

SCIENCE IN CUBA, 2009: A CUBAN SCIENTIST OVERVIEW

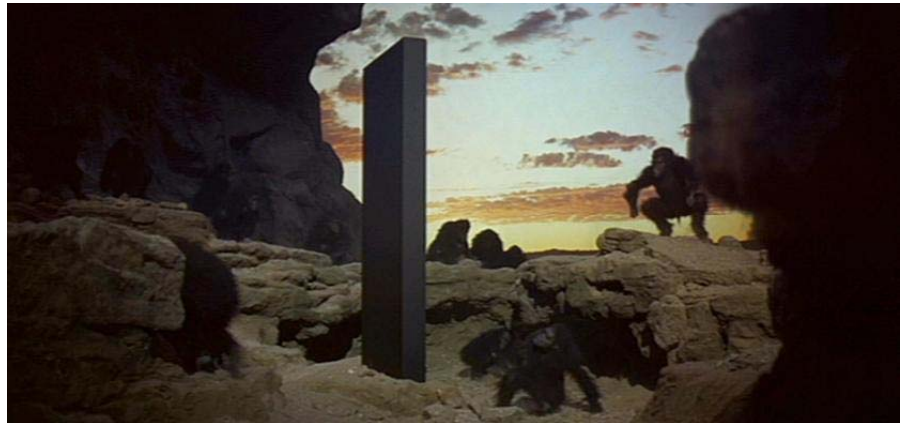


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Why thinking and science in humans?

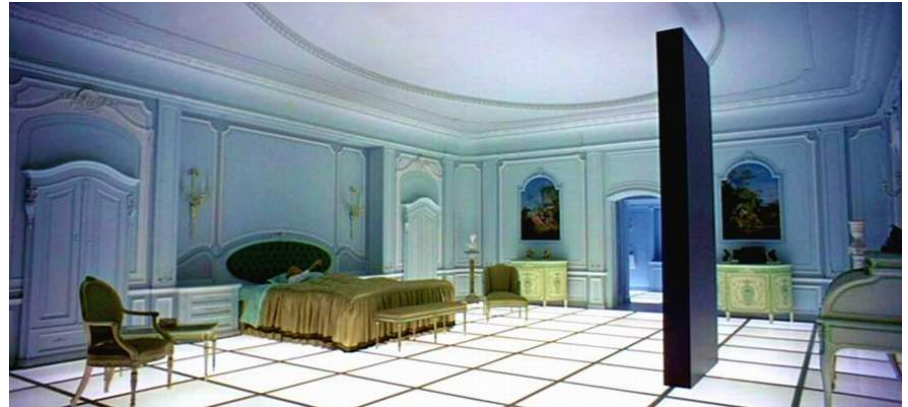
We, human beings, are increasing distance from our animal ancestors since the times when :

- began the **exchange of active information** between individuals,
- **cooperation** predominated on **competition**,
- and the **personal conscience** became **determining on survival**.

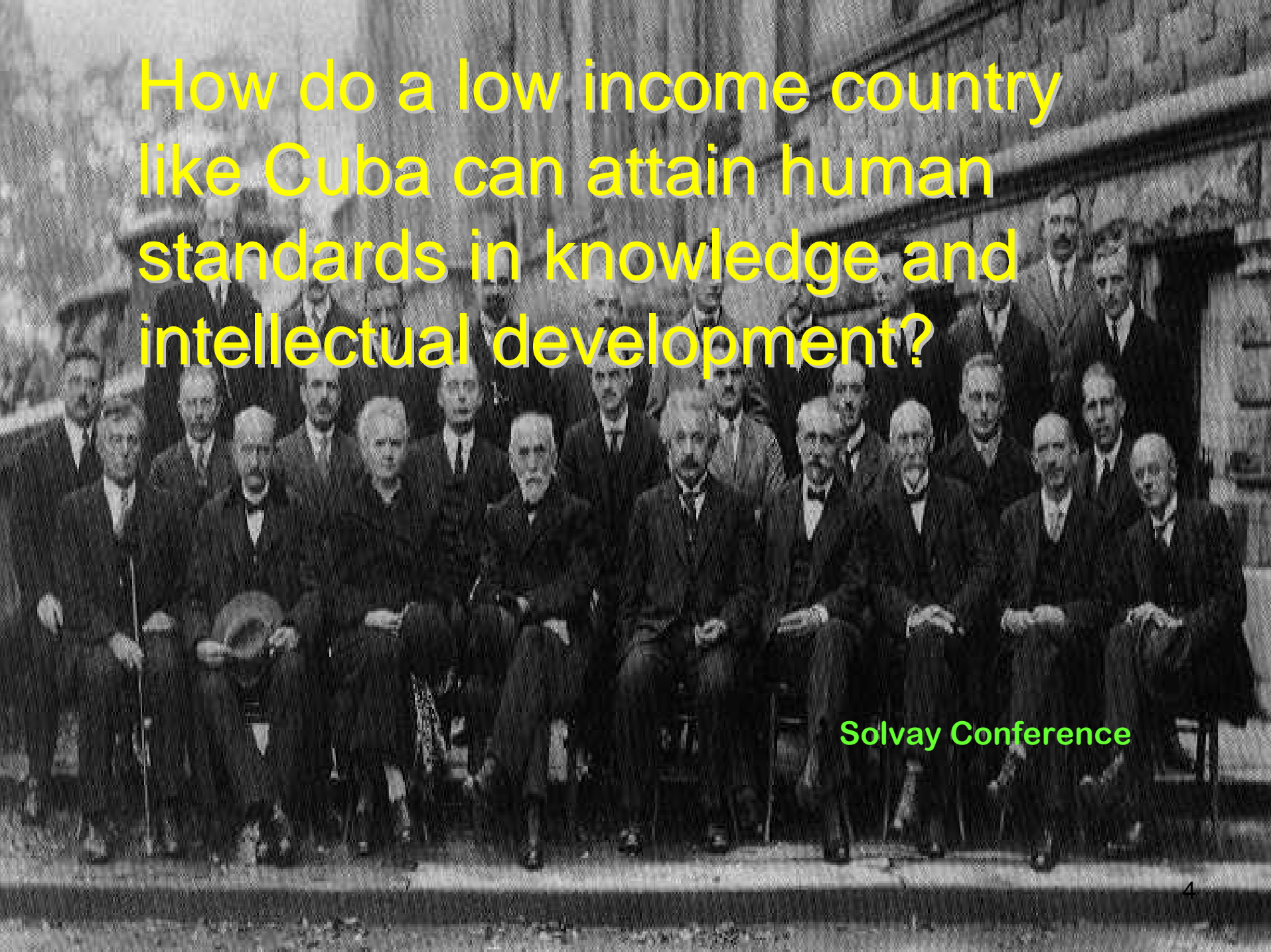


Are poor countries condemned?

- Economic differences among different human societies mean that certain communities appear to be condemned to remain behind others in progress, and these differences are frequently increasing in time, in place to be reduced.
- This must not be a fatal fate.



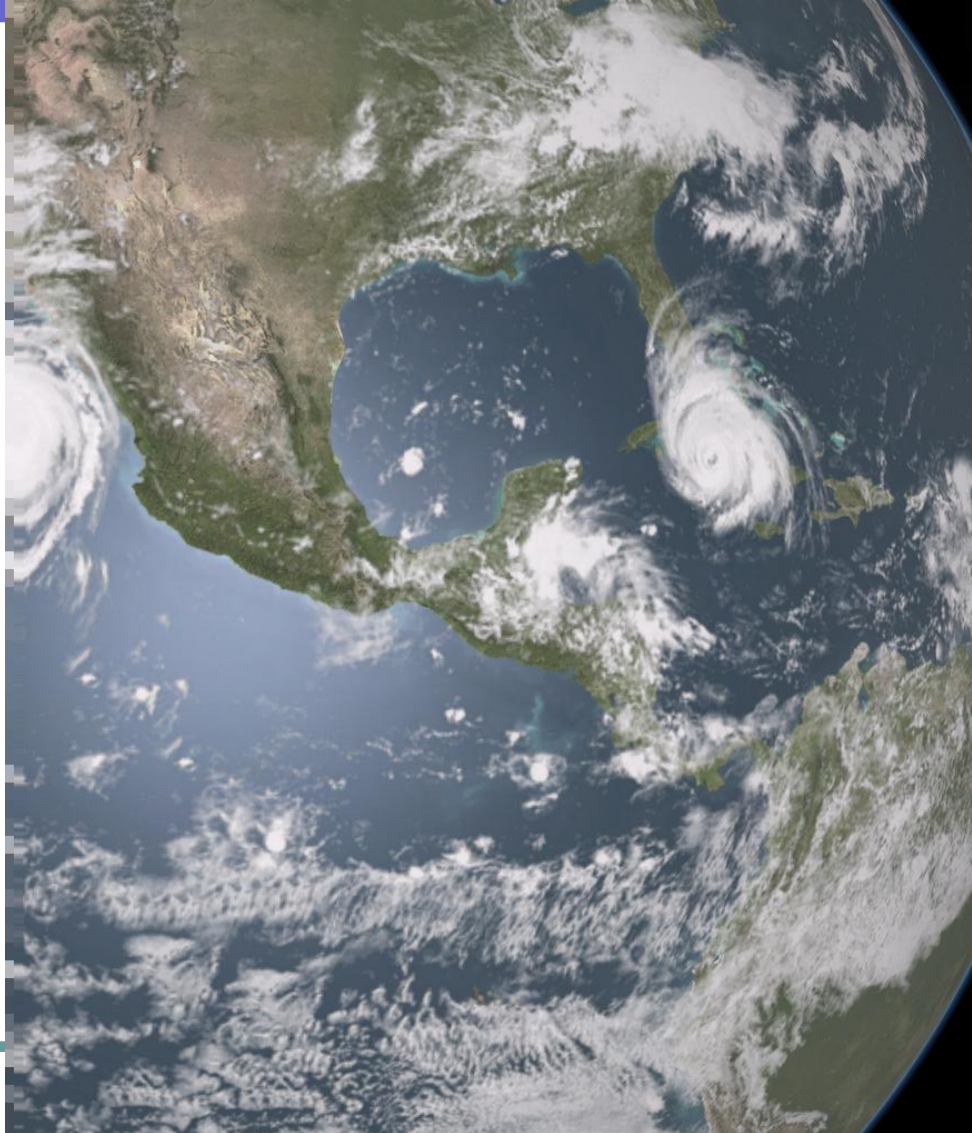
How do a low income country like Cuba can attain human standards in knowledge and intellectual development?



Solvay Conference

The geographical scenario

Cuba in America



The very early times

- The development of Havana's harbour for supporting the Spanish empire in America appears stimulating the physician *Lázaro de Flores* to write the **first science book in Cuba**, "*Arte de Navegar*" (*Art of Navigation*), published in Madrid, **1673** (there was not yet a printing office in Cuba)



Advanced education begins

- The Jesuits's
“*Colegio San José*”
(later “*Seminario de
San Carlos y San
Ambrosio*”)
appeared since
1724 in Havana and
Puerto Príncipe
(today's Camagüey)



Higher education begins

- The “*Universidad de San Gerónimo de La Habana*” (later *Universidad de La Habana*) was founded by “predicators” (St. Dominique) priests in **1728**.
- Higher education was initiated for physicians since the beginnings, together with theologians and lawyers.



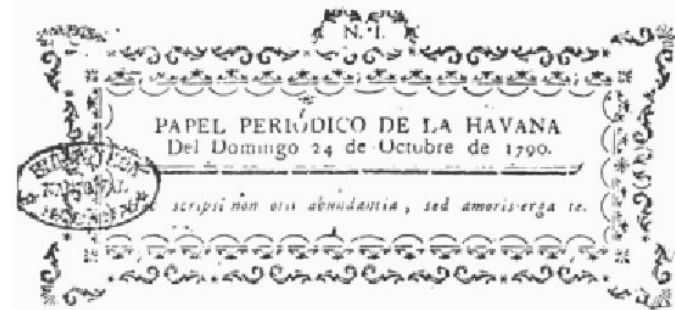
Social projection of knowledge

- Since **1793**, the “*Sociedad Económica de Amigos del País*” founded ***the first Public Library***.



Science information appears

- ***“El Papel Periódico de La Havana”*** appeared in **1790** where known physicians, philosophers and economists published works on the Cuban society and some scientific problems as agriculture and public vaccination.
- ***The first science book*** appeared written and printed in **1787** in Havana: ***“Descripción de Diferentes Piezas de Historia Natural”***, by the Portuguese amateur naturalist Antonio Parra.



EN las ciudades populosas son de muy grande utilidad los papeles públicos en que se anuncia á los vecinos quanto ha de hacerse en la semana referente á sus intereses ó á sus diversiones. La Havana cuya poblacion es ya tan considerable echa menos uno de estos papeles que dé al Público noticia del precio de los efectos comerciables y de los bastimentos, de las cosas que algunas personas quieren vender ó comprar, de los espectáculos, de las obras nuevas de toda clase, de las emboscaciones que han entrado, ó han de salir, en una palabra de todo aquello que puede contribuir á las comodidades de la vida.

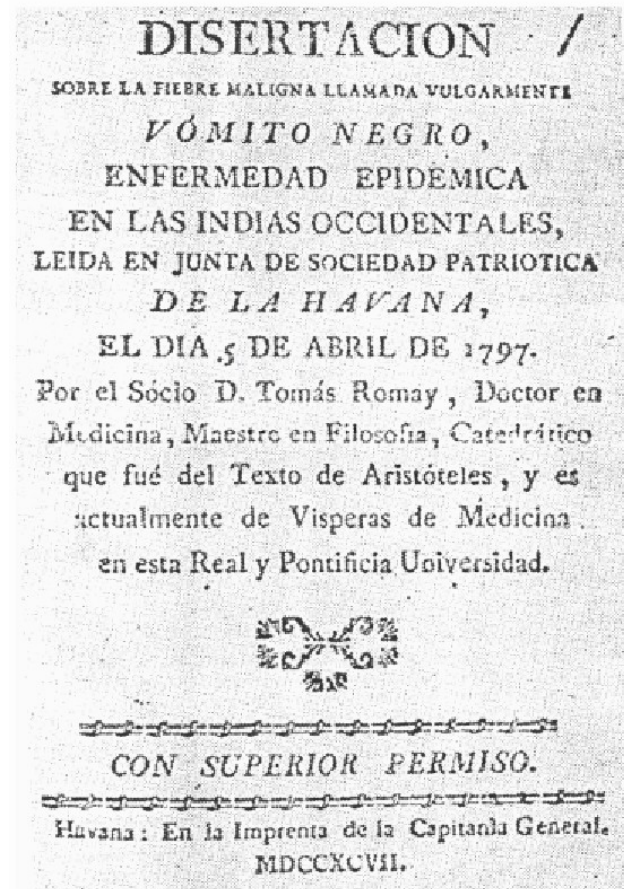
El deseo de que nuestros compatriotas disfruten quantas puedan proporcionarse nos mueve á tomarnos el trabajo de escribir todas las semanas medio pliego de papel en que se recogen las explicadas noticias. A imitacion de otros que se publican en la Europa comenzarán tambien nuestros papeles con algunos extractos de literatura, que procuraremos escoger con el mayor esmero. Así declaramos desde ahora que á excepcion de las equivocaciones y errores, que tal vez se encontrarán en nuestra obrilla, todo lo demás es nuestro, todo copiado.

Los aficionados que quisiere adornarla con sus producciones se servirán ponerlas en la Libreria de D. Franco Seguí que ofrece insertarlas, quando para ello hubiere lugar y no se tuieren inconvenientes, conservando oculto ó publicando el nombre del autor segun este lo previniere.

do el que desee vender ó comprar alguna casa, estancia, es-

The “eclosion” of science

- **1797** was *the “eclosion” of science in Cuba*, because several books and papers appeared on the most important topics of the “plantation” economy and on health matters of interest for the inhabitants of the island.



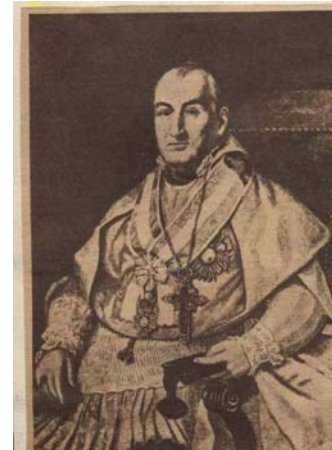
Second “discovery” of Cuba

- The Spanish king also allowed expeditions from Europe for comprehensive studies of the country, including two visits of the very relevant German scientist **Alexander von Humboldt**, perhaps the last great “generalist” scientist. He left an important treatise about the country that appeared in Paris in the middle of 19th century.



Birth of basic sciences

- Early 19th century consolidated respect for knowledge among cultured people and was characterized by the influence of liberal priests like both the Spanish bishop **Juan José Díaz de Espada** and the Cuban **Felix Varela**, who established **the first teaching labs of physics and chemistry** in the “*Seminario de San Carlos*” by about **1813-15** (NOT in the then scholastic University of Havana).



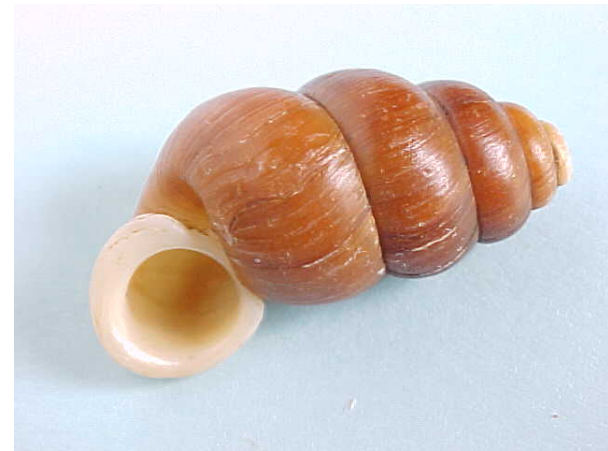
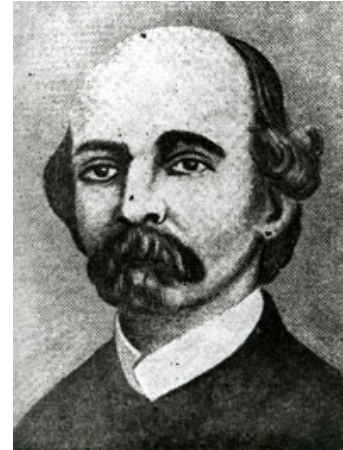
Research institutions

- The **first botanical garden** was established in Havana in **1817**. In **1848** was created the “*Instituto de Investigaciones Químicas de La Habana*” for supporting the sugar cane industry
- They were among the earliest research centres in the Americas.



Cuban science in the world

- Important persons of Cuban sciences apparently published works in early European (mostly French) journals of the 19th century, although only the names of **Alvaro Reynoso** (very related to sugar cane culture and industry), **Felipe and Andrés Poey**, and perhaps some others, can be identified.



Technology in 19th century

- Cuban engineering was represented by the **first railway (1837)**, earlier than in Spain, and a monumental **water distribution system (1856-1893)** for Havana, still active, all based on underground sources and without pumping.



The Academy of Sciences

- The first **Academy of Sciences** in the Western hemisphere was founded in Havana in **1861**
- The first **Cuban scientific journal** appeared in **1864** under the auspices of the Academy.



Wars for independence

- The last third of 19th century was characterised by social convulsion across the country because the political situation of the Spanish colony and the war for independence, that ended in 1898.
- Science survived maintained by individuals, although important work and new initiatives were severely hindered at that time.



Science in the early “free” Cuba

- The United State's protectorate in Cuba during the first half of the 20th century meant a very strong and dominant dependency of Cuban scientific development with respect to the new neighbouring political and economic power.



An example of “science promotion”

A significant example was the relevant parasitological discovery of the transmission of fatal diseases by mosquitoes made by the Cuban **Carlos J. Finlay**, in **1871** that was firstly denied and further appropriated by US military scientists:

- Finlay, Carlos J. (Encyclopædia Britannica) Cuban epidemiologist who discovered that yellow fever is transmitted from infected to healthy humans by a mosquito. Although he published experimental evidence of this discovery in 1886, his ideas were ignored for 20 years.
- Nobel Prize winners Ronald Ross and Alphonse Laveran, nominated Finlay for this award in 1905, but it was given to Koch and Pasteur.



The USA approach to this fact

- **Congressional Gold Medal Recipient**
Walter Reed was awarded because “his”
discovery of mosquito as the agent for
transmission of yellow fever during his mission
in Cuba

- **Yellow Fever Experimentations Congressional**
Gold Medal Awardees

Walter Reed, James Carroll, Jesse W. Lazear, Aristides Agramonte, James A. Andrus, John R. Bullard, A. W. Covington, William H. Dean, Wallace W. Forbes, Levi E. Folk, Paul Hamann, James F. Hanberry, Warren G. Jernegan, John R. Kissinger, John J. Moran, William Olsen, Charles G. Sonntag, Clyde L. West, Doctor R. P. Cooke, Thomas M. England, James Hildebrand, and Edward Weatherwalks (Medal awarded in **Monday, 2 July 1956**)

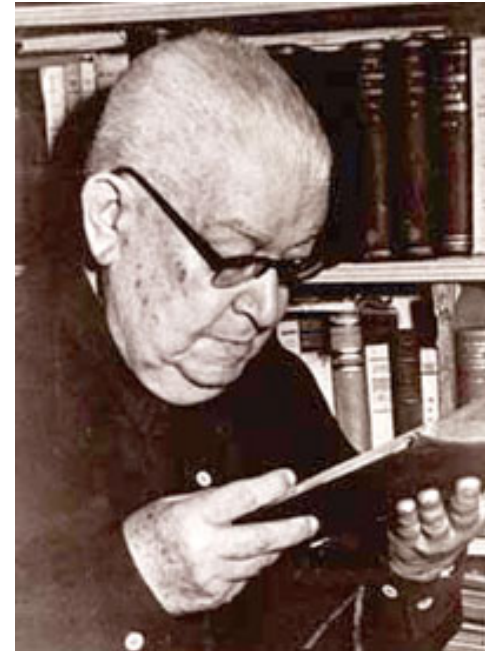


John W. 30th G. Brother, Incorporated

By Dean Cornwell, N.Y.

Irony by Fernando Ortiz in 1906

- “Our science? Ah! Uncontroversial surprise of the world, according a tacit agreement of its stepsons, remains quite always as an unbeatable “*Celestina*” of personal ambition. Thinking about philosophical problems, year after year, or isolate ourselves during years for robbing secrets to mother nature... Bah! Another stupidity! What is the reason because we would shake our characteristic somnolence? **What the foreigners are indeed useful for?**” (appeared originally in “Entre cubanos”, *El Mundo*, La Habana, May 1, 1906)



Facts of “republican” Cuba

- A very limited and pragmatic development of endogenous research, mostly oriented to naturalism, tropical agriculture, sociology and human health characterized Cuban science in 1900 - 1958.



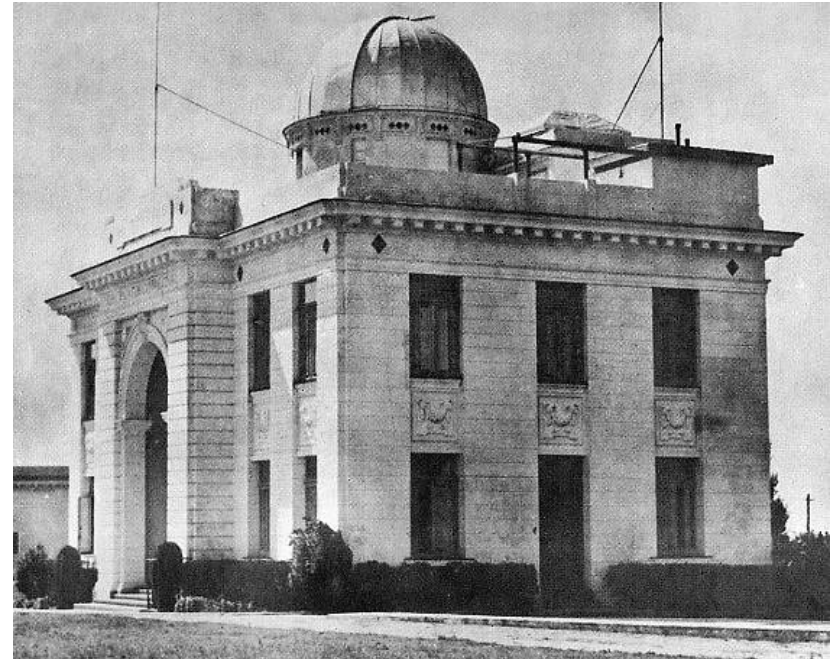
Facts of “republican” Cuba

- The only existing university until the late 40's showed a typical “teaching only” framework, with very limited research activities. “Doctorates” remained for denominating graduation diplomas, NOT for third cycle education. Other then founded universities followed the same style, in general.
- 9.3 % of students were in basic sciences and technology in 1959.



Facts of “republican” Cuba

- There was neither public nor private national system for supporting science.
- For example: the “*Academia de Ciencias Médicas, Físicas y Naturales de La Habana*” was budgeted by the **Ministry of Justice**, the “*Sociedad Geográfica de Cuba*” by the **Ministry of State** (foreign affairs) and the “*Observatorio Nacional*” (meteorology agency) by the **Cuban Navy**.



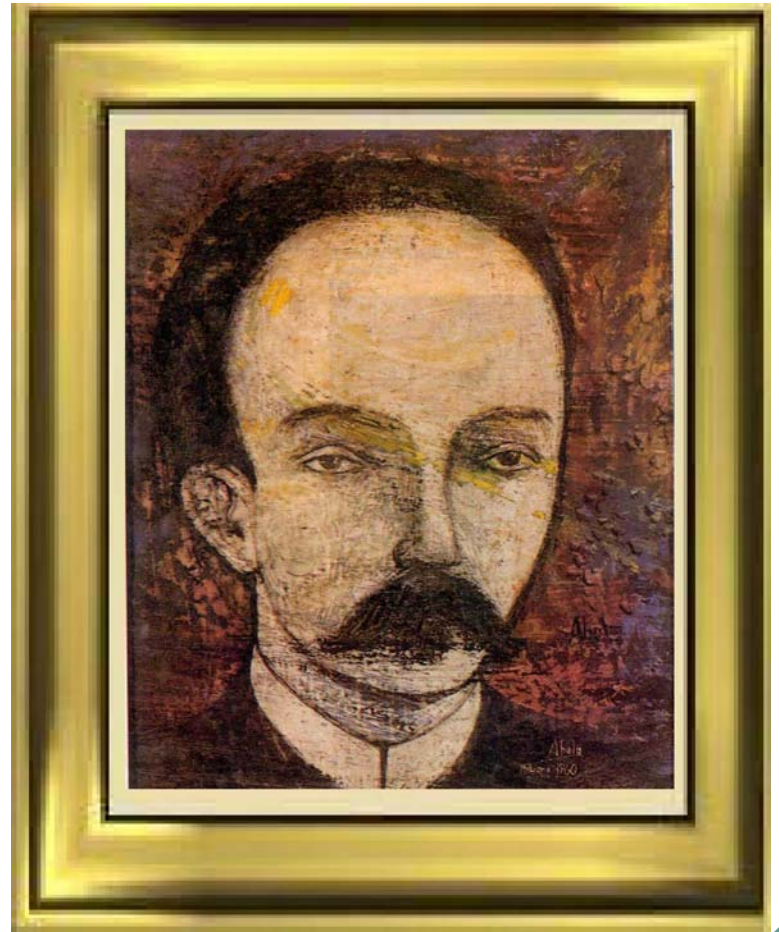
A necessary turning point

- While during the first two thirds of 19th century the presence of science in the Cuban society was comparable to that in some European countries, the deceleration during the first half of 20th century left the country far behind from averages in European and North American societies.
- The Cuban society suffered a process of degradation with respect to the prestige of knowledge since the establishing of the republic until the end of the 50's.



Ideas and facts of a young Revolution

- In contrast to mentioned degradation factors, during the first part of 20th century, Cuban educational system included much ideas of José Martí (1863 – 1895), who was a very advanced intellectual, journalist and politician.



Ideas and facts of a young Revolution

- In January 15, 1960, Fidel Castro stated in a speech because the 20th Anniversary of the Cuban Speleological Society that “*The future of our country must be a future of science men, of thinking men...*”



Ideas and facts of a young Revolution

- During 1961, a huge “*Campaña de Alfabetización*”, mostly done by the Cuban youth contributed massively by teaching 700,000 illiterates, to increase the prestige of knowledge. It started a process of relevant educational change and improvements.

Year	1958	1961
Illit. population	23.1 %	3.9 %

Ideas and facts of a young Revolution

A **Reform of Cuban higher education** was established in 1962

- *Establishing as a principle the “link of theory and practice” and declaring higher education as a social protagonist*
- *Creation of research oriented science careers.*
- *Allowing changes in demographic composition of universities by introducing strong economic support for students*

In fact, it **promoted scientific research** and creation of knowledge together with teaching in Cuban universities. It was consolidated during the period of 1966 – 1972, when **several research centres** were created or associated to higher education and **third cycle (graduate) education was implemented.**



Ideas and facts of a young Revolution

- A main point: *Education, health, science and culture are, nowadays, pre-requisites of economical development* and not the other way around.

Impact of US blockade on early revolutionary science

- The impact of the **US blockade created a situation of isolation** in the new born scientific community
- It promoted a remarkable **interest in breaking the blockade** and establishing very good relations with several scientific communities in the world. In particular, initial links were established with Eastern Europe and the Soviet Union.

Che Guevara

- In 1962 Dr. Ernesto Guevara (Che) is designated as Minister of Industries in Cuba.
- His Ministry established the scientific and technological conditions for Cuban economy to survive the US blockade, and created the first institutes of research related to particular industrial sector, as Cuban sugar industry.



Some Che's sci-tech successes

- Introduction of sugar cane crop mechanization.
- Establishing the production of the then paralyzed nickel sulfur industry.
- Full geological prospecting of Cuban territory
- System of research institutions associated with industries
- Association of industry with universities for special sci-tech purposes.

Cuba today:

- **Total area:** 109 886 km²
- **Population:** 11 239 043
- **Density of population:** 102.3 inh./km²



Cuba's population by ages

Year	% Age 0 – 14	% Age 15 – 59	% Age > 59
1953	36.2	56.9	6.9
2006	18.4	65.6	15.9
Projected 2020	14.6	63.7	21.6

Ethnics:

“Admixture Mapping” of Cuban population genes (not phenotypes) from a sample of 600 individuals (for managing disease forecasting):

- Caucasian: 73.8%,
- African: 16.8%
- Aboriginal and Asiatic: 9.4%

Post-revolutionary periods

- I. **Creating basis infrastructure and social conscience (1960 – 1972)**
- II. **Establishing the third cycle of education (graduate studies) on science and technology and a national system of scientific research (1973 – 1983)**
- III. **Attempts for formal integration of science, technological innovation and national economy (1984 – 1990)**
- IV. **National economic crisis, restructuring and investments in selected fields (1991 – 1994)**
- V. **A society of knowledge? (1995 -)**

I. Basis infrastructure and social conscience (1960 – 1972)

- Foundation of **new general and thematic centres for research and development**
(*Centro Nacional de Investigaciones Científicas, Instituto de Ciencia Animal, Instituto Nacional de Investigaciones Nucleares, Instituto de Investigaciones sobre los derivados de la Caña de Azúcar, etc.*)



I. Basis infrastructure and social conscience (1960 – 1972)

- **University reforms**
and creation of the
***National
Commission for the
Academy of
Sciences***



I. Basis infrastructure and social conscience (1960 – 1972)

- First promotions of science graduates educated in Cuba and Europe.
- Beginning of scientific exchanges with the Soviet Union and Europe.



I. Basis infrastructure and social conscience (1960 – 1972)

- The first Cuban designed and Cuban built computer of third generation appears in the University of Havana in 1970.



II. Third cycle of education and a national system of scientific research (1973 – 1983)

- First national doctoral promotions at international standards and regulation of scientific degrees. Extension of third cycle education.
- Large scale doctoral education in the Soviet Union and Eastern Europe



II. Third cycle of education and a national system of scientific research (1973 – 1983)

- Creation of the Ministry of Higher Education and national governmental bodies for science policy and development.



II. Third cycle of education and a national system of scientific research (1973 – 1983)

- First labour regulations for manpower in science and development, as the law establishing **scientific degrees, higher education teaching** and **scientific research** labour scales and salaries.

II. Third cycle of education and a national system of scientific research (1973 – 1983)

- New **research and development centres** associated with different branches of the national economy: agriculture, sugar industry, basic industries, construction and transportations
- New Cuban designed and Cuban built **sugar factories**



II. Third cycle of education and a national system of scientific research (1973 – 1983)

- Development of a body and national policy on **standards and metrology**.

III. Integration of science, technological innovation and national economy (1984 – 1990)

- Promoting policy of “**progress pushed by science and not pulled by social demand**” and establishing **national programs for science and technology**

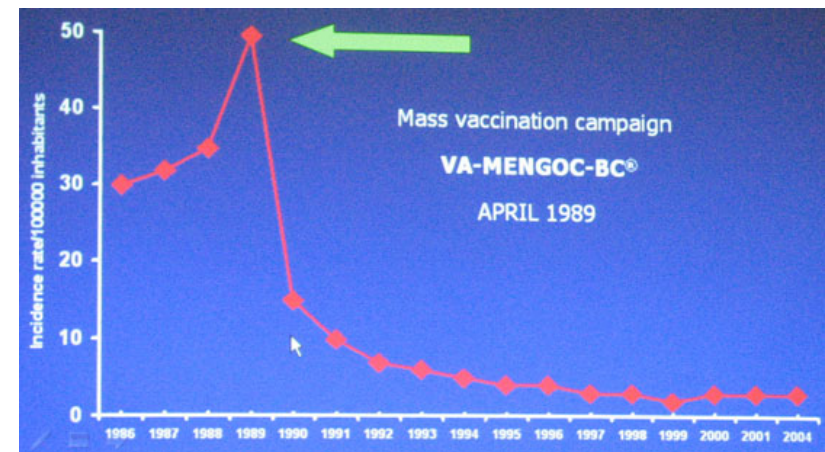
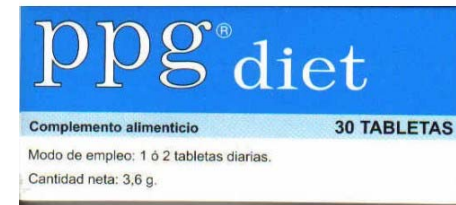
III. Integration of science, technological innovation and national economy (1984 – 1990)

- Applied technological advances were determined by imports of old fashioned systems from Eastern Europe, although at very favourable trade conditions



III. Integration of science, technological innovation and national economy (1984 – 1990)

- Begins the application of science products that were nationally generated in public health



III. Integration of science, technological innovation and national economy (1984 – 1990)

- Strong support for endogenous “in site” technological advance by social mobilisation (“Forum de Piezas de Repuesto”, ANIR, BTJ, etc.)



Brigadas Técnicas
Juveniles

III. Integration of science, technological innovation and national economy (1984 – 1990)

- Creation of “scientific poles” for research and development and nuclear science institutions



III. Integration of science, technological innovation and national economy (1984 – 1990)

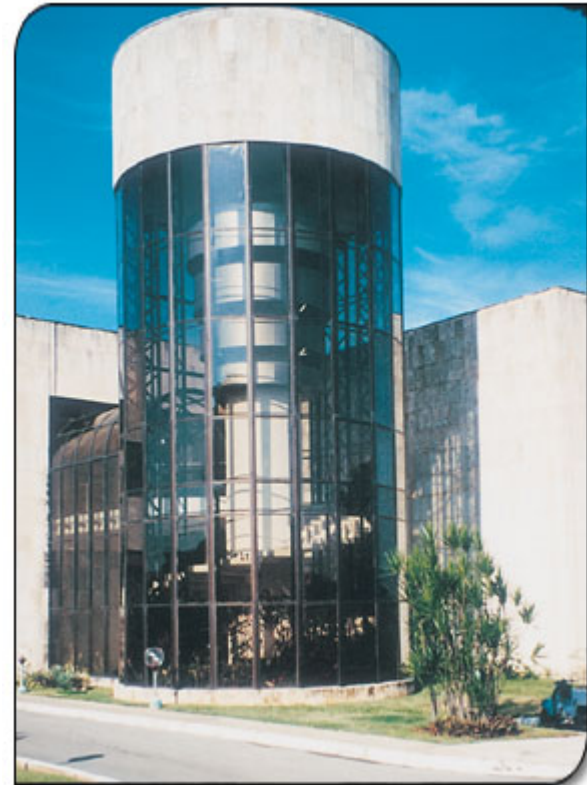
- Questioning of non-utilitarian character and other problems of doctoral education

IV. National economic crisis: investments in selected fields (1991 – 1994)

- Application of the “**período especial**” in an economy of survival for science policy by encouraging self funding of research teams and quite all the research institutions

IV. National economic crisis: investments in selected fields (1991 – 1994)

- Establishing new laboratories and factories by investments of the central government in selected fields where products of science were economically promising, mostly in the field of applications on public health



IV. National economic crisis: investments in selected fields (1991 – 1994)

- Beginnings of significant loss of highly qualified and skilled manpower because emigration to other flourishing economic fields, like tourism, and looking for opportunities in foreign countries.

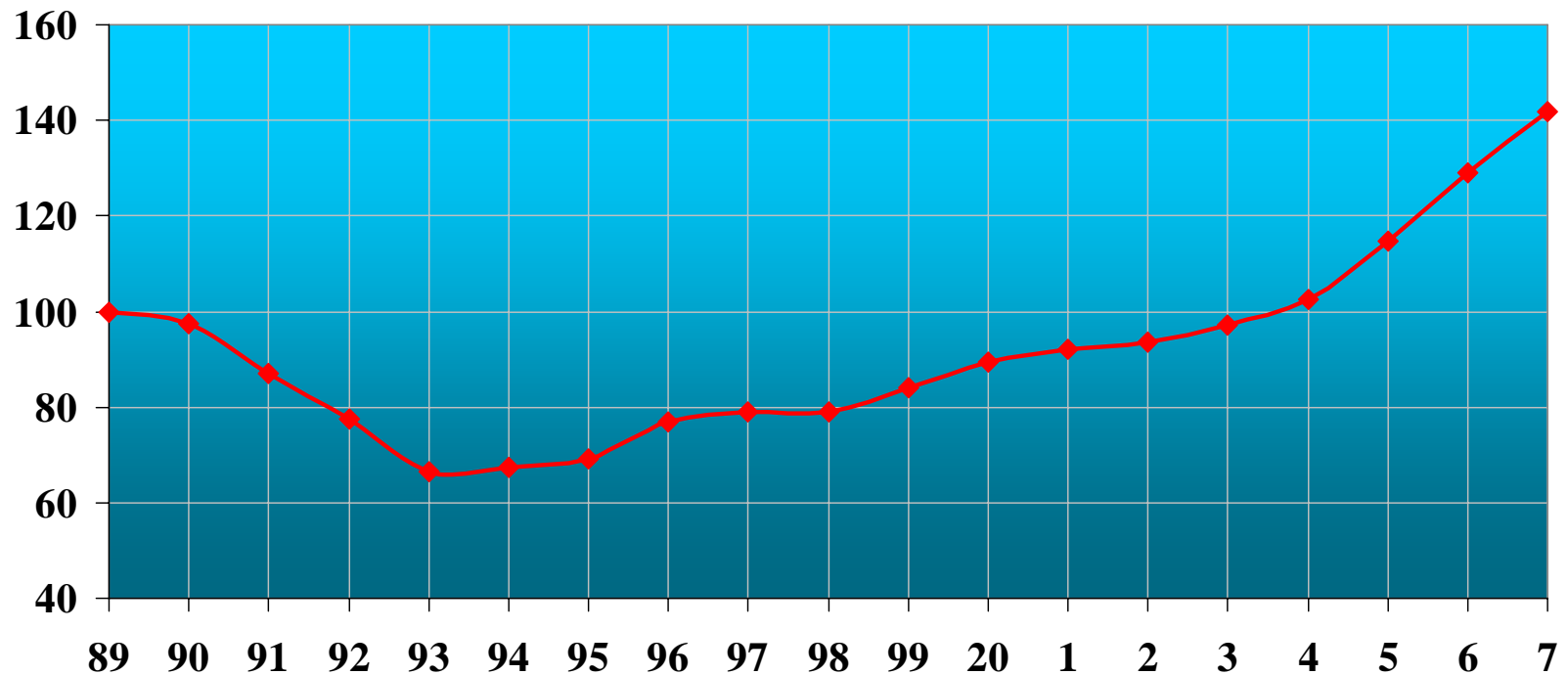
IV. National economic crisis: investments in selected fields (1991 – 1994)

- Higher education kept a good level although the infrastructure was severely damaged and not renewed.



V. A society of knowledge? (1995 -)

Increase of the NGP (prices of 1997; 1989=100)



V. A society of knowledge? (1995 -)

In the negative side:

- The impact of the crisis remains on most fields, including a decreased stability of human resources.
- Partnerships and cooperation in science with foreign institutions become sometimes crucial for developing frontier research.
- The national system of science and technological innovation remains waiting for endogenous stable and multilateral economic management and integration.
- The impact of the US blockade remains dramatic and increased its scope after 2001.

V. A society of knowledge? (1995 -)

In the positive side:

- Basic sciences are recognized as a national priority
- Doctoral education begins recovery and takes part of relevant scientific results
- Higher education is extended to all regions in the country, including research for scientific education, mostly in social sciences.
- Transcendent results in the field of vaccines and treatment of common diseases are generated and applied.
- Projecting the “economy of knowledge”

Today's facts:

- Cuba is among the most advanced countries in connection with economic support of science and technology relative to national gross income

Today's facts:

- Science staff is strongly represented by women.

Today's facts:

- Among 16 countries in Latin America and the Caribbean, **Cuba resulted with the highest positive value of 0.11 of the RAND's index of creation of capacities in science and technology in 2001**, only followed by Brazil in the positive manifold. All other countries (Argentina, Chile, Mexico, Colombia, Venezuela, Costa Rica, Bolivia, Uruguay, Peru, Ecuador, Panama, Nicaragua, Trinidad – Tobago and El Salvador) got negative indices (2002)

Today's facts:

- The connection between the real economy and science and technological innovation remains mostly represented by the biotech sector and the so called “closed circle results”. Planning and promotion of innovation does not include, nor stimulates, the participation of the Cuban scientific potential.

Results

Relevant results 1989 – 2006

- The Academy of Sciences of Cuba (ACC) awards the most relevant Cuban science results since 1990. It can be taken as a general survey, by themes, about the main topics and impact in knowledge and economy of Cuban science.

ACC awards on agriculture and fishery sciences

174 awards on:

- Animal and plant health
- New cultivation varieties and methods
- Commercial animal feeding from national and environmentally friendly sources
- Food production

ACC awards on biomedical sciences

299 awards on:

- Biotechnological products
- Vaccines
- Medical instruments
- New biomaterials
- Disease treatments
- Neurosciences
- New drugs

ACC awards on human and social sciences

148 awards on:

- Cuban and universal history
- Sociology
- Cuban economics
- Language and literature
- Philosophy
- Religion

ACC awards on technology

175 awards on:

- Computer devices and applications
- Sugar industry and sugar cane derivatives
- Mining and processing of Cuban minerals
- Energy saving and recovery
- Applied materials
- Electronic instruments

Scientific poles

- More than 20 **biofarmaceuticals and vaccines** incorporated to the national health system
- More than 900 **registered patents**.
- New vaccines produced with national technologies, as that against **meningitis B** and ***hæmofilus influenzae***, the first commercial synthetic vaccine in the world.
- The **best covered population by vaccination** in the world is Cuba (13 vaccines with systematic application)
- Wide **access of the whole population to “high tech” pharmaceuticals** (interferons, eritropoyetine, monoclonal antibodies and others)
- National **network for “high tech” inmuno-diagnostics** including perinatal screening with total covering for several diseases.
- New **drugs for reduction of cholesterol and stroke** treatments.
- National **network of neurodiagnostics** with self produced high tech instruments.

Effective staff in scientific and technological activities, according to the educational level (2006)

	2001	2002	2003	2004	2005	2006
Total	69 778	73 470	78 497	78 987	79 030	74 068
Higher education	30 596	31 807	35 306	35 037	37 184	44 827
Middle education	17 205	18 147	20 408	20 756	21 036	19 096
Other	21 977	23 516	22 783	23 194	20 810	10 145
Cumulative given PhD's	6 287	6 642	6 965	7 527	7 971	8 494

Third cycle (graduate) education

	2001	2002	2003	2004	2005	2006
Cursos	92 582	93 836	314 560	342 200	385 191	413 139
Entrenamientos	4 311	4 103	26 734	34 289	20 124	25 616
Diplomados	16 521	14 123	71 183	70 083	76 870	59 185
Maestrías y Especialidades	11 708	12 403	49 337	37 419	113 091	143 597
Doctorados	958	930	2 942	2 511	4 129	3 930

An answer to the initial question:

- The ground work of near to 50 years of scientific promotion has created a sustainable intellectual development in Cuba, even having been and remaining as a low income country.

Photographie Benjamin Couprie

28, Avenue Lo

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O. W. RICH

Future scenarios

- Any conceivable scenario of future Cuban development will rest on the outstanding human resources in science and technology innovation created by the Revolution of 1959.

¡Más es mía el alba de oro! [Rubén Darío]

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