Passover break - Fifth episode

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A few years ago, at Pesach time, I published a 4-part article in Sharsheret Hadorot which recounted short stories of relevance to Passover and to genealogy[1]. Here is a fifth tale which I told at this year' *Seder*, essentially more of a troubling anecdote than a story.

This academic semester I have been busy writing notes for a new graduate course I decided to teach this year at the Weizmann Institute. The lectures deal with the mechanics of biological materials and includes aspects of the elasticity of soft and hard tissues, the fracture physics of solid bodies, the mechanical behavior of plants and natural structures, and so on. I sometimes enjoy delving into the original sources of the material I am teaching, and tell the students about the often astonishing brainpower of scientists-philosophers from two, three or four centuries ago. In this case I read in its entirety Galileo Galilei's book 'Dialogues Concerning Two New Sciences'. As expected, or even more than expected, this book reveals the genius of one of the architects of man's universal knowledge, one of the true makers of our civilization. I must tell you, however, that I could not have guessed that I would discover the following.

'Two New Sciences' was printed in 1638 in Leiden by the Elzevir, a celebrated family of Dutch booksellers, publishers, and printers of the 17th and early 18th centuries. Originally from Leuven, Belgium, the family was involved with the book trade from the 16th century, but ceased printing in 1712. The homonymic contemporary publisher Elsevier is well-known to all of us scientists, as many of our research articles are published in specialized journals and books belonging to the Elsevier Group. The symbol of the modern publishing house is an elm tree, a fruitful vine and a man alone, with a motto, *Non Solus*, the same symbol and motto as those of the ancient Dutch booksellers.

Rather than being made of traditionally numbered chapters, Galileo's 'Two New Sciences' is divided into 4 Days (a 5th Day was eventually left out to allow faster publication). The text consists of a lively scientific exchange between three apparently fictional interlocutors: Salviati, Sagredo, and Simplicio. The protagonists are discussing the fundamentals of quantitative reasoning as applied to two sciences: (1) the resistance of solids to fracture, and (2) the motions of objects (what we would call today dynamics and mechanics). Salviati is apparently named after Filipo Salviati, who until his death in 1614 had been a close friend of Galileo's in Florence. Sagredo is an initially neutral, intelligent and clear-thinking representative of the educated public, presumably named after Galileo's former student and friend Giovanni Francesco Sagredo of Venice (1571–1620). The doctrinaire Aristotelian of the trio is called Simplicio, apparently named after Simplicius, a Greek philosopher of the 6th century AD, known for his commentaries on Aristotle. Galileo is obviously speaking through Salviati and presents the modern (Copernician) view of science, contrasting with Aristotle's traditional standpoint which is

defended by Simplicius. The Italian word for 'simple-minded' is "semplice" and Galileo's insinuation is evident. The book is a penetrating dialogue on fundamental scientific questions and the genius of Galileo is clearly perceptible throughout the whole text.

While reading Galileo's lively volume, I found myself wondering why it all looked so familiar to me. It soon became clear: the conversation between Salviati, Sagredo and Simplicio, the mutual questioning and argumentation, were curiously reminiscent of the Haggadah of Pesach!

As is well known, the Haggadah commemorates the story of the Exodus, in which the ancient Israelites were freed from slavery in Egypt. The theme of the Haggadah is thus liberation from slavery and has universal implications... The theme of "Two New Sciences" is liberation from the slavery of Ptolemaic and Aristotelian frozen scientific truths (and indirectly, from the strict religious diktat in Galileo's time, which is why his world-shattering views caused him much trouble with the Church), and has, too, universal implications. Compared to the 3 questioning protagonists in Galileo's text, there are 4 questioning children in the Haggadah: the wise one, who wants to know the technical details; the wicked one, who excludes himself from the community; the simple one (the Haggadah's Simplicio!), who needs to know the basics; and the one who does not know how to ask, who doesn't even know enough to know what he needs to know. There are 4 questions being asked and answered (the most famous one, *Ma Nishtana*? What has Changed or What is Different? may be compared to Galileo's Why is this science different from previous science?), and 4 cups of wine to be drunk during the *Seder.* Finally, it is hard to ignore the comparison between the shank bone on the *Seder* plate, which reminds us of the tenth plague in Egypt, and Galileo's discussion of the unexpected effect of size and scale on the strength of materials –accompanied by a drawing of a bone by Galileo's hand.

Was Galileo inspired by the Haggadah? Did he have Jewish acquaintances in Padua, Venice or Florence, where he lived at different periods of his life? Did he ever participate in a *Seder*? The answers to these questions will likely remain Galileo's *Afikoman*, and will most probably never be discovered.

Reference:

1. *H.D. Wagner, "Passover Break, in Four Episodes", Sharsheret Hadorot 20 (3) (August 2006).*

DISCORSI
E
DIMOSTRAZIONI
MATEMATICHE,
intorno à due nuoue ſcienze
Attenenti alla
MECANICA & i MOVIMENTI LOCALI;
del Signor
GALILEO GALILEI LINCEO,
Filoſofo e Matematico primario del Sereniſſimo
Grand Duca di Toſcana.
Con vna Appendice del centro di grauità d'alcuni Solidi.

IN LEIDA,
Appreſſo gli Elſeuirii. M. D. C. XXXVIII.

FIRST DAY

INTERLOCUTORS: SALVIATI, SAGREDO AND SIMPLICIO

SALV. The constant activity which you Venetians display in your famous arsenal suggests to the studious mind a large field for investigation, especially that part of the work which involves mechanics; for in this department all types of instruments and machines are constantly being constructed by many artisans, among whom there must be some who, partly by inherited experience and partly by their own observations, have become highly expert and clever in explanation.

SAGR. You are quite right. Indeed, I myself, being curious by nature, frequently visit this place for the mere pleasure of

To illustrate briefly, I have sketched a bone whose natural length has been increased three times and whose thickness has been multiplied until, for a correspondingly large animal, it would perform the same function which the small bone performs for its small animal. From the figures here shown you can see how out of proportion the enlarged bone appears. Clearly then if one wishes to maintain in a great giant the same proportion of limb as that found in an ordinary man he must either find a harder and stronger material for making the

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bones, or he must admit a diminution of strength in comparison with men of medium stature; for if his height be increased inordinately he will fall and be crushed under his own weight. Whereas, if the size of a body be diminished, the strength of that body is not diminished in the same proportion; indeed the smaller the body the greater its relative strength. Thus a small dog could probably carry on his back two or three dogs of his own size; but I believe that a horse could not carry even one of his own size.

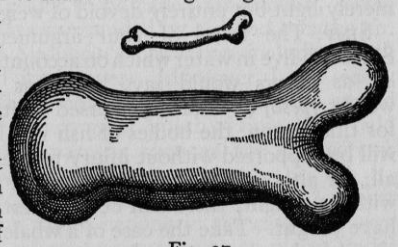

Fig. 27