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Eric Hounshell & Daniel Midena

**“Historicizing Big Data” Conference, MPIWG,
October 31 - November 2, 2013**

Report

This conference will examine the material culture, epistemology, practice, and cultural and political history of data in the modern sciences. Since the late 20th century, huge databases have become ubiquitous, and the term “Big Data” has become a buzzword for describing an ostensibly new and distinctive mode of knowledge production. This conference examines the broader cultural preoccupation with Big Data in critical historical perspective. It brings together scholars studying data from a variety of different disciplinary, temporal, and methodological perspectives, in the hopes both of identifying the important central problems in a history of data and of generating new lines of inquiry for the future.

The set of themes for this conference—epistemology, practice, material culture, and political economy of data—are overlapping, interrelated categories. Data is immanent to the practices and technologies that support it: not only are epistemologies of data embodied in tools and machines, but in a concrete sense data itself cannot exist apart from them. Furthermore, while Big Data is often associated with the era of computer databases, we will also explore important continuities with data practices stretching back to the 18th century and earlier. We will historicize the material cultures and practices of data in a broad context, including the development of information processing technologies; the relationships between collections of physical objects and collections of data; and visualizations and representations of data, both as working tools and also as means of communication.

In the era following the Second World War, new technologies have emerged that allow new kinds of data analysis and ever larger data production. The term “Big Data” ostensibly refers to the enormous amount of information collected, stored, and processed in fields as varied as genomics, climate science, paleontology, anthropology, and economics. But it also implicates a Cold War political economy, and these political and cultural ramifications of data cannot be separated from the broader historical consideration of data-driven science.

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Historicizing Big Data



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Illustrations:

cover: U.S. Census Bureau machines and operators, 1908.
Library of Congress Prints and Photographs Collections
Division Washington, D.C. ; „Spindle Diagram“, H.G. Bronn,
Untersuchungen über die Entwicklungsgesetze der Organischen
Welt (Stuttgart: E. Schweizerbart. 1858), p. 312.
inside: „Universal Tree of Life“, David M. Hillis, Derrick Zwickl,
and Robin Gutell, University of Texas. <http://www.zo.utexas.edu/faculty/antisense/downloadfilestol.html>.

flyer design: Mala Shah

Conference

October 31 - November 2, 2013

Organization:
David Sepkoski
Elena Aronova
Christine von Oertzen

Sciences of the Archive

HISTORICIZING BIG DATA

a Conference at the

Max Planck Institute
for the History of Science

October 31- November 2, 2013

Thursday, October 31

15.00 Welcome and Organizational Information

15.15-17.30 **Biographies of Data**

Dan Bouk „Writing Biographies of Data“

Christine von Oertzen „Punch Card Transformations: The Dawn of European Data Power, 1890-1920“

Mirjam Brusius „Data and Material Culture. Finds and Specimens as ‚Raw Archival Data‘“

Dan Rosenberg „Personal Data“

Friday, November 1

09.00-10.30 **Data Motion and Translation**

Cathy Gere „Big Data and Racial Science“

Joanna Radin „Off the Rez: How Indigenous Bodies Became Big Data“

Elena Aronova „Do (Big) Data Have Politics? Cold War and the Political Economy of Data Exchange“

Coffee Break

11.00-12.30 **Data Visualization and Modeling**

David Sepkoski „Simulations, Databases, and Models“

Caitlin Wylie „Fossils as Gigabytes“

Susanne Bauer „Data Recombination and the Performativity of Modeling“

12.30 **Catered Lunch at MPIWG**

14.00-16.00 **Data Cultures and Infrastructure**

Hallam Stevens „The Infrastructures of Sequence Data in Biology“

Judy Kaplan „The Global Lexicostatistical Database: Integrating Traditions in Long-Range Historical Linguistics“

Sharon Traweek „Changing Data Infrastructures and Practices in 20th Century Astronomy“

Markus Krajewski „Big Data in Bibliometrics and the Introduction of the OPAC“

19.00 **Dinner at Restaurant Weyers (invitation only)**

Saturday, November 2

09.30-12.30 **Data Collections and Accumulation**

James Delbourgo „Listmania, Label-Madness and Containerization in the Early Modern Era“

Staffan Müller-Wille „Counting Species in Classical Natural History“

10.45 **Coffee Break**

Rebecca Lemov „The Dream of Data and the Data of Dreams: How to Make the Invisible Visible“

Bruno Strasser „Data Not Good Enough to See the Light of Day: Shifting Boundaries Between Private and Public Experimental Data“

12.30 **Catered Lunch at MPIWG**

13.30-15.30 **Final Commentary and Discussion**

Soraya de Chadarevian
Lorraine Daston
Sabina Leonelli
John Pickstone
Ted Porter

Animals

You are here

Plants

Protists

Fungi

Bacteria
Archaea

“HISTORICIZING BIG DATA”

CONFERENCE, MPIWG, OCTOBER 31 – NOVEMBER 2, 2013

REPORT

Eric Hounshell & Daniel Midena

The Max Planck Institute for the History of Science (MPIWG) hosted a conference to trace the epistemological, practical, material, moral, political, and economic dimensions of “big data” in the history of the human and natural sciences. MPIWG research scholars David Sepkoski, Elena Aronova, and Christine von Oertzen organized the three-day meeting. As Sepkoski emphasized in his opening remarks, the workshop’s point of departure was the conveners’ shared skepticism toward the novelty assumed by harbingers and proponents of the so-called “fourth paradigm” of data-driven science.¹ Two key qualities commonly found in accounts of data-driven science across the natural and social sciences and even the humanities are (a) an emphasis on harvesting, mining, and induction from preexisting data; and (b) the central place of data-processing technology and “automated reasoning” for interpreting data.² Exploratory approaches, tentative theses, and productive disagreement across eighteen individual talks and the culminating roundtable discussion confirmed the novelty and richness of the problematic. By historicizing the concept and practices of big data, the papers demonstrated that big data has a longer history than is usually claimed. However, by the conference conclusion, how this history could be meaningfully synthesized remained an open question. Nevertheless, the workshop’s focus on “bigness” of data inspired new approaches to familiar episodes in the history of science and brought attention to new objects of inquiry.

Across several panels of speakers, five broad problems pervaded the talks and subsequent discussions: (1) A search for satisfactory, historicized definitions of key terms (data, fact, database, information, etc.). (2) The specific role of data-processing and computing technologies, especially the digital computer, in scientific practice within a longer and broader history of the material culture of data. This includes the rhetorical and

¹ See Tony Hey, Stewart Tansley, and Kristin Tolle, eds., *The Fourth Paradigm: Data-Intensive Scientific Discovery* (Redmond, Washington: Microsoft Research, 2009) and Chris Anderson, “The End of Theory: The Data Deluge Makes the Scientific Method Obsolete” in *Wired Magazine*, July 16, 2008. For a recent, similar effort in the humanities, see Franco Moretti, “Operationalizing, Or, the Function of Measurement in Literary Theory,” *New Left Review* no. 84 (December 2013): 103–119.

² Our gloss on data-driven science comes from the proceedings of an April 2010 conference at the University of Exeter, which was an early assessment of the purported paradigm shift and included several subsequent MPIWG conference participants. See Sabina Leonelli, “Introduction: Making Sense of Data-Driven Research in the Biological and Biomedical Sciences,” *Studies in History and Philosophy of Biological and Biomedical Sciences* 43, no. 1 (March 2012): 1–3.

epistemological functions of “bigness” before and after the computer and other impressive machinery. (3) How the journeys, chains of inscriptions, uses and reuses, and decontextualizations and contextualizations of data should be understood. (4) How communities of practitioners form around projects of data accumulation, processing, and analysis. (5) The “value” of big data within the social structures of states and economies.

In a final roundtable session, five panelists (Ted Porter, John Pickstone, Sabina Leonelli, Lorraine Daston, and Soraya de Chadarevian) each summarized and highlighted themes and problems from the conference as a whole. The panelists and the subsequent general discussion focused on possible historicizations of big data and emphasized the need for further conceptual clarification. Daston wondered, for example, what a general history of big data might look like: Would it be a history of ideas, practices, material or technology? Where would the turning points be in such a story? Many participants agreed that the utopian, dystopian, and megalomaniacal spirit of sheer bigness is as important in the longer history of science as it is prescient of the contemporary rhetoric. The papers reinforced the roundtable panelists’ initial doubts as to whether big data eliminates “bias” (Leonelli) or “thinking” (Porter). While a strong showing of historians lent historical depth and richness to the problematic, particularly around the journey of data and “big data” communities, the conference nevertheless left a more systematic treatment of the role of theories and hypotheses in “data-driven science” open. Since the Fall 2014 conference, scholars at the MPIWG have continued to help organize the historical and philosophical discussion through its Department II working group, “Historicizing Big Data.”

PANEL SESSIONS

BIOGRAPHIES OF DATA (THURSDAY OCTOBER 31, 15.00-17.30)

DAN BOUK’s meditations on “Writing Histories of Data in an Age of Big Data” highlighted two interrelated qualities of large-scale data—the lifecycle of data from its initial collection through its many inscriptions and the economic value and political import of these inscriptions at each stage. Within this framework, he urged historians to study the maintenance (or not) of the linkages in these chains of inscriptions. Bouk drew specific examples on the movement and trading of data in various monetized and non-monetized, proprietary and nonproprietary ways from his own research on life insurance in the late-nineteenth and twentieth centuries. CHRISTINE von OERTZEN also spoke on demographic data but shifted attention from the market to state actors in her paper on the material practices and politics of census-taking in nineteenth- and early twentieth-century Central Europe. Taking two political entities as her case studies, she showed how politics and prior material practices of census-taking led Austria-Hungary to adopt punch-card tabulating machinery much earlier than the Prussians. One key variable was the prevailing labor regime: while the Austro-Hungarian census developed a factory-like organization and sharp division of labor, the socially-paternalistic Prussians farmed out piece work to

disabled veterans and therefore resisted the technological unemployment posed by machine tabulation.

MIRJAM BRUSIUS thematized the circulation and inscription of data and the multiple material forms of data in her paper on the German excavation and reconstruction of Babylon's Ishtar Gate at the beginning of the twentieth century. She focused on the work required to move bricks from the dig site to Berlin—the circulation of photographic negatives, prints, annotations and molds back and forth between the two locations—to study the relationships between material things, data, and facts. How and when does a thing, such as a brick, become data? DAN ROSENBERG shared Brusius's interest in terminology and employed Google's Ngram tool to study when and in what grammatical contexts "data," as opposed to "fact," appeared in linguistic usage. By graphing the use of these terms paired with certain verbs and adjectives, Rosenberg approached the questions of when data were seen as something given versus sought, when data became associated with measurable facts, when they were demanded in sufficient quantity and quality, and so forth. Moreover, the singular "datum," as opposed to "fact" is statistically negligible, which one member of the audience interpreted as "facts' have a granularity like things, while 'data' tends to be like porridge—smooth and homogeneous."

DATA MOTION AND TRANSLATION (FRIDAY NOVEMBER 1, 09.00-10.30)

ELENA ARONOVA brought the history of big data into the geopolitical context of the Cold War with her talk on the sharing of geophysical data between Western and Eastern Blocs in the International Geophysical Year and its World Data Centers. This project enlisted 67 countries, thousands of scientists, and many thousands of observational stations around the world. Aronova stressed that the project was characterized by unresolvable tensions and contradictions: "dual-use" military and civilian agendas, secrecy and access to raw data and reports, and so on. Political mistrust compounded the challenges of data-sharing and circulation, such that data, more accumulated than used, became an end in itself. JOANNA RADIN's paper on "How Indigenous Bodies Become Big Data" provided another rich case of circulation by following the collection of hereditary and public health data from the Pima indigenous people of the American Southwest to these data's unexpected and unsanctioned uses far beyond the field of medicine. The Pima dataset, decontextualized from the research into diabetes and obesity that had produced it, found its way into undergraduate statistics problem sets and a machine-learning data repository. Ultimately this repository generated an algorithm that was then applied to contexts yet further removed from public health and biomedical research—the prediction of electrical fires in urban environments, for example. Radin thus gave ethical depth to Bouk's remarks on the politics of data's circulation. Pivoting on this connection between ethics and the life of data in heredity research, CATHY GERE led a genealogy from non-human to human genetics research back to a discussion of the ethics of research on indigenous populations. The UN Indigenous Peoples Council on Biocolonialism (est. 1999) protested the collection of their genetic data—prized for their hereditary isolation—to be used for commercial, scientific, and military purposes. Taking off from Theodosius

Dobzhansky's anti-eugenicist research on wild fruit flies in the 1930s, Gere's talk linked several eras in the politics of hereditary research to informed and "tiered" consent in medical ethics.

DATA VISUALIZATION AND MODELING (FRIDAY NOVEMBER 1, 11.00-12.30)

DAVID SEPKOSKI discussed the role of large datasets and modeling in Stephen Jay Gould's and Jack Sepkoski's mathematical analysis of the fossil record in the early 1970s "paleobiologic revolution." Unlike others at the time who used math but no data to generate their hypothetical models of evolution, Jack Sepkoski based his model on a paper database of the fossil record drawn from publications and museum collections. He and Gould used this model to "replay life's tape," testing the latter's claim that the history of life is contingent. By contrast, CAITLIN WYLIE's paper entertained a different sense of "big" data in paleontology by looking at contemporary high-resolution (and therefore large) digital 3D imaging technologies such as CT scanning. Her ethnographic study found that many researchers and technicians in vertebrate paleontology resist image-based research in favor of traditional tactile contact with fossils, which they see as essential to interpreting the fossil record.

SUSANNE BAUER then linked modeling back to the political and demographic themes of earlier panels with her study of Denmark's regime of comprehensive and interconnected data practices. In an epidemiologist's dream come true, each resident has a unique identification number that is carried through an entire lifetime of medical, police, financial, and cellular telephone records and so on. This enables longitudinal studies and censuses with a density of data unparalleled by traditional survey methods. Moreover, as Bauer showed, risk-modeling based on this rich dataset has shaped Danish health policy, which thereby performatively shapes the population. Some audience members were shocked by the Danish citizenry's lack of resistance to such comprehensive surveillance.

DATA CULTURES AND INFRASTRUCTURE (FRIDAY NOVEMBER 1, 14.00-1600)

This panel brought computers sharply into focus. More than perhaps any other participant, though with clear caveats, HALLAM STEVENS defended the novelty of computer-aided, data-driven biological research. He discussed two computer-aided projects for collecting and analyzing biochemical data from the 1970s and the present day. Though he saw computers as a rupture in biological research, he rejected Big Data prophets' claims of a science without theory, arguing instead that the theories are built into the hardware, software, database infrastructures and front-end platforms themselves. JUDITH KAPLAN showed that theory is also built into the database infrastructure of contemporary linguistics research in the Global Lexicostatistical Database, a sort of human genome project for historical linguistics. While this collaborative online database is new (est. 2011), it brings together two century-old, formerly competing traditions in linguistics. In contrast to Stevens, Kaplan saw this big-data stage of the field as a continuity rather than a rupture.

Based on her field observations of disciplines ranging from high-energy physics to information studies and her ongoing collaboration on digital data practices, SHARON TRAWEEK sketched out the microsociological and professional implications of big data. More than any other speaker, she highlighted the ways that collaborative (sometimes competitive) communities and new professional profiles form across disciplines around data practices. Such practices erode the conventional distinctions between theorist, support staff, experimentalist, instrumentalist, and so on as they create new divisions of labor. For the vast network of researchers and policy-makers involved in big-data science, “bigness” has clear social and epistemic implications. MARKUS KRAJEWSKI staked out the longest chronological span of all speakers by delimiting the continuities and discontinuities of library catalogs from antiquity to the present. Across this broad historical arc, the user experience has changed with the shifting interrelations between data (the text itself), metadata (bibliographic data), and spatiality/materiality (where and how the text is stored). The latest generation of the computerized library catalog, OPAC, has collapsed these dimensions. Digital storage and processing of complete digital texts has expanded the thin reed of metadata traditionally entered manually by librarians (author, subject, etc.) to encompass the full content of the text, allowing for a new kind of connectivity between catalog entries and a rich collection and exploitation of bibliometric statistics (reading, citation, word use, etc.).

DATA COLLECTION AND ACCUMULATION (SATURDAY NOVEMBER 2, 09.30-12.30)

The first two papers in this panel looked at collections and collecting in early modern Europe as possible early instantiations of big data. Based on Hans Sloan’s natural history collection at the British Museum, JAMES DELBOURGO posed several questions that arise when trying to talk about big data in the early modern period: What terms did early modern actors use for “information”? Can early modern forms of accumulation (e.g. the *Wunderkammer*) be regarded as forerunners of big data? And, in an era before big government, how did state and non-state actors as well as imperial patterns of data exchange interact to produce large amounts of data? For Delbourgo, the “value” of natural history collections brings together the commodification of natural history objects with the aesthetic value (or “beautiful totality”) that the display of big collections inspired. This was followed by STAFFAN MÜLLER-WILLE’s examination of the use of numbers in the work of eighteenth- and nineteenth-century naturalists. For these naturalists, numbering was a way to bring species into commensurable relations. Numbering species also introduced the value of bigness. Once numbered, increasing the number of known species became—not unlike Aronova’s Cold War example—an end in itself, where the most consummate botanists had access to the greatest number of species and where the number of documented species was a measure, at any given time, of the state of natural history knowledge.

Taking collections into the twentieth century, REBECCA LEMOV described the fascinating efforts of social scientists in the mid-twentieth century to create databases of dreams. By leading the audience through the largely failed attempts to record and catalogue

dreams (i.e. to turn dreams into data), Lemov showed that for these social science communities data had itself become a dream. Again, as for Mülle-Wille's early modern naturalists, collecting for its own sake—or at least for some ill-defined future purpose and nascent research community—inspired the origin of databases. Lemov argued that the elusive materiality of what she called “personal data,” such as dreams or even clicks on Facebook, subverted the efforts of collectors. In the following paper, BRUNO STRASSER demonstrated that labeling something as data has not just epistemic but also political and moral consequences. By tracing changes in attitudes towards data accumulation and use in the case of research into protein crystallography from the 1960s until today, Strasser emphasized that the rise of public databases depended on data being considered valuable for science as well as “belonging to the public sphere.” In the wake of biomedical research into cancer and AIDS, data that were once considered private are now obliged to be shared and accessible through public databases.

Taken together, the panel contributions and concluding roundtable discussion offered a breathtakingly rich array of problems, approaches, and concrete cases from the history of big data in its epistemological, practical, material, moral, political, and economic dimensions. Future work at the MPIWG and in the field at large could integrate further case studies from the natural and human sciences. However, as the roundtable discussion registered, perhaps more urgent are sharper conceptualization and the difficult work of carving out the contours and periods in the history of data. How exactly did the various dimensions of data interrelate at specific turning points across its history? With a long view into the history of data, we might better assess the claims and expectations of its contemporary proponents. By looking backward from today's big data boom, moreover, we will likely gain new perspectives on the history of the natural and human sciences.

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- 422** Pietro Daniel Omodeo, Irina Tupikova **Aristotle and Ptolemy on Geocentrism: Diverging Argumentative Strategies and Epistemologies** (TOPOI – Towards a Historical Epistemology of Space)
- 423** Han F. Vermeulen **Linguistik und Völkerkunde – der Beitrag der historisch-vergleichenden Linguistik von G.W. Leibniz zur Entstehung der Völkerkunde im 18. Jahrhundert** [Leicht erweiterte Fassung des Working Papers No. 133 aus dem MPI for Social Anthropology]
- 424** Alfred Gierer **Mit Schiller gegen den „Egoismus der Vernunft“**. Zeitübergreifende Gedanken zur Natur des Menschen
- 425** Annette Vogt **Die Berliner Humboldt-Universität von 1945/1946 bis 1960/1961**
- 426** Klaus Geus, Martin Thiering (eds.) **Common Sense Geography and Mental Modelling**
- 427** Renate Wahsner **Kann eine moderne Naturphilosophie auf Hegelsche Prinzipien gegründet werden?** Spekulative und naturwissenschaftliches Denken
- 428** Stefano Bordoni **Widening the Scope of Analytical Mechanics** Duhem's third pathway to Thermodynamics
- 429** Pietro Daniel Omodeo **Copernicus in the Cultural Debates of the Renaissance: Reception, Legacy, Transformation** [Part I & II]
- 430** Mark Geller & Klaus Geus (eds.) **Productive Errors: Scientific Concepts in Antiquity** (TOPOI – Dahlem Seminar for the History of Ancient Sciences)
- 431** Klaus Gottstein **The Amaldi Conferences. Their Past and Their Potential Future**
- 432** Mikuláš Teich **The Scientific Revolution Revisited**
- 433** Lorraine Daston & Jürgen Renn (Hrsg.) **Festkolloquium für Hans-Jörg Rheinberger** Beiträge zum Symposium am 24. 1. 2011 im Max-Planck-Institut für Wissenschaftsgeschichte
- 434** Conference **Epistemology and History. From Bachelard and Canguilhem to Today's History of Science**
- 435** Jens Høyrup **Sanskrit-Prakrit interaction in elementary mathematics as reflected in Arabic and Italian formulations of the rule of three – and something more on the rule elsewhere**
- 436** Jens Høyrup **A hypothetical history of Old Babylonian mathematics: places, passages, stages, development**
- 437** Jürgen Renn **Schrödinger and the Genesis of Wave Mechanics**
- 438** Pietro Daniel Omodeo **L'iter europeo del matematico e medico scozzese Duncan Liddel**
- 439** Irina Tupikova & Klaus Geus **The Circumference of the Earth and Ptolemy's World Map**
- 440** Pietro Daniel Omodeo und Jürgen Renn **Das Prinzip Kontingenz in der Naturwissenschaft der Renaissance**
- 441** Horst Kant und Jürgen Renn **Eine utopische Episode – Carl Friedrich von Weizsäcker in den Netzwerken der Max-Planck-Gesellschaft**
- 442** William G. Boltz and Matthias Schemmel **The Language of 'Knowledge' and 'Space' in the Later Mohist Canon** (TOPOI – Towards a Historical Epistemology of Space)

- 443** Stefano Bordoni **Looking for a Rational Thermodynamics in the late XIX century**
- 444** Sonja Brentjes and Jürgen Renn **The Arabic Transmission of Knowledge on the Balance**
- 445** Horst Nowacki **Archimedes and Ship Design**
- 446** Matthias Schemmel **Elements of a Historical Epistemology of Space** (TOPOI – Towards a Historical Epistemology of Space)
- 447** Martin Thiering and Wulf Schiefenhövel **Spatial Concepts in Non-Literate Societies: Language and Practice in Eipo and Dene Chipewyan** (TOPOI – Towards a Historical Epistemology of Space)
- 448** Jürgen Renn **Einstein as a Missionary of Science**
- 449** Hubert Laitko **Der Ambivalenzbegriff in Carl Friedrich von Weizsäckers Starnberger Institutskonzept**
- 450** Stefano Bordoni **When Historiography met Epistemology.** Duhem's early philosophy of science in context
- 451** Renate Wahsner **Tausch – Allgemeines – Ontologie oder Das Auseinanderlegen des Konkreten und seine Aufhebung**
- 452** Jens Høyrup **Algebra in Cuneiform.** Introduction to an Old Babylonian Geometrical Technique
- 453** Horst Nowacki **Zur Vorgeschichte des Schiffbauversuchswesens**
- 454** Klaus Geus and Mark Geller (eds.) **Esoteric Knowledge in Antiquity** (TOPOI – Dahlem Seminar for the History of Ancient Sciences Vol. II)
- 455** Carola Sachse **Grundlagenforschung. Zur Historisierung eines wissenschaftspolitischen Ordnungsprinzips am Beispiel der Max-Planck-Gesellschaft (1945-1970)**
- 456** David E. Rowe and Robert Schulmann **General Relativity in the Context of Weimar Culture**
- 457** F. Jamil Ragep **From Tūn to Turun: The Twists and Turns of the Tūsī-Couple**
- 458** Pietro Daniel Omodeo **Efemeridi e critica all'astrologia tra filosofia naturale ed etica: La contesa tra Benedetti e Altavilla nel tardo Rinascimento torinese**
- 459** Simone Mammola **Il problema della grandezza della terra e dell'acqua negli scritti di Alessandro Piccolomini, Antonio Berga e G. B. Benedetti e la progressiva dissoluzione della cosmologia delle sfere elementari nel secondo '500**
- 460** Stefano Bordoni **Unexpected Convergence between Science and Philosophy: A debate on determinism in France around 1880**
- 461** Angelo Baracca **Subalternity vs. Hegemony – Cuba's Unique Way of Overcoming Subalternity through the Development of Science**