James Dashow

ARCHIMEDES

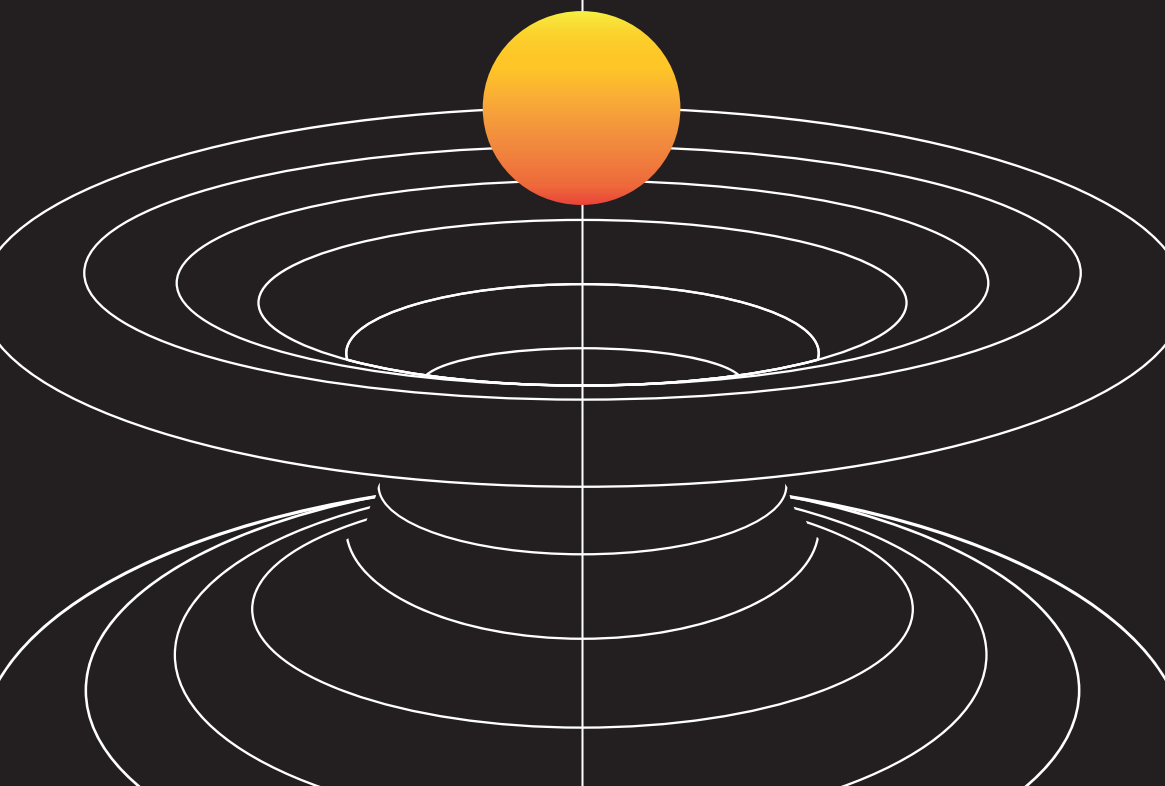
A PLANETARIUM OPERA

SELECTED SCENES

Libretto by Cary Plotkin *with* Ted Weiss
based on a conception of the composer

Digital video art

Prologue	Kevin Beaulieu
Mathematics I	Rudolfo Quintas
Mathematics II	Sebastian Cudicio
Mathematics III	Lorenzo Ceccotti



ARCHIMEDES

A planetarium opera by JAMES DASHOW
(2000-2008)

Selected scenes with narrator (1:07 h). In English with subtitles.
The selected scenes include computer animations that represent Archimedes' intuitions, synchronized with music (hexaphonic electronic sounds). The narrator's account gives continuity to the story, replacing the scenes not included. He is synchronized with music derived from the complete opera for this performance. The projected videos are the original ones digitized around 2005 by various graphic artists. Their aim is to generate an audio-visual planetarium ballet with attention to the spatialization of sounds.

EXORDIUM		The narrator (Marcellus) begins the story
PROLOGUE	**PART I**	***In Which it All Begins*** for actor (the Prime Mover), electronic sounds and computer animations (by Kevin Beaulieu)
	PART II	***The Demiurge*** for high tenor, high soprano, electronic sounds, electronically transformed instrumental sounds
ACT I	**SCENE II**	***Young Archimedes*** – narrator followed by ***Mathematics I*** – electronic sounds and computer animations (by Rudolfo Quintas)
	SCENES III & IV	***EUREKA and Archimedes goes to Syracuse*** narrator followed by Mechanical Mime (Archimedes shows his inventions)
ACT II	**SCENE I**	***Marcellus enters the scene*** – narrator
	SCENE II	***Syracuse comes to Archimedes*** – narrator including ***Mathematics II*** – electronic sounds and computer animation (by Sebastian Cudicio)
	SCENE III	***Archimedes at War*** – narrator (Archimedes' deadly machines)
ACT III		***The Death of Archimedes*** ***Mathematics III*** – electronic sounds and computer animations (by Lorenzo Ceccotti)

CAST, DIRECTION & PRODUCTION TEAM

General direction and adaptations	James Dashow
Iniciative and coordination	Chantal Ferrer Roca, Andrea Bombi
Musical director	Gregorio Jiménez Payá
Stage director	Andrés Moreno Valdivieso
Light and sound (Hemisfèric, CAC)	Juan Vicente la Parra
Narrator (Marcellus)	Luis Peset
Demiurge	Sara Peinado Russell, Miriam Silva Martínez, María Prats Escriche
Contemporary mime/ Idea	Andrés Moreno Valdivieso
Interpreters	Alberto Á. Escartí Castañeda, Aurora García i Agud, David Lagarde, David Rodríguez Jiménez, Gemma Miravet Andreu, Irene Dehesa, Jorge Tárraga Camacho, Marc Orero Quiles, Nara Pérez Gómez, Pablo Sanmartín Torres, Ramón Bixquert Castelló, Xavier Giménez Antonio José Grande García
Singers preparation	Gloria Fabuel
Consulting, texts and program	Andrea Bombi, Chantal Ferrer
Graphic design	Alejandra Ramiro
Costumes	CONTACTART (Acciones Artísticas Contemporáneas) Rafael Ricart In collaboration with Koopera and Xavi Villaplana
Hemisfèric Coordinator (CAC)	Mª José Cebrián

PERFORMANCES

Hemisfèric (Ciutat de les Arts i les Ciències, Valencia) 2019

June 10	09.30 h – School students
	21.30 h – Invisibles conference and general audience
July 10 and 12	22.30 h – GR 22 and Amaldi 13 conference
July 18	22.00 h – ICIAM 2019 conference

JAMES DASHOW

(1944, Chicago, USA) is a composer of electroacoustic music, instrumental music and opera. One of the first composers for digital audio synthesis, he studied with Arthur Berger and Goffredo Petrassi (Fullbright scholarship), and was invited by G. Tisato to work at the computer center of the University of Padua, where he created the first computer-based compositions. He has lectured at MIT and Princeton University and continues to teach master classes and give concerts in Europe and North America. He has been vice-president of the "International Computer Music Association". He is the author of the MUSIC30 language for digital sound synthesis and inventor of the Dyad system. For several years, he co-produced a weekly program of contemporary music for RAI in collaboration with Riccardo Bianchini. The most important awards and prizes he has received include the "Prix Magistere" de Bourges (2000), the Guggenheim Foundation (1989) the Koussevitzky Foundation (1998), and in 2011 the CEMAT Foundation awarded him the prize for his entire career in recognition for his exceptional contributions to electro-acoustic music.

http://www.jamesdashow.net/

SYNOPSIS AND REFLECTIONS

James Dashow

The opera tells the story of one of the greatest scientists who ever lived framed as both a human tragedy and a tragedy of humanity. It is told by Archimedes' great antagonist, Marcellus, the Roman consul whose military suffered so horribly at Archimedes hands, but who understood that Archimedes was equally a force for good, that it depended on who wielded that force and to what purpose.

The narrator (Marcellus) begins from the beginning, starting with the Platonic vision of the creation, the immense forces that produce in the end the extremely gifted being called Archimedes, as the Demiurge's experiment. He grows from childhood into the youth who

discovers that he magnificently understands geometry, all with music and imagery swirling around the planetarium dome. His adventures in the public baths, both mathematical and more, end with the famous EUREKA, and he goes to Hieron's court with his discoveries, to become part of the splendid civilization Hieron is constructing. But after Hieron's death, Syracuse, allied with Carthage, becomes prey to the Roman imperial vision. Desperate, the people of Syracuse beg Archimedes to turn his geometries to the defense of his city. Here, the human tragedy takes the form of Archimedes' dilemma: defile his mathematics in order to do battle with Rome, or maintain the purity of his thought while his people suffer. He relents, and the horrifying devastation of the Roman forces by his war machines is told in the climactic battle scene. Marcellus is able to defeat Syracuse only by deceit, and in the third act, the consul invites Archimedes to help Rome build a golden age of peace. But the forces that made Archimedes now see the tragic flaw, foresee the death and destruction that will be the first yield of Archimedes' science, the inevitable distortions in the way humans use the gifts of the great men and women who so rarely come among us. For they, the cosmic forces, have also failed in their experiment. In the form of a Roman soldier, they kill him.

The story of Archimedes is based on what we know about his life from those few pages in Plutarch, from the legends and his extant writings. The general approach to this work involves a great deal of "electronic stagecraft" and in particular the immense possibilities of full immersion in the sights and sounds offered by the extraordinary digital Planetarium technology. To borrow a phrase from William James, the opera is conceived as "a stream of metamorphosing tableaux and echoing images", complete with an unexpected Da Ponte-like ending. During the opera, Archimedes imagines not only the mathematics of his time, but the entire course of mathematics and physics up to our own (Feynman diagrams, strings, multiverses, etc.). This gives me an opportunity to use the extraordinary images, symbols and diagrams as materials for a sort of planetarium ballet, elaborated with particular attention to surround sound and, eventually, surround video. A great deal of attention has been given to the spatialization of the sounds, or the movement of sounds in space and the movement of space using sounds, in order to create a theatrical experience that includes the listener, not just situating the audience outside the unfolding events as an external observer.

Archimedes' science in also present in this opera in a less evident way. Archimedes demonstrated that, given a cylinder circumscribing a sphere, the ratio between the volumes and the surfaces of the two solids is 3:2. According to Plutarch, he considered this finding so important that he asked both geometric figures to be inscribed over his grave. The music that I conceived for the character of Archimedes develops in the music interval of fifth, which keeps precisely this proportion.

AN ARCHIMEDEAN CIRCLE

Chantal Ferrer-Roca

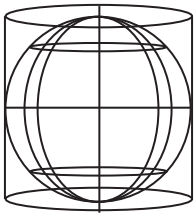
We have all learned that Archimedes ran naked through the city of Syracuse, shouting Eureka!, after he had found, while taking a bath, the solution to King Hieron's problem: how to tell if a crown was made of gold or if it was just amalgamated. Apparently, the water overflow when entering in the bathtub would have inspired him the method to solve it. Galileo Galilei, a fervent reader and admirer of Archimedes, gives no credit to this story mentioned by Vitruvius, as

he thinks it is not consistent with the scientific sophistication he had found in Archimedes' treatises. In fact, Galilei wrote "La Bilancetta" (the little balance) to describe a method -still used nowadays- to measure the density of a body following the Archimedean hydrostatics from the treatise "On the floating bodies".

Different authors have evidenced[1] that Archimedes' theoretical and technological interests ran in parallel. It is known that he addressed many physics and mathematics problems: the method of exhaustion, precursor of the infinitesimal-integral calculus recovered in the modern era, combinatorial calculus and many different mechanical and hydrostatics studies. Also the design of gears and pulleys (it is said he could launch a ship with just one hand), the *manus ferrea* (claw) that destroyed the Roman navy, or the ship *Syracusia* cited by Ateneus, a sort of Titanic. Also the mechanical planetarium referred to by Cicero, whose theoretical foundations Archimedes collected in a treatise on spheroids, the science behind astrolabes and armillary spheres that was recovered in the 15th century thanks to Islamic and Byzantine treatises that partially preserved the ancient knowledge. Even Leonardo da Vinci admitted that some of his futuristic inventions such as the Architronito, (steam-powered cannon) were Archimedean.

No doubt Archimedes was an outstanding scientist in extraordinary historical coordinates, the cosmopolitan Hellenistic culture (IV-II c. B.C.E.), gravitating around metropolis like Alexandria and Athens in the vast territories once conquered by Alexander the Great. And with a no less exceptional company: Herophilos, Ctesibius, Philo, Eratosthenes, Appolonius, Aristarchus, Hipparchus or Seleucus. A later Heron's treatise[2] that included coin-operated dispensers, mechanical automatons and hydraulic clocks has continuously been supported by archaeological findings: vacuum pistons, hydraulic pumps, precision screws, gear reducers, camshafts or devices such as the Antikythera mechanism. Discovered in a sunken ship near Crete, it turned out to be a sophisticated calendar clock indicating the positions of the Moon, the Sun and the planets throughout the year. The Archimedes planetarium cited by Cicero might have been one of this kind. François Charette[3] declared that this mechanism, of stupefying technological sophistication, "is a useful reminder that history seldom follows simple, linear paths". Historian of science Alexander Koyrè summarized the scientific work in the 16th century as the admission and gradual comprehension of Archimedes' writings. For some others, the prodigious flowering of modern science in the 17th century would be the result of the reception in fertile soil of the vestiges of Hellenistic science. In other words, that singularity we call "modern science" did not happen *ex-novo* with Galileo, Kepler, Hooke or Newton. It was also a return, as they themselves often acknowledged[4].

Archimedes and what he symbolizes is here now, in many ways. In the scientific and technological developments involved in our research, in the sophistication of these synthesized sounds and synchronized videos projected on this planetary dome, where cutting-edge art and science meet. And in the questions and dilemmas posed by this opera about humanity and our relation with science and technology. Some sort of Archimedean circle is closing.



1. Paipetis, S. A. & Ceccarelli, M. (2010): *The genius of Archimedes. 23 centuries of influence on mathematics, science and engineering*. Dordrecht, New York: Springer.
2. Woodcroft, B. (1851): *The Pneumatics of Hero of Alexandria*. London: Taylor Walton And Maberly (Library of Congress https://www.loc.gov/item/07041532/)
3. Charette, François (2006): *High tech from Ancient Greece*. Nature 444 (7119): 551-552.
4. Russo, Lucio (2004). *The Forgotten Revolution. How Science Was Born in 300 BCE and Why It Had To Be Reborn*. Berlin: Springer.

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