academic Drug Discovery, *Angew. Chem. Int.Ed.* **2012**, *51*,11680; S Frye et al., US Academic Drug Discovery, *Nature Rev. Drug Discov.* **2011**, *10*, 409; C J Tralau-Stewart et al., Drug Discovery: New models for Industry-Academic partnerships, *Drug Discov. Today* **2009**, *14*, 95; PG Wyatt, The emerging academic drug discovery sector, *Future Med. Chem*. **2009**, *1*, 1013.

" .... a university has a number of unique characteristics that could contribute to making it an ideal enviroment where drug discovery & medicinal chemistry activities can thrive....*There is no doubt that academia can play an important role in drug discovery*"

ACS Med. Chem. Lett. **2013**, *4*, 313

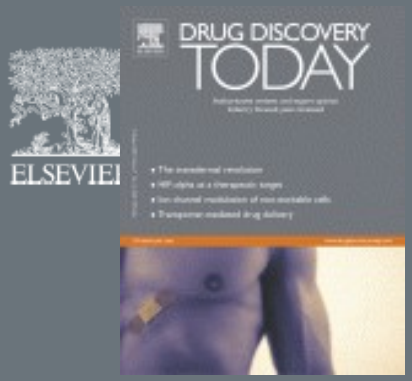


Henry Chesbrough

Drug Discovery Today • Volume 14, Numbers 1/2 • January 2009

07 October 2009 vol 1, issue 1, 95-101

REVIEWS



Drug discovery: new models for industry–academic partnerships

Cathy J. Tralau-Stewart, Colin A. Wyatt, Dominique E. Kleyn and Alex Ayad

Drug Discovery Centre and Business Development, Imperial College London SW7 2AZ, UK

The re-focusing of pharmaceutical industry research away from early discovery activities is stimulating the development of novel models of drug discovery, notably involving academia as a 'front end'. In this article the authors explore the drivers of change, the role of new entrants (universities with specialised core facilities) and novel partnership models. If they are to be sustainable and deliver, these new models must be flexible and properly funded by industry or public funding, rewarding all partners for

A A Toole, The impact of public basic research on industrial innovation: Evidence from the pharmaceutical industry, *Res. Policy* **2012**, *41*, 1; AJ Stevens *et al.,* The role of public-sector research in the discovery of drugs and vaccines. *N. Engl. J. Med.* **2011**, *364*, 535; R Kneller, The importance of new companies for drug discovery: origins of a decade of new drugs. *Nature Rev. Drug Discov.* **2010**, *9*, 867; MR Barnes *et al*., Lowering industry firewalls: pre-competitive informatics iniciatives in drug discovery, *Nature Rev. Drug Discov.* **2009**, *8*, 701; PG Wyatt, The emerging academic drug-discovery sector. *Future Med. Chem.* **2009**, *1*, 1013.

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CNPq
Conselho Nacional de Desenvolvimento Científico e Tecnológico

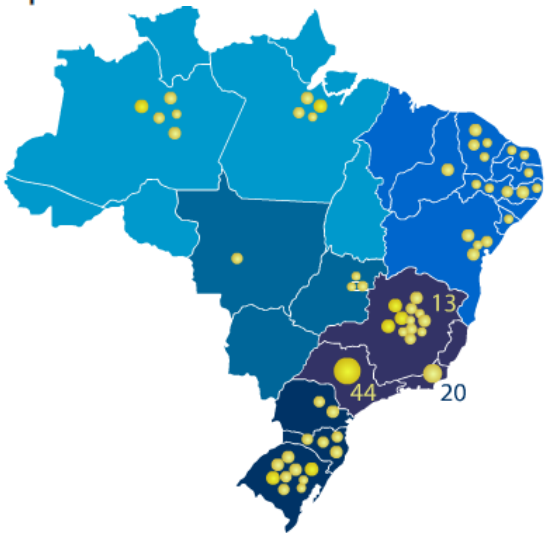
Ministério da Ciência e Tecnologia

PROGRAMA INSTITUTOS NACIONAIS DE C&T

DOCUMENTO DE ORIENTAÇÃO APROVADO PELO COMITÊ DE COORDENAÇÃO

EM 29 DE JULHO DE 2008

Dentre os objetivos maiores do PACTI relativos ao Sistema Nacional de C,T&I (SNCTI) está a busca da excelência nas atividades em ciência e tecnologia em nível internacional, uma vigorosa integração do sistema de C&T com o sistema empresarial, a melhoria da educação científica, e a participação mais equilibrada das diferentes regiões do país no esforço produtivo com base no conhecimento.



ENERGIA, EXATAS
AGRÁRIAS, MEIO-AMBIENTE
TECNOLOGIA DA INFORMAÇÃO
SAÚDE (>20)

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The mission...

- To organize the scientific capacity in an effective & productive drug discovery network ;
- Contribute to Brazil capacity on radical & incremental innovation in drugs ;

INCT-INOFAR...

Contribute to continuous qualification of students in drug discovery process (*e.g.* medicinal chemistry + pharmacology);

Instituto Nacional de Ciência e Tecnologia de Fármacos e Medicamentos

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www.inct-inofar.ccs.ufrj.br

Projeto CNPq nº 573.564/2008-6 « » FAPERJ nº E-26/170.020/2008

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medicinal chemistry

Sede

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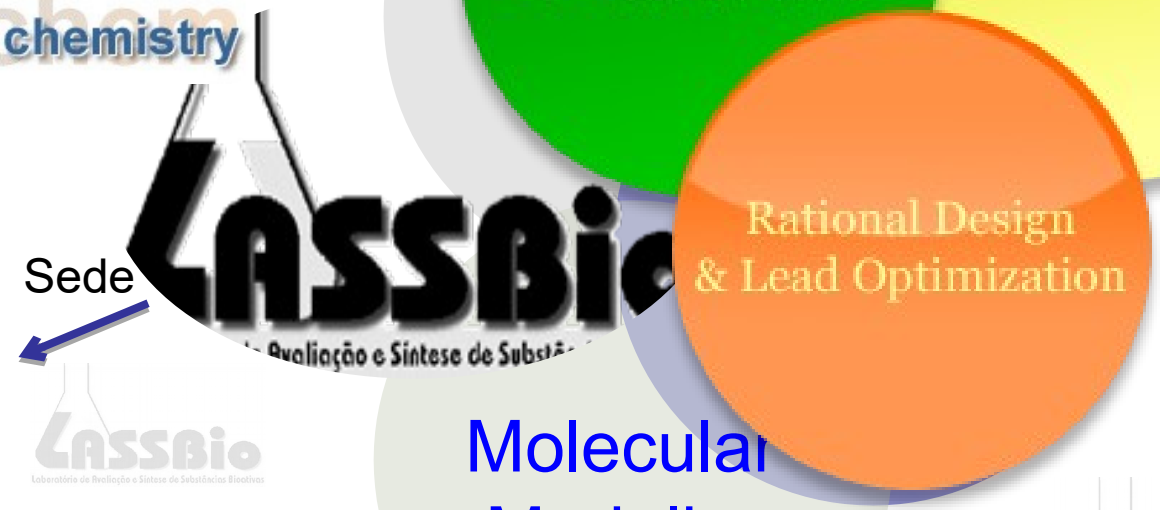

therapeutic innovation

The process of drug discovery & development

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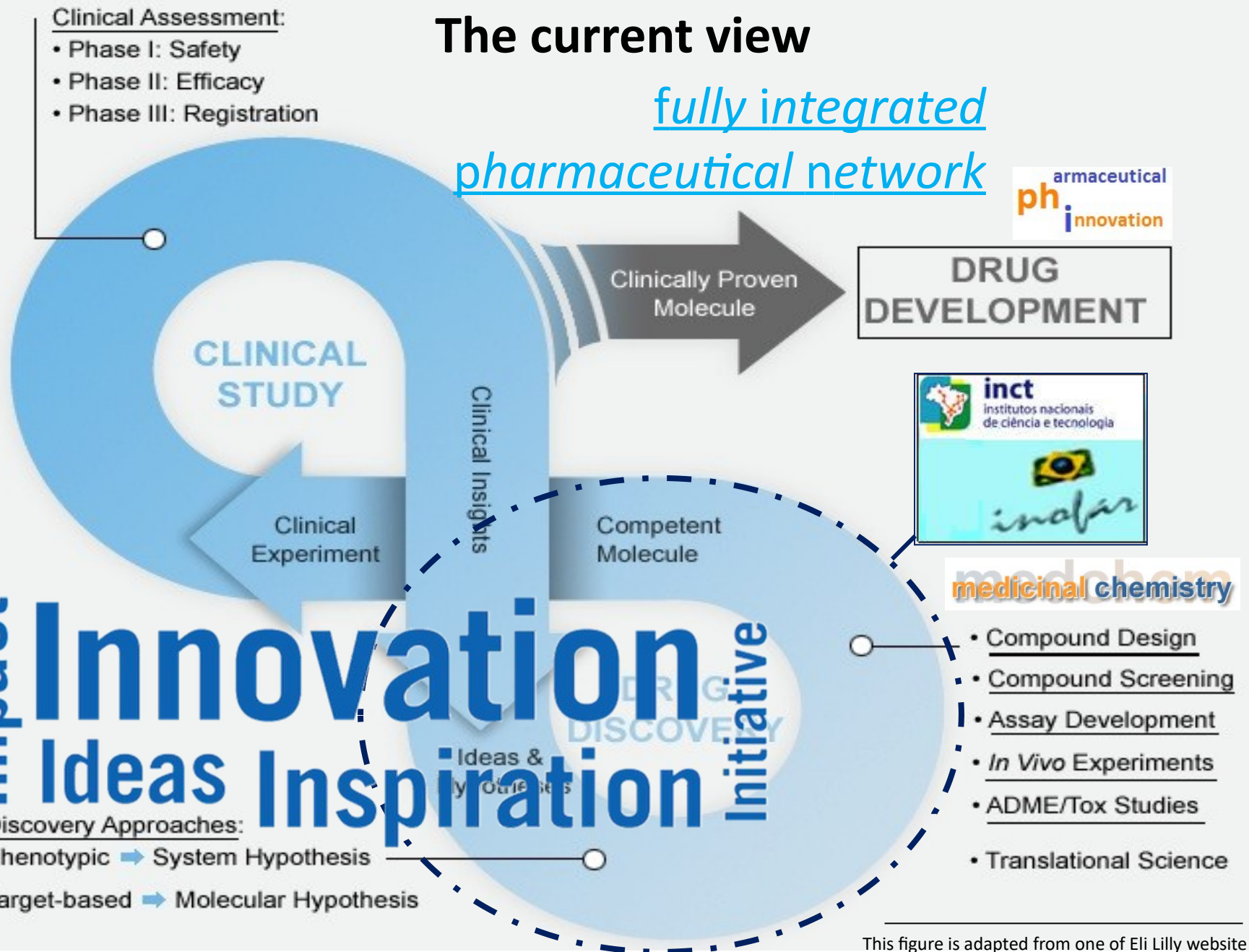
The process of drug discovery & development

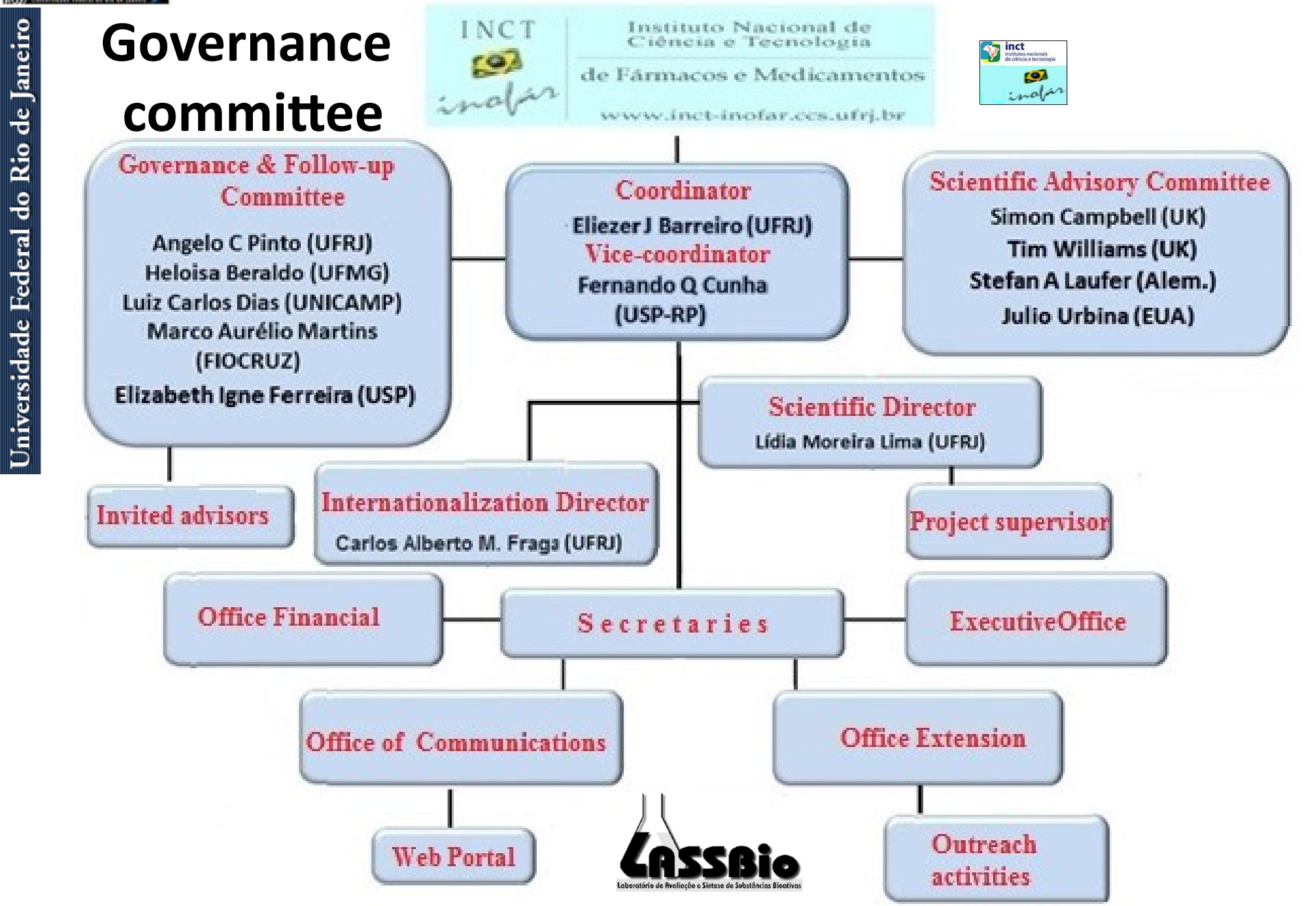
The current view

fully integrated pharmaceutical network



This figure is adapted from one of Eli Lilly website

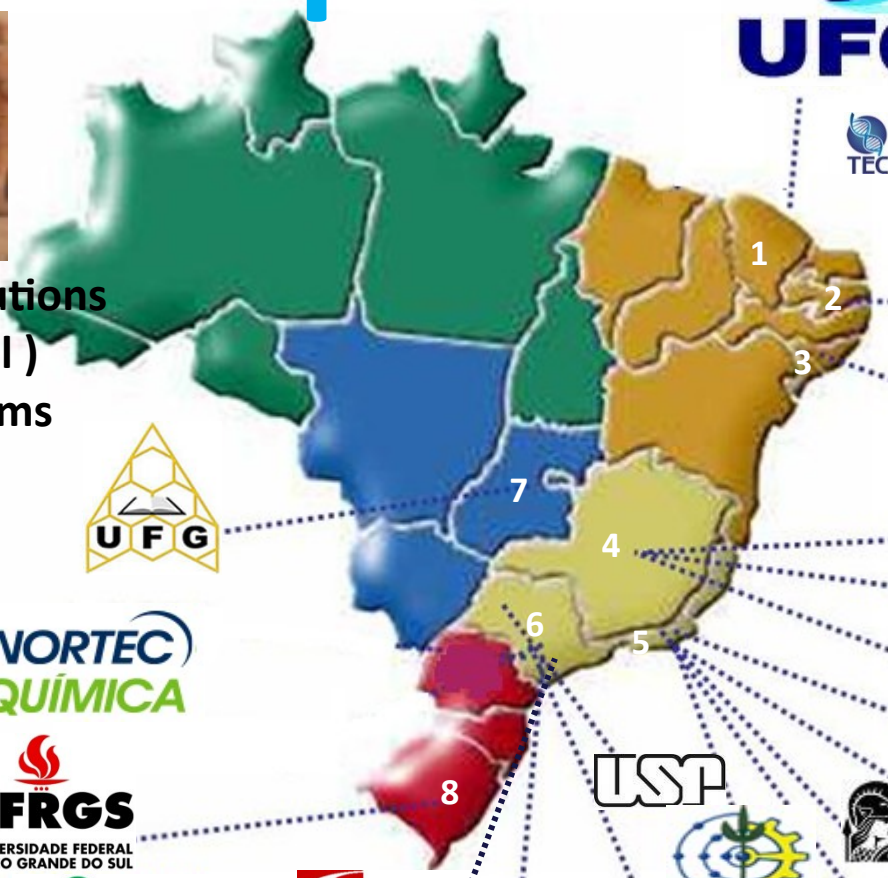
Governance committee



INCT-INOFAR

Partnerships

16 scientific institutions
(4 international)
30 research teams
6 companies



UFC
bio TECHCELL
UFPB
UFAL
UNIFAL-MG
In Vitro Cells
UFMG
FIOCRUZ
UFRJ
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UFRRJ
LNCC
unesp
LNCC
UNICAMP
Ciallyx
UFRGS
UNIVERSIDADE FEDERAL DO RIO GRANDE DO SUL
unipampa
Universidade Federal do Pampa
UNIVERSITÄT TÜBINGEN
SANOFI
CRISTÁLIA
NORTEC QUÍMICA
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icephA

becas

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INTERNATIONAL ACTIVITIES

http://www.icepha.de/

INCT-INOFAR established, on November 18, 2011, a cooperation agreement with the Interdisciplinary Center of Pharmacogenomics and Pharmaceutical Research (ICEPHA) of the University of Tübingen, Germany. Through this deal, we broaden the international scope of INCT-INOFAR and the bases for scientific exchange and the development of innovative research projects in new pharmaceuticals. On the other hand, the agreement establishes the organization of scientific and academic activities, like courses, conferences, seminars, symposiums, or lectures, and the exchange of researchers and/or students, as well as the exchange of materials and publications of mutual interest.

Professor Stefan Laufer (ICEPHA, University of Tübinben) & Professor Eliezer J. Barreiro (INCT-INOFAR, UFRJ, BR)

At the end of 2011, INCT-INOFAR through the Dean of the Federal University of Rio de Janeiro (UFRJ) signed a cooperation agreement with the Interdisciplinary Center for Pharmacogenomics and Pharmaceutical Research (ICEPHA) of the University of Tübingen, Germany, directed by Professor Stefan Laufer.

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Annual Activities Report

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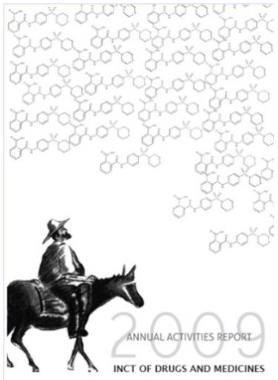
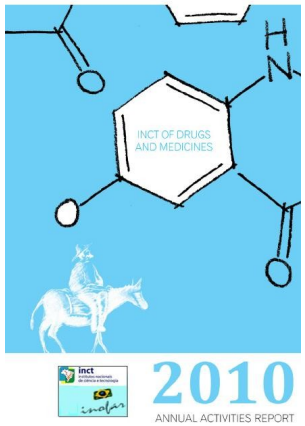
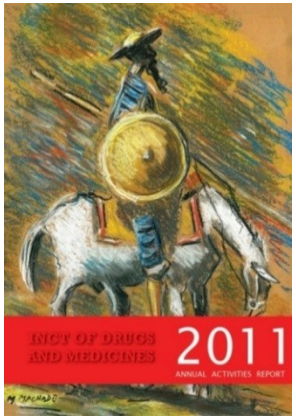
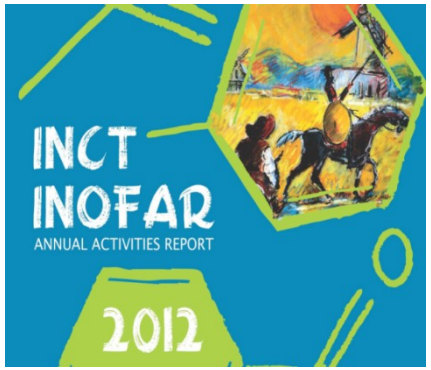






Coordinator:
Eliezer J. Barreiro



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www.inct-inofar.ccs.ufrj.br/download/aar/2014.pdf

Incremental *Innovation*

Generic drugs*

The market of generic drugs in Brazil: *ca*. US$ 7.0 bi (2013)

Active pharmaceutical ingredients
(API's)

The INCT-INOFAR seeks to reverse the usual process in which API come from abroad, developing in ours laboratories a scalable synthetic route to generic & future generic drugs.

Incremental Innovation

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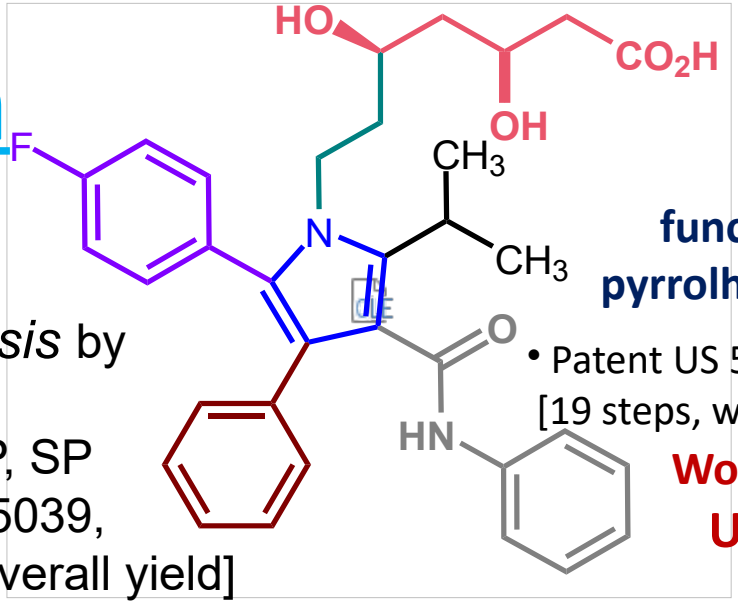
- **Atorvastatin**

1991 Lipitor™



functionalized pyrrolheptenoic acid

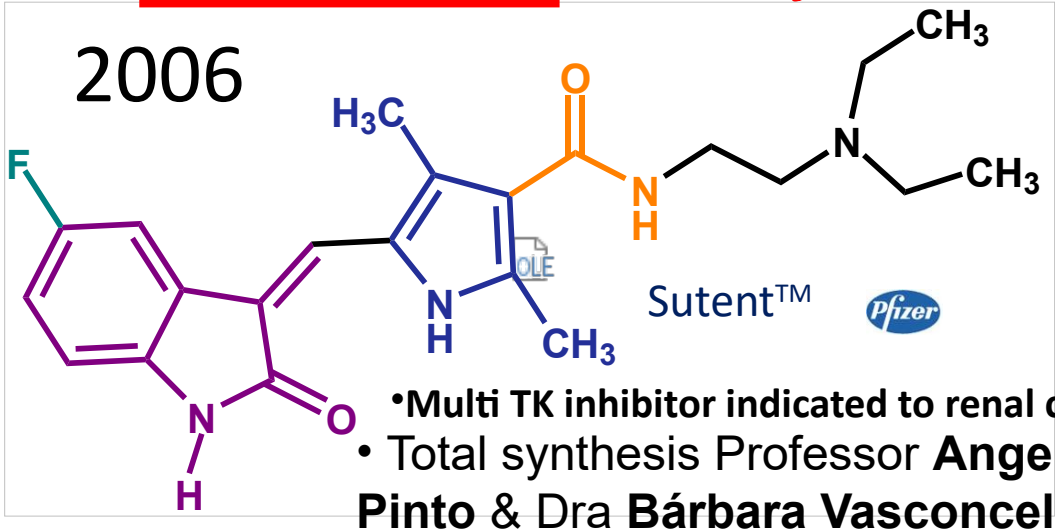
• *New stereoselective synthesis* by Professor **Luiz Carlos Dias** & Dr **Adriano S. Vieira**, UNICAMP, SP (2010) – INPI Patent, 018110015039, 2011 (BR) [18 steps, with 19% overall yield]

• Patent US 5273995 Pfizer (1991) [19 steps, with *ca.* 5% overall yield]

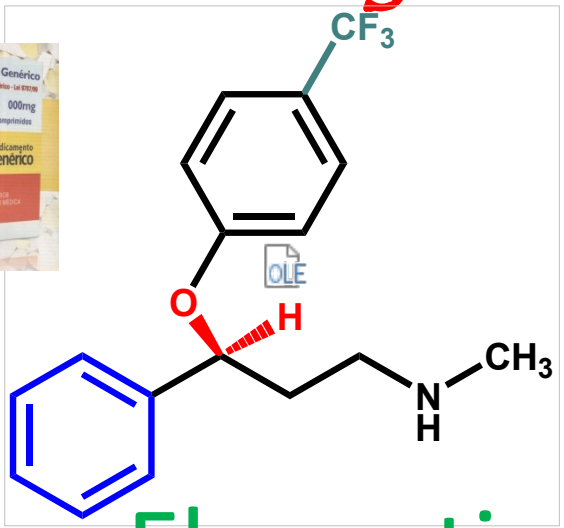
World total sales:
US$ > 150 bi
(1991-2011)

- **Sunitinib** *super blockbuster-drug*

2006



Sutent™



•Multi TK inhibitor indicated to renal carcinoma

• Total synthesis Professor **Angelo da Cunha Pinto** & Dra **Bárbara Vasconcellos da Silva** IQ - UFRJ, **2011** (BR)

Fluoxetin

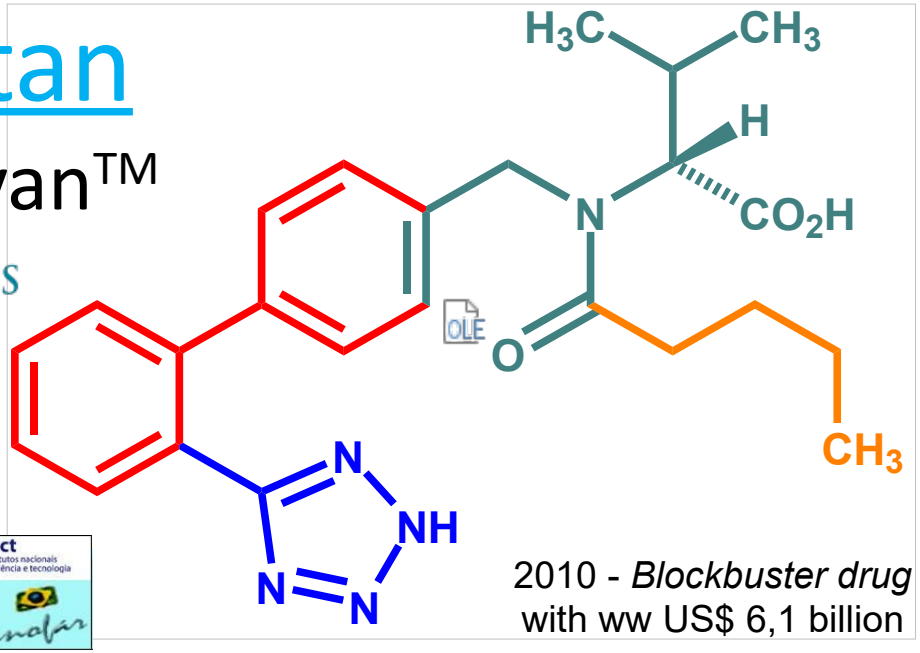
• Valsartan

1990 Diovan™

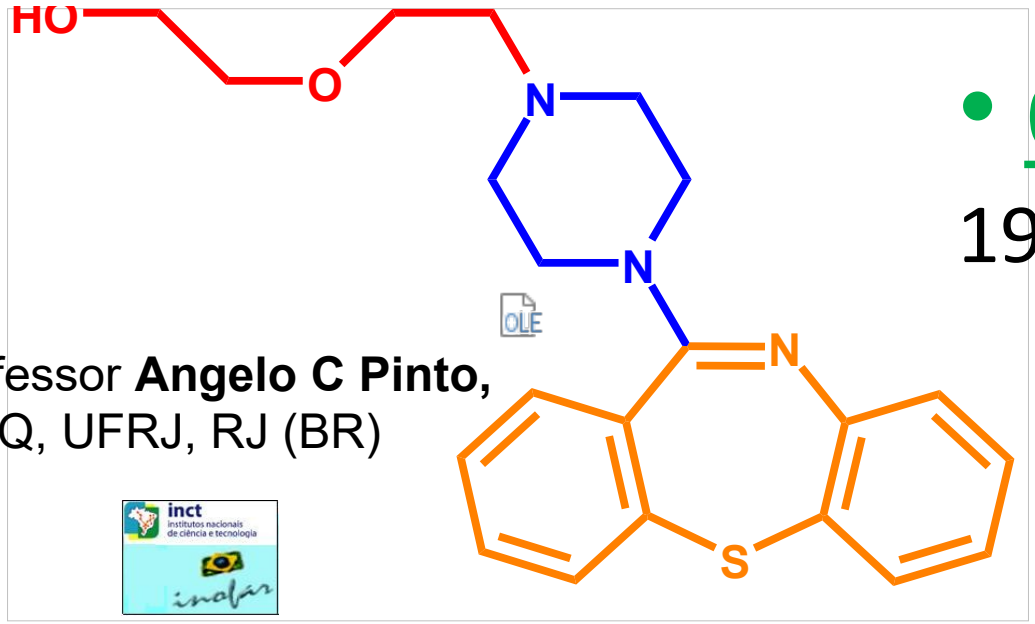
NOVARTIS

Angiotensin II receptor antagonist or AT_1 receptor blocker (ARB)

• Professor **Luiz Carlos Dias,** IQ, UNICAMP, SP (BR)



2010 - *Blockbuster drug* with ww US$ 6,1 billion



• Quetiapine

1996 Seroquel™

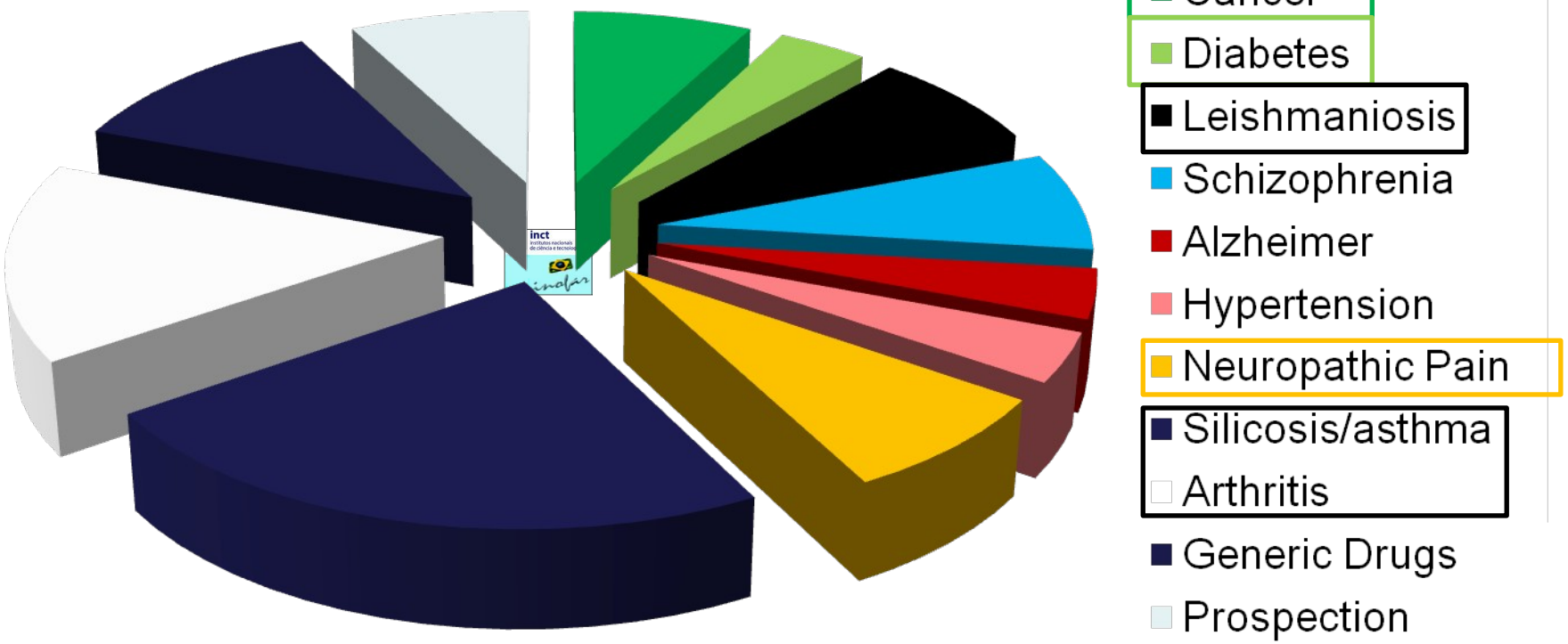
AstraZeneca

• Professor **Angelo C Pinto,** IQ, UFRJ, RJ (BR)

5-HT_2 & D2 receptors blocker (multitarget drug)

2011 - Blockbuster drug
US Sales = US$ 4,6 billion

Radical Innovation



* At right **colors** squares the principal's research projects

Radical *Innovation*

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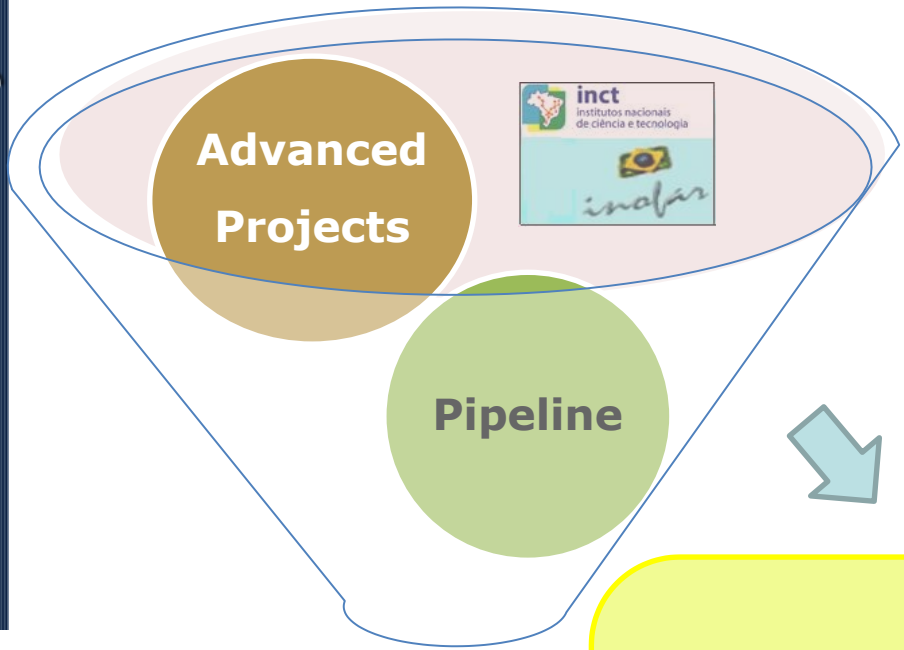

Antileishmanial activity of new *N*-acylhydrazone derivatives and analogues ICB-UFAL / LASSBio-UFRJ

Studies on design & discovery of new antidiabetes drug candidates.
LASSBio-UFRJ
BR102013012646-2

Studies of new oncolytic agent, dual inhibitor of kinases
LASSBio-UFRJ
WO2014113859
WO2013142935

Studies of anti-inflammatory & analgesic effect of LASSBio-591, a new candidate of AIA drug.
LASSBio-UFRJ/FM-USP,RP

medicinal chemistry

Studies on new drug candidate useful for neuropatic pain
LASSBio-UFRJ / FM-USP,RP
WO2012054996

Universidade Federal do Rio de Janeiro

Novel 2-chloro-4-anilino-quinazoline derivatives as EGFR and VEGFR-2 dual inhibitors

Maria Letícia de Castro Barbosa [a,b], Lídia Moreira Lima [a,b], Roberta Tesch [a], Carlos Mauricio R. Sant'Anna [c], Frank Totzke [d], Michael H.G. Kubbutat [d], Christoph Schächtele [d], Stefan A. Laufer [e], Eliezer J. Barreiro [a,b,*]

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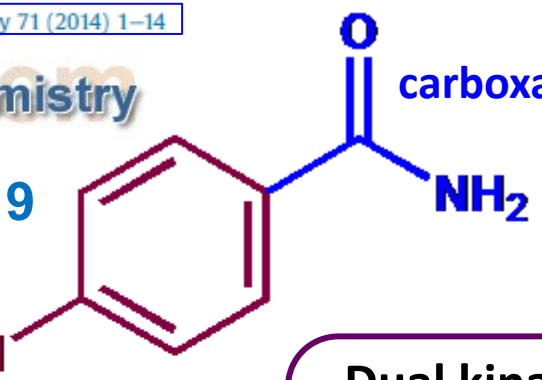
[b] Graduate Program of Chemistry (PGQu), Chemistry Institute, Federal University of Rio de Janeiro, Rio de Janeiro, RJ, Brazil
[c] Department of Chemistry, Federal Rural University of Rio de Janeiro (UFRRJ), Seropédica, RJ, Brazil
[d] ProQinase GmbH, Freiburg, Germany
[e] Department of Pharmaceutical/Medicinal Chemistry, Institute of Pharmacy, Eberhard-Karls-University Tübingen, Tübingen, Germany

European Journal of Medicinal Chemistry 71 (2014) 1–14

medicinal chemistry

LASSBio-1819



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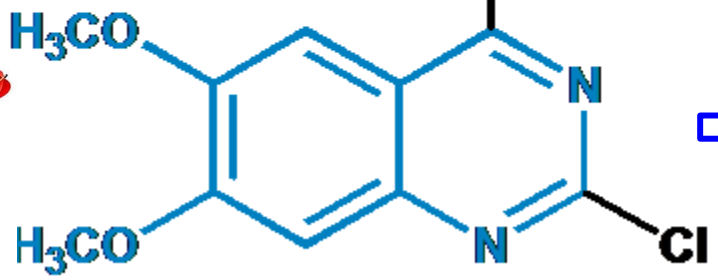
UNIVERSITÄT TÜBINGEN



Dual kinase activity

IC_{50} (EGFR) = 0,90 µM

IC_{50} (VEGFR) = 1,17 µM

Dual
Inhibitor
Dual

MLC Barbosa, Novos derivados quinazolínicos funcionalizados inibidores duais das tirosina cinases receptoras EGFR & VEGFR-2, PhD Thesis, Instituto de Química, UFRJ, 2013.

Universidade Federal do Rio de Janeiro

Patent

PEDIDO INTERNACIONAL PUBLICADO SOB O TRATADO DE COOPERAÇÃO EM MATÉRIA DE PATENTES (PCT)

(19) Organização Mundial da Propriedade Intelectual
Secretaria Internacional

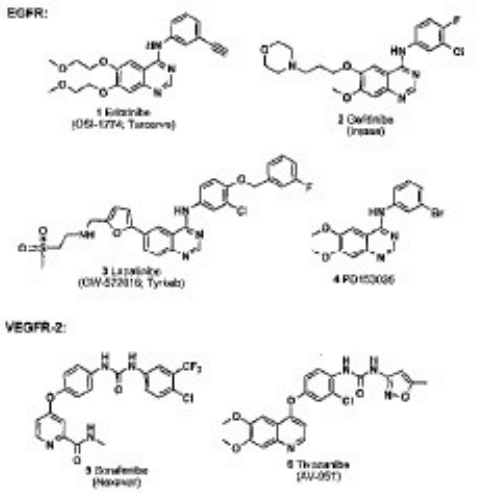
(43) Data de Publicação Internacional
31 de Julho de 2014 (31.07.2014)

WIPO | PCT

(10) Número de Publicação Internacional
WO 2014/113859 A1

(54) Title : 2-CHLORO-4-ANILINO-QUINAZOLINE COMPOUNDS INHIBITING PROTEIN TYROSINE KINASES, PHARMACEUTICAL COMPOSITIONS COMPRISING THE SAME, METHOD FOR PRODUCING THE SAME AND TYROSINE KINASE INHIBITION METHOD

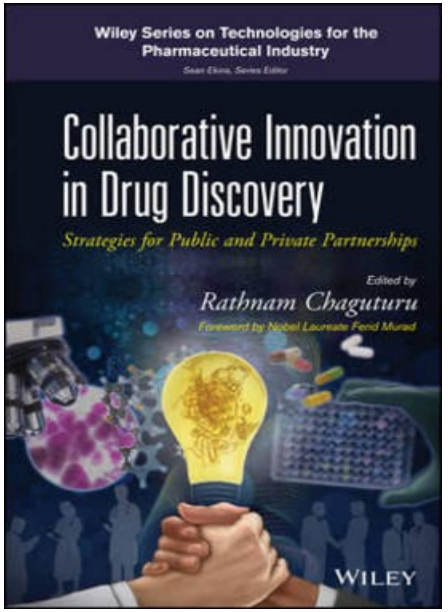
(54) Título : COMPOSTOS 2-CLORO-4-ANILINO-QUINAZOLINICOS INIBIDORES DE PROTEÍNAS TIROSINA CINASES, COMPOSIÇÕES FARMACÊUTICAS COMPREENDENDO OS MESMOS, PROCESSO PARA SUA PRODUÇÃO E MÉTODO PARA INIBIÇÃO DE TIROSINA CINASES



(57) Abstract : The present invention relates to 2-chloro-4-anilino-quinazoline derivatives with EGFR and/or VEGFR-2 protein tyrosine kinase inhibiting activity, to anti-tumour pharmaceutical compositions that comprise said compounds, and to methods for producing the same. The present invention further provides a method for treating solid tumours by inhibition of tyrosine kinases.

(72) Inventores : **BARREIRO, Eliezer Jesus;**
DE CASTRO BARBOSA, Maria Letícia;
MOREIRA LIMA, Lidia;
LAUFER, Stefan, Andreas;
RABELLO SANT'ANNA, Carlos Mauricio;
TESCH, Roberta;

Process of technology transferring



Government ($)

University

inct institutos nacionais de ciência e tecnologia

inofar

Pharma Companies

drawback

Lack of long-terms goals!

Lack of scientific policy for new drugs

Revista Virtual de Química (SBQ)

Opportunities and Challenges for Innovation in Pharmaceuticals: Now or Never!

Barreiro, E. J.;* Pinto, A. C.

Rev. Virtual Quim., **2013**, *5* (6), 1059-1074. Online publication: 6 September 2013

http://www.uff.br/rvq

Rev Virtual Quim 2013, 5, 1059

Abstracts

The article describes the discovery of new drugs and presents some of the pioneer scientists of these findings. It also shows the innovation in pharmaceuticals and the contributions of INCT-INOFAR that will help Brazil to be one of the players in drug development.

Keywords: Pharmaceutical innovation; new drugs; process of drug discovery.

DOI: 10.5935/1984-6835.20130078

Universidade Federal do Rio de Janeiro

Muchas Gracias!

ejbarreiro@ccsdecania.ufrj.br