



*A multidisciplinary conference presented by ARIA-SA and
the Science Attaché, Embassy of Italy, Canberra*



*Embassy of Italy
Canberra*

The Impact of Italian Science in the World from the Renaissance to the Present

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Flinders University*





Art preceded and is continuous with science in human history.
The Romans were close to develop science based on artistic realism and sense of space (Pompei 64 AD)



With the slow decadence of the Roma Empire and the advent of Christianity, the sense of pictorial space from was lost and with it the development of science.

Ezra Codex Amiatinus
8th Century

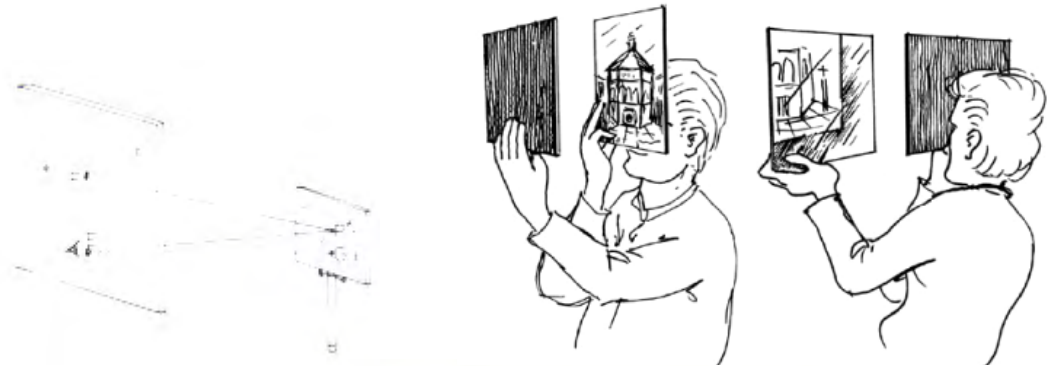


Filippo Brunelleschi
(1377-1446)



PERSPECTIVE

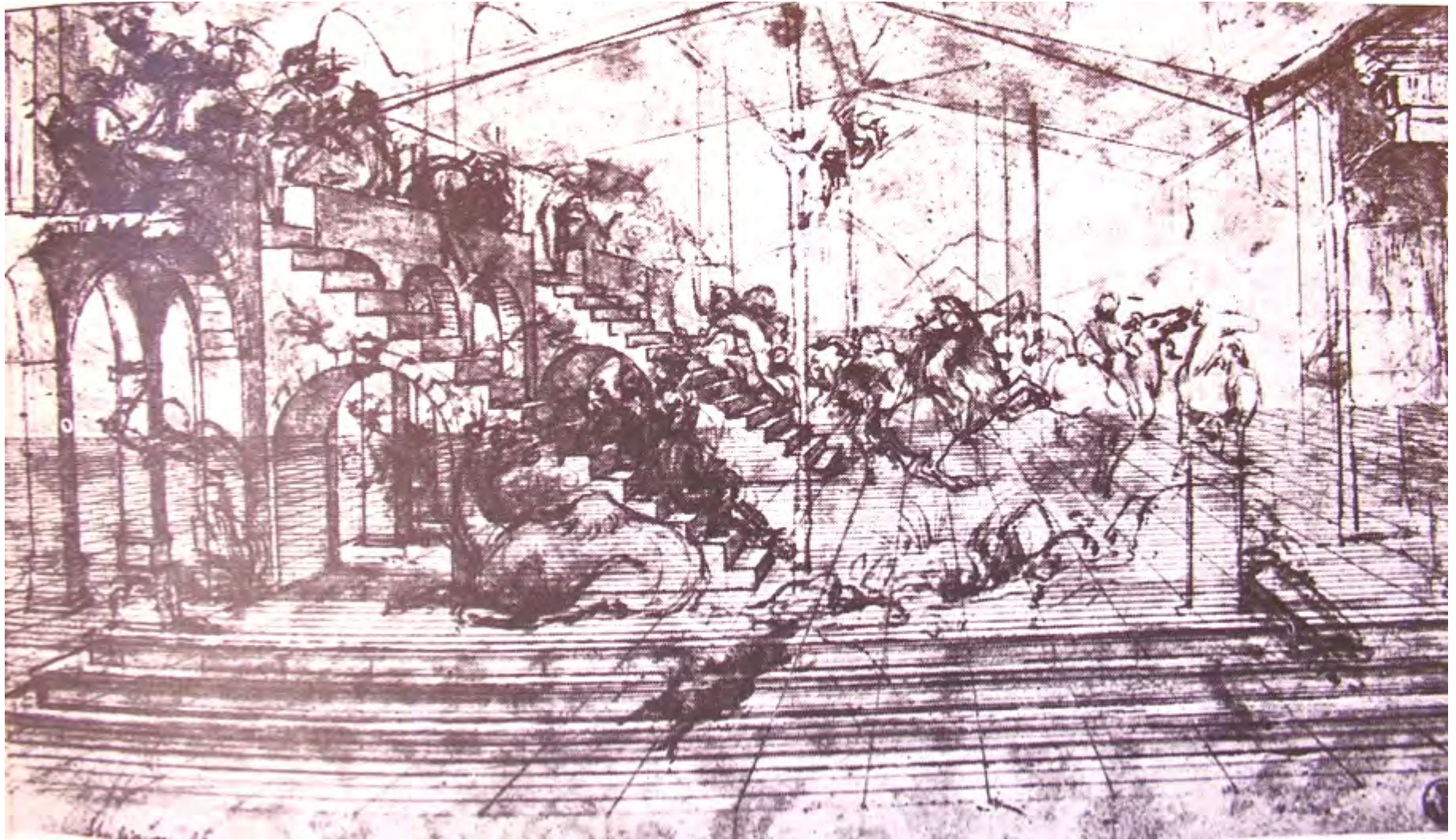
Brunelleschi at the beginning of 'il Quattrocento' invents a new method to represent objects in space (in perspective) and draws the baptistery from the entrance of the Cathedral in Florence. This marks the beginning of the **Renaissance** after the Dark Ages, with the development of **geometrical perspective**.



The first legacy of the Renaissance

Recognition of personal authorship and the birth of Humanism

The creation of objective space by the geometrical description of objects in space (perspective)
creating the foundations of Physics



Leonardo da Vinci; study of perspective, Uffizi

The apotheosis of geometrical space



School of Piero della Francesca;
“veduta della città ideale”, 1475

From light in Art to Geometry, Mathematics and Physics

“Intra li studi delle naturali considerationi la luce diletta di più i contemplanti; in tralle cose grandi delle matematiche la certezza della dimostrazione innalza più preclaramente l’ingegni delli investiganti; la prospettiva adunque è da essere preposta a tutte le tradizioni e discipline umane, ne’l campo della quale la linia radiosa complicata dà e modi delle dimostrazioni, in nella quale si truova la gloria non tanto della matematica quanto della fisica, ornata co’ fiori dell’una e dell’altra.”

Leonardo da Vinci, Codice Atlantico, 203r-d, dalla Perspectiva Communis di John Peckham, XIII secolo.

Amongst studies of the natural considerations light most pleases observers; Amongst **the greatness of mathematics**, the certainty of its demonstrations most clearly enhances the ingenuity of the investigators; **perspective thus must be placed above of all human traditions and disciplines**, and within this discipline (perspective) the complex bright line affords demonstrations **for the glory** not so much **of mathematics**, but **for Physics**, enriched by the flowers of both disciplines

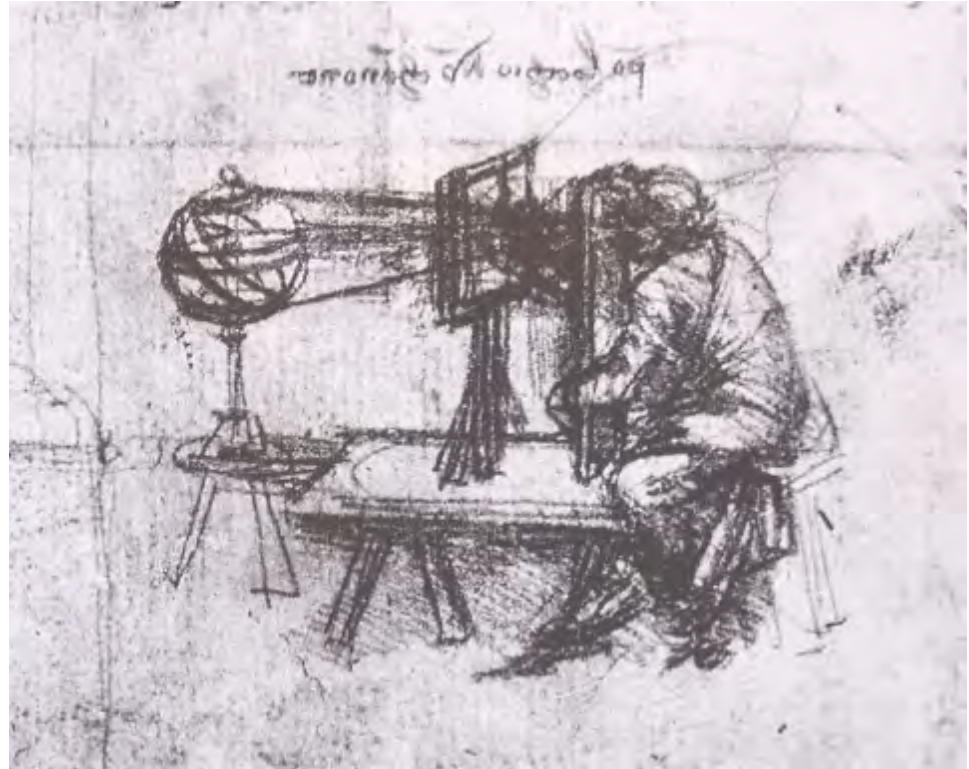
Geometry and proportions

Influence of geometry started from from art then extended to commerce, architecture, cosmology and the birth of anatomy (biologicals sciences) and cosmology (physics)



Self-portrait (c.1512-1515)

Application of geometrical perspective to science

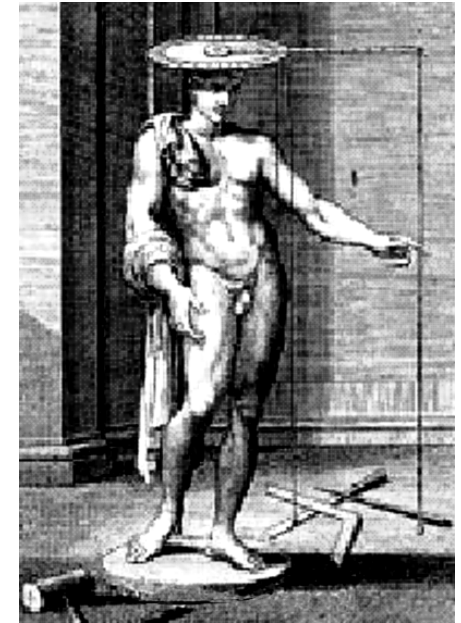
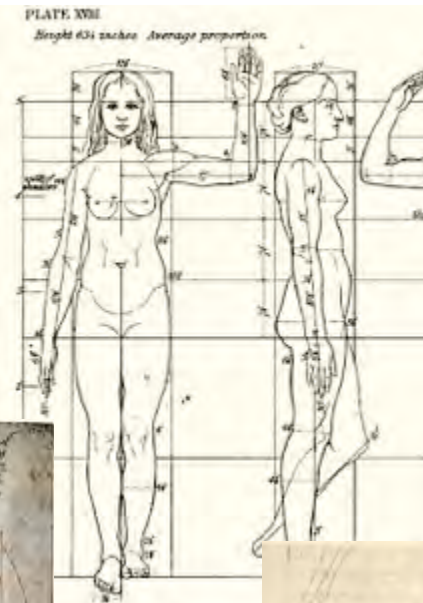


Leonardo da Vinci: using perspective to represent difficult objects
(1510 Atlantic Codex)

Painting becomes geometry and quantitative

Measurements of natural objects and phenomena in the Renaissance revealed the desire of naturalising all aspects of the universe and marked **the birth of experimental observations and modern science**

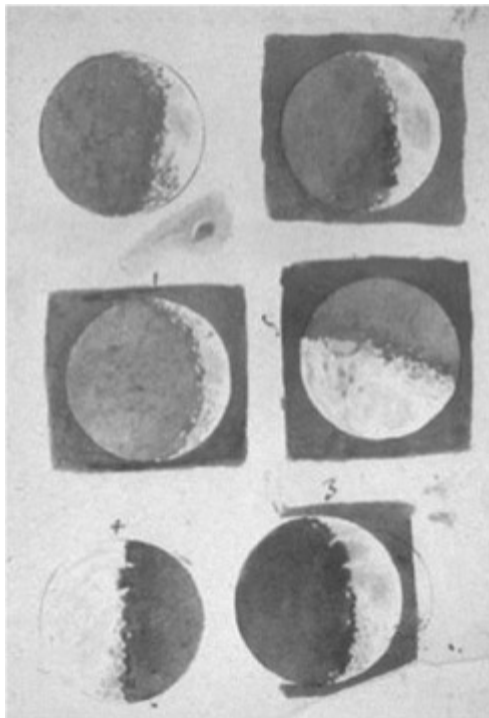
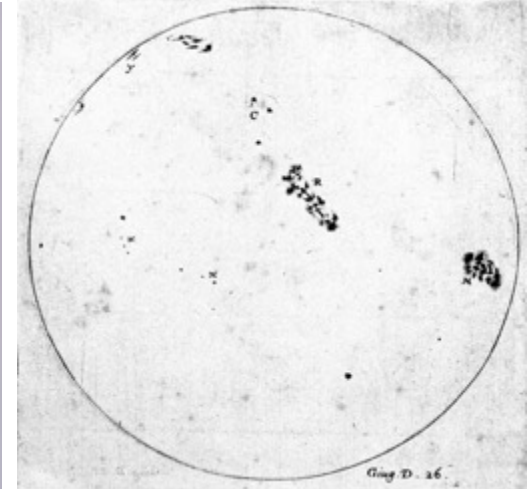
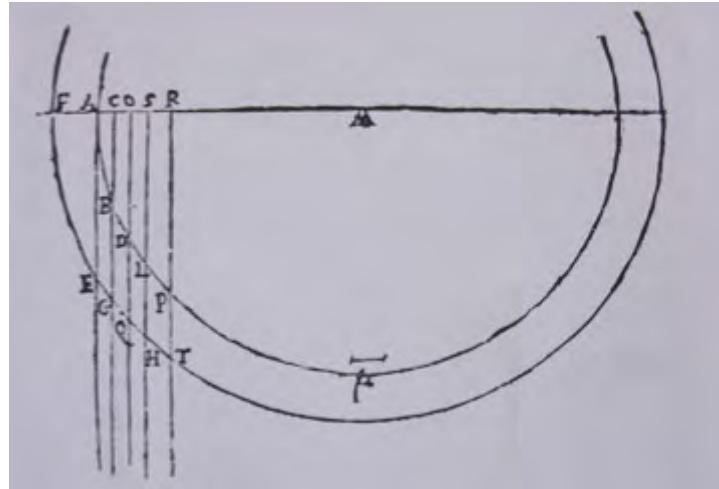
Leonardo da Vinci;
human proportions



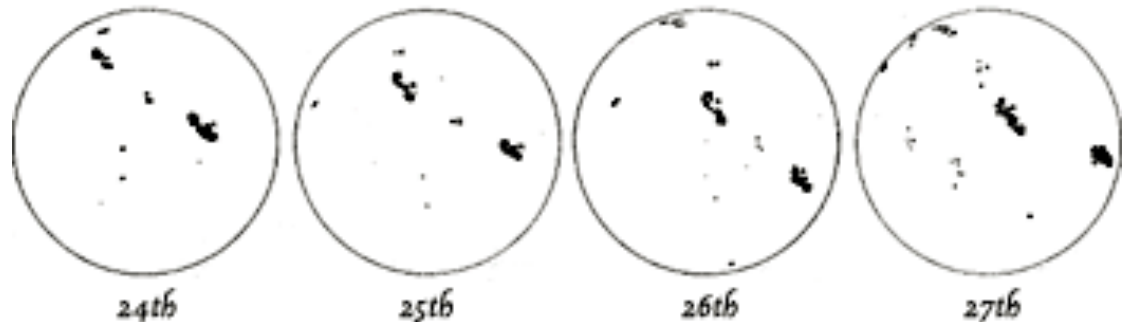


Space becomes Geometry with Galileo Galilei (1564-1642)

Sun spots projected by perspective



Sunspots drawn by Galileo, June 1612

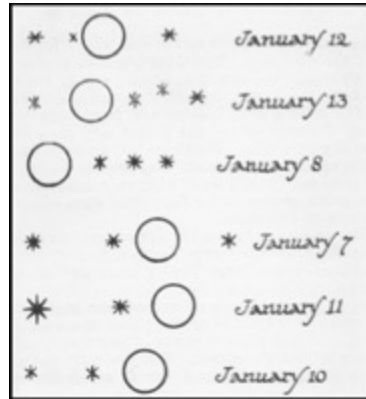


From art in the Renaissance to modern science

- Space become pictorial in the Renaissance
- Painting becomes Geometry in the Renaissance
- Space becomes Geometry with Galileo Galilei
- Geometry after Galileo becomes Physics, Mathematics, Chemistry and Biology

From Galileo' astronomy to modern Astrophysics

Galileo Galilei (1564-1642)



First astronomical observation (1610) of the Jupiter moons with *il canocchiale* (telescope)



Giovanni Virginio Schiaparelli (1835-1910) Martian astronomer and science historian.

Giovanni Domenico Cassini (1625-1712) from Perinaldo, near Imperia, mathematician, astronomer, astrologer and engineer. **Cassini's laws** provide a compact description of the motion of the Moon.



Riccardo Giacconi (1931- Genova) son of Italian migrants. Nobel Prize in Physics 2002 for pioneering contributions to **astrophysics**, which have led to the discovery of cosmic X-ray sources



From Geometry of Galileo to mathematics



Bonaventura Cavalieri
(1598-1647)

Bologna. Pupil of Galileo developed first idea of **infinitesimals** ahead of Calculus in **classic physics**.



Galileo Galilei (1564-1642)



Niccolo' Tartaglia (1499-1557), Venice. His greatest legacy to mathematical history, though, occurred when he won the 1535 Bologna University mathematics competition by demonstrating a general algebraic formula for **solving cubic equations**



Girolamo Cardano (1501-1576) Pavia, accomplished gambler and chess player, wrote a book called "Liber de ludo aleae" ("Book on Games of Chance") when he was just 25 years old, Was the first systematic treatment of **probability in games and in all sciences**.

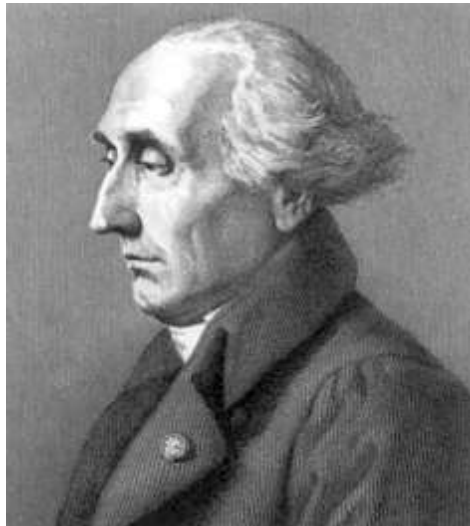
From Geometry of Galileo to mathematics



Galileo Galilei (1564-1642)



Giuseppe Peano(1858-1932) Torino, Theory of numbers, leading **modern cryptography** for internet communications

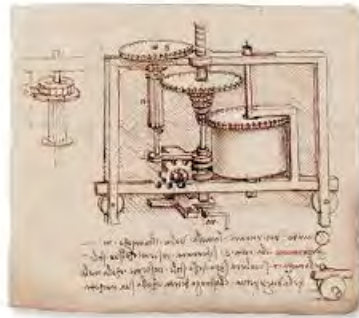


Giuseppe Lodovico Lagrangia (Lagrange) (1736-1813) Torino. re-formulated Classical-Newtonian mechanics to simplify formulas and ease calculations. These mechanics are called **Lagrangian mechanics** and for identifying for **ideal satellite locations** around the Earth still in use.



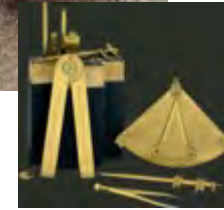
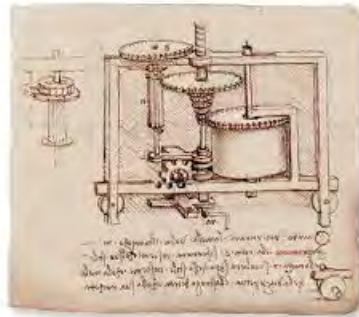
Vito Volterra (1860-1940), University of Pisa mathematician and physicist, known for his contributions to mathematical foundation of **Chaos Theory** applied to biological fluctuations in ecology

From the early gadgets of Leonardo and Galileo to modern applied sciences



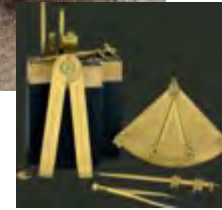
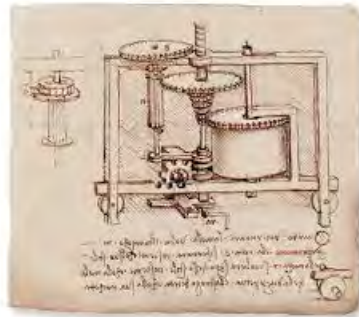
Galileo Ferraris (1847-1897)
physicist and electrical
engineer, one of the
pioneers of **Alternating
current power** system and
the inventor of induction
motor; Torino

From the early gadgets of Leonardo and Galileo to modern applied sciences



Luigi Palmieri (1807-1896)
physicist and meteorologist;
scientific studies of the eruptions
of Mount Vesuvius, **earthquakes**
and meteorological phenomena
Naples

From the early gadgets of Leonardo and Galileo to modern applied sciences



Scipione Riva Rocci
(1863-1937),
internist, pathologist
and pediatrician.
Invented the mercury
sphygmomanometer
for the **measurement
of blood pressure.**
University of Torino



Guglielmo Marconi
(1874-1937) Nobel
Prize in Physics 1909;
son of a migrant and
migrant himself
Invented the radio
(wireless telegraphy)

From Galileo to modern Physics

Galileo Galilei (1564-1642)



Laura Maria Caterina Bassi (1711-1778) physicist; the **first woman** in the world to earn a **university chair in a scientific field** of studies. University of Bologna



Evangelista Torricelli (1608–1647) invention of the **barometer**.

From Galileo to modern Physics

Galileo Galilei (1564-1642)



The “ragazzi di via Panisperma” Roma



From left Oscar D'Agostino, **Emilio Segrè**, Edoardo Amaldi, Franco Rasetti and **Enrico Fermi**



Enrico Fermi (1901-1954) Nobel Prize in Physics 1938; demonstrated the existence of new radioactive elements produced by neutron irradiation, **father of Atomic Energy**.



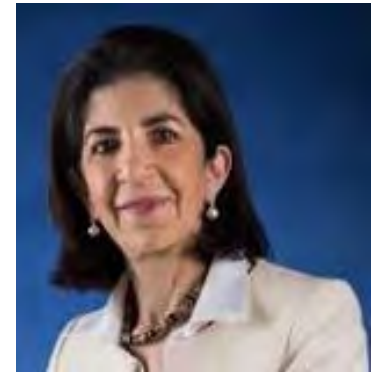
Emilio Gino Segrè (1905-1989) discovered the elements technetium and astatine, and the antiproton, a **sub-atomic antiparticle**; Nobel Prize in Physics in 1959.



Carlo Rubbia (1934-) son of refugees and migrated to USA and Switzerland; Nobel Prize in Physics 1984 for the large project, which led to the discovery of the field particles W and Z, communicators of **weak atomic interaction**“



William D. Phillips (1948-), son of Italian migrants; Nobel Prize in Physics 1997 for **atomic physics**.



Fabiola Gianotti (Torino) director-general of CERN; physicist who announced the **discovery of the Higgs boson** in 2012,



From Leonardo to fundamental chemistry and modern biology



Marcello Malpighi (1628-1694) reader at Bologna, and then a professor of physics at Pisa, developed a more **experimental method of research** on human internal organs (lungs, kidneys)



Francesco Redi (1626-1697) physician, naturalist, biologist and poet. Regarded as one of the "founders of experimental biology", and as the "**father of modern parasitology**". First to challenge theory of spontaneous generation
University of Pisa



Lazzaro Spallanzani (1729-1799) biologist and physiologist on experimental study of bodily functions, animal reproduction, and animal echolocation. University of Bologna



Lorenzo Avogadro (1776-1856); Founder of **molecular theory** now known as Avogadro's law. University of Turin

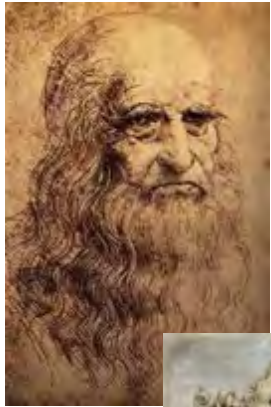


Stanislao Cannizzaro FRS (1826-1910) the Cannizzaro reaction; **atomic-weights**. University of Palermo

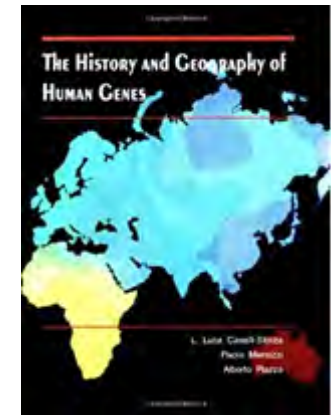


Giulio Natta (1903-1979) Nobel Prize in Chemistry 1963 "for discoveries in the field of the chemistry and technology of high Polymers" **Plastic materials**.

From Leonardo to modern biology, medicine and genetics



Giovanni Battista Morgagni
(1682-1771) father of
modern anatomical
pathology.



Luigi Luca Cavalli-Sforza
population geneticist professor
at Stanford University (1922-),
University of Pavia.



Angelo Mosso (1846-1910)
Professor of Physiology in Torino;
High altitude Laboratory
foundation of space travelling



If there's any interaction between genes and languages, it is often languages that influence genes, since linguistic differences between populations lessen the chance of genetic exchange between them. -Luigi Luca Cavalli Sforza

From Leonardo to modern biology, medicine and genetics



Salvador E. Luria (1912-1991) migrated in 1938. Nobel Prize in Physiology or Medicine 1969 "for discoveries concerning the replication mechanism and the **genetic structure of viruses**"



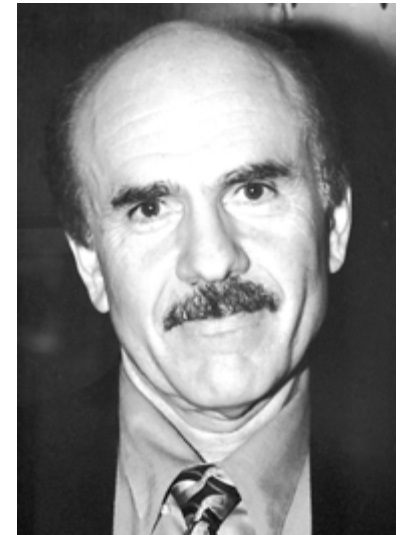
Both from Torino

Renato Dulbecco (1914-2012) migrated to USA in 1947. Nobel Prize in Physiology or Medicine 1975 "for discoveries concerning the interaction between tumour viruses and the genetic material of the cell". Father of **Human Genome Project**



Mario R. Capecchi (1937-) migrant and son of migrant mother and migrant grandparents Nobel Prize in Physiology or Medicine 2007 "for discoveries of principles for introducing specific gene modifications in mice by the use of **embryonic stem cells**"

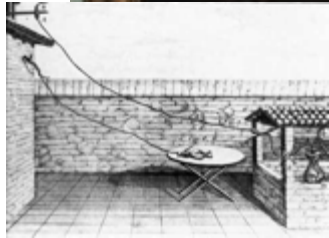
Louis J. Ignarro (1941-), son of Italian migrants Nobel Prize in Physiology or Medicine 1998 "for discoveries concerning **nitric oxide as a signalling molecule** in the cardiovascular system" (and nervous system)



The historical clash of Volta and Galvani on electricity

Luigi Galvani (1737 –1798) professor of Anatomy in Bologna; in 1791 published experiments he performed decades earlier: *“De viribus electricitatis in motu musculari commentarius”*.

He thought that he discovered an innate, vital force. He termed this force **“animal electricity”**, which activated nerve and muscle when spanned by metal probes. He believed that this new force was a form of electricity. He considered the brain to be the most important organ for the secretion of this “electric fluid” and the nerves to be conductors of the fluid to the nerve and muscle.



Alessandro Volta, (1745-1827) professor of Physics in Pavia

Volta rejected the idea of an “animal electric fluid,” replying that the frog’s legs responded to differences in metal temper, composition, and bulk. He referred to the electricity so generated as “metallic electricity”. While opposing Galvani’s theory of animal electricity he discovered (invented) the battery.

The two adversaries respectively set the foundations Galvani of **modern neurophysiology** and Volta of all development using **electricity in the modern world**.



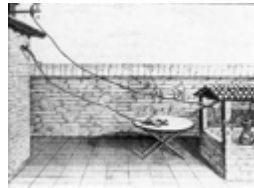
Leonardo



From Leonardo to modern Neuroscience



Luigi Galvani (1737 –1798)



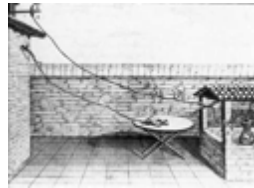
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Leonardo Bianchi (1848 –1927)
Giuseppe Moruzzi (1910-1986)
Giacomo Rizzolatti (1937-)**

Leonardo

From Leonardo to modern Neuroscience

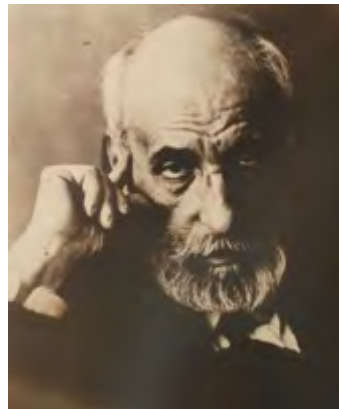
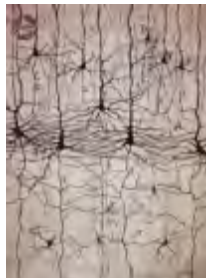


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The historical clash between **Camillo Golgi** (1843-1926) from Pavia and Santiago **Ramón y Cajal** () from Spain about the nature of the Brain. Both won the Nobel prize in Physiology and Medicine in 1906 for holding opposite theories on the nature of the nervous system.

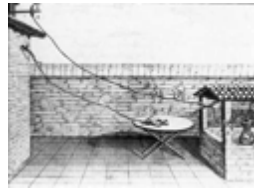


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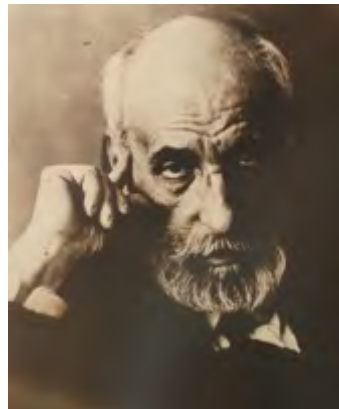
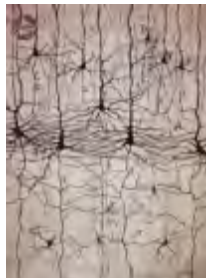


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Rita Levi-Montalcini (1909-2010) Torino migrated to USA after the WWII. Nobel Prize in Physiology or Medicine 1986 “for the discoveries of **nerve growth factors**”.



Some closing considerations

- Italian science has played critical roles in all historical periods



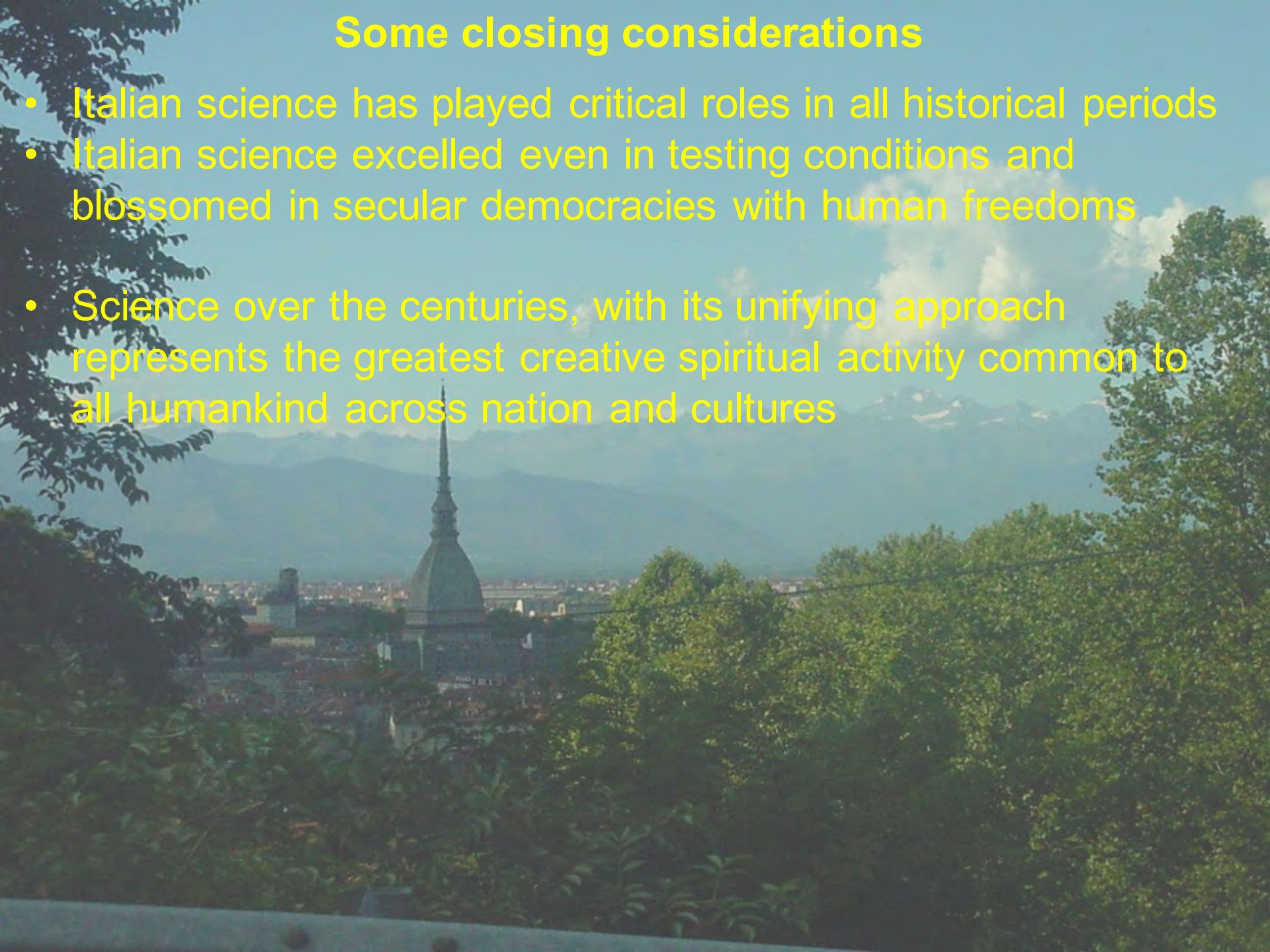
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- Italian science has played critical roles in all historical periods
- Italian science excelled even in testing conditions and blossomed in secular democracies with human freedoms



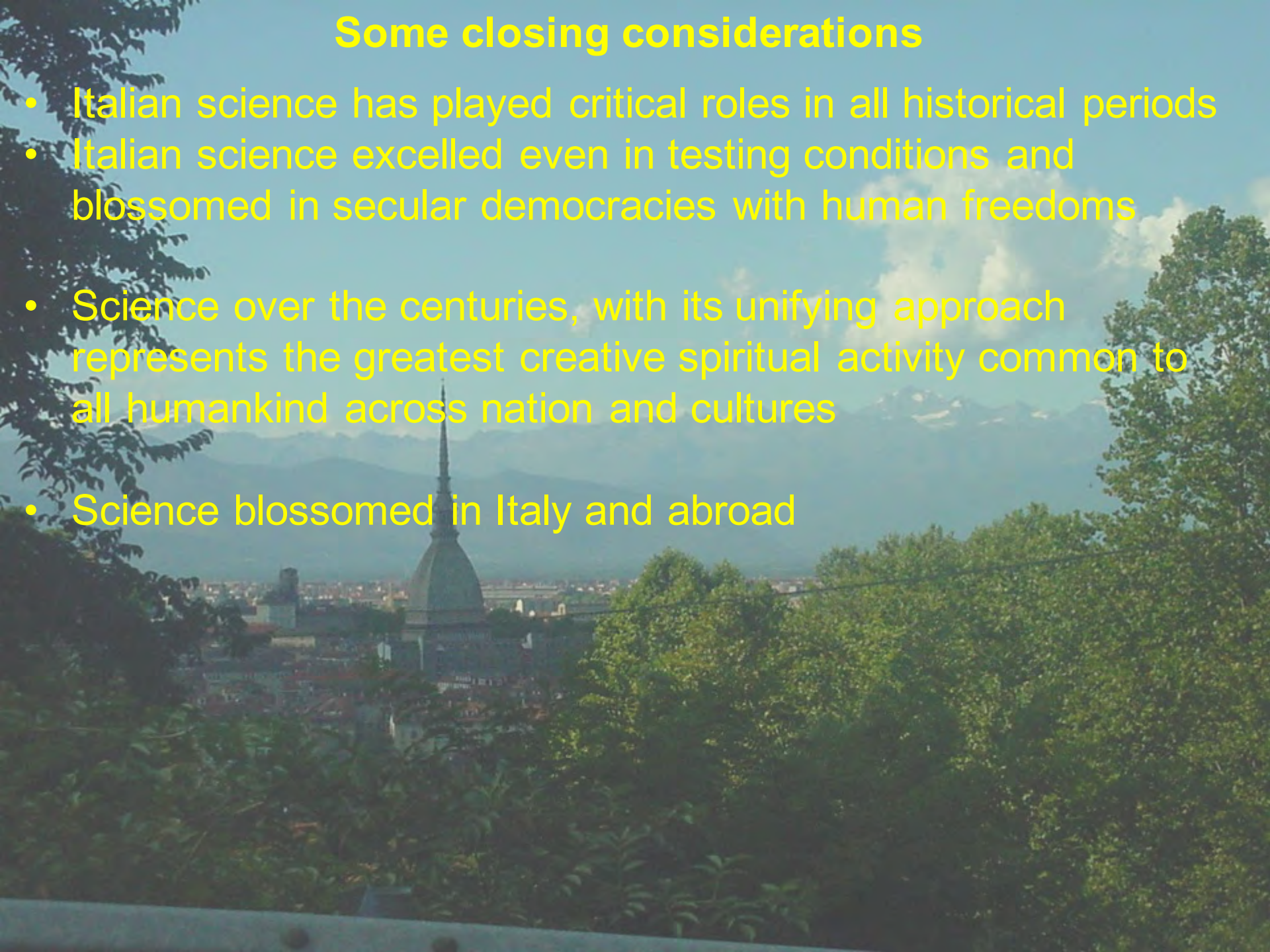
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- Science over the centuries, with its unifying approach represents the greatest creative spiritual activity common to all humankind across nation and cultures



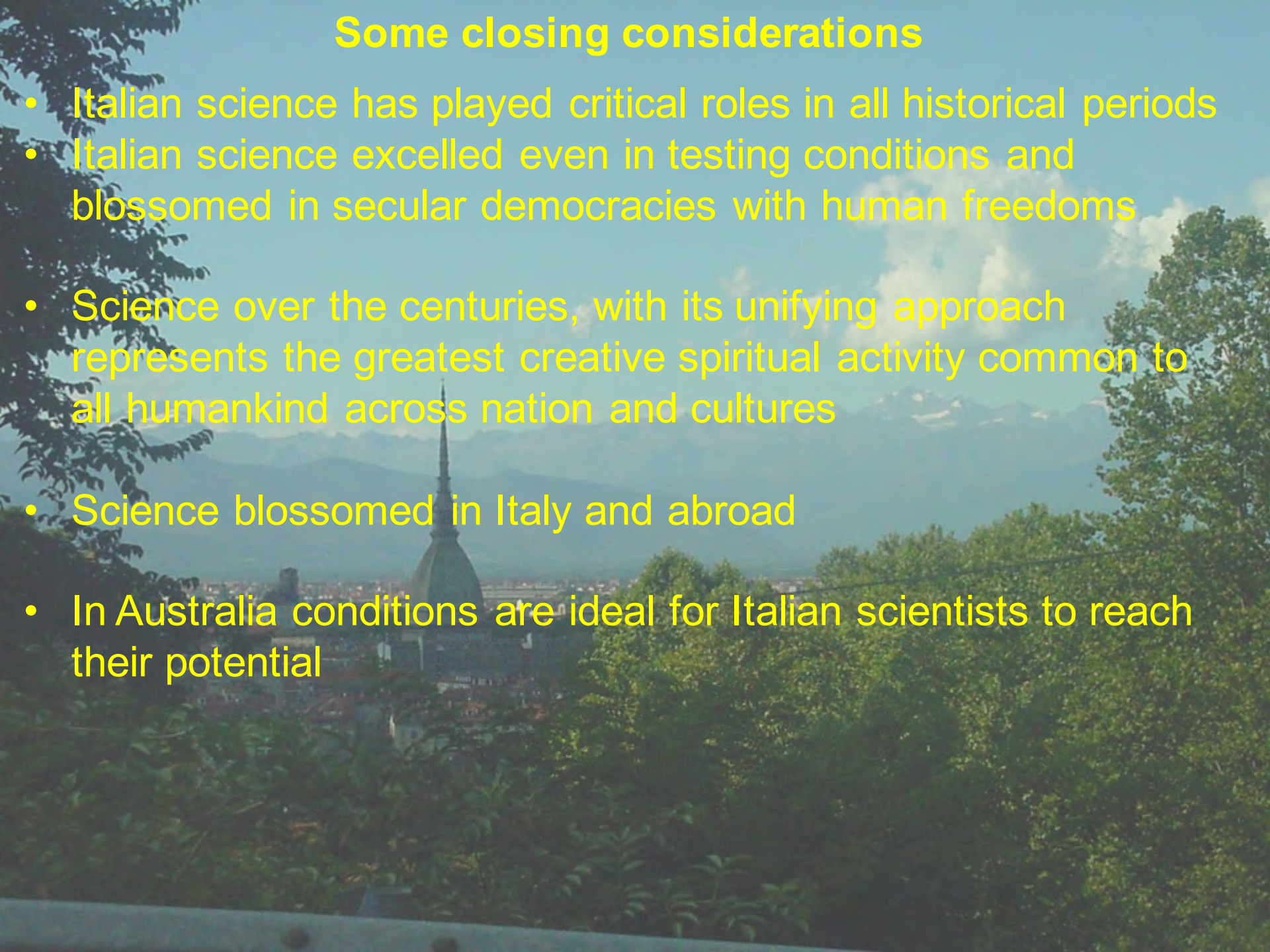
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- In Australia conditions are ideal for Italian scientists to reach their potential
- Migrants from all over the world and their children are a most promising source of future excellent scientists



**ONE HUNDRED
YEARS OF RITA**