Cardinal Cusas Dialogue of Static Experiments

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Translated from the German by Michael Kirsch

1.*Nicolai Cusani, De staticis experimentis dialogus, finds itself with M. Vitruvii Pollionis de Architectura Libri X. Strassburg1550*:

A philosopher entertains himself with a mechanic; the mechanic observes that these scales serve the purpose of recognizing the nature of bodies. Water of equal mass does not have equal weight. Sure enough its weight changes, as the water at its source, is different from the same water at a distance from it, though these barely appreciable differences can be set aside. The weight of blood and urine are not equal for the sick and healthy, the young and old, German and African. So a physician would do well to make note of these distinctions. Also, recording the division of weight and juices of plants, with their origin, would teach more about their nature than the deception of their taste. Comparing these weights with the weights of blood and urine determined the doses and taught the diagnosis. Thus easily through weight experiments, one can ascertain such knowledge. Water is allowed to flow from the narrow hole of a water clock, thus lasting as long as a hundred heartbeats of a healthy young man, and in turn a hundred of a sick man. One will not find the same weight of emanating waters. Thus, with the differences of pulses, weight renders knowledge of diseases. In the same way compare a hundred respirations of a sick person and a healthy person. People could be weighed in air and water; even animals. Accordingly, make modifications and write down that which is measured.

2.These modifications which the philosopher does not understand, the mechanic explains thus: he takes a piece of wood, whose weight, compared to the weight of water filling up an equally big space, is in a 3:5 proportion; he divides it into two unequal parts, one twice as big as the other; he puts them in a large tank, presses them down to the bottom with a stick, pours water in, filling the tank, and then pulling the stick away, both parts ascend, the bigger one faster than the smaller. *Ecce tu vides diuersitatem motus in identitate proportions ex eo euenire quia in leuibus lignis, in maiori est plus leuitatis. Philo. Video et placetmultum.* The philosopher receives continuous pure lessons from the mechanic, and expresses gratitude. Therefore he had conformed his take to reflect the mechanics experience, adjusting to the same concepts, and testing the conclusions. But sure enough terms and conclusions of the philosopher were at that

time still quite imperfect, as were the mechanics.

The lightness of wood in water had to be caused by the water forcing the wood up, since wood in air is not light. Sure enough, the larger piece of wood is forced upwards by a greater body of water, but it is larger by the same ratio, whereas the force that forces it up is equal to the force that lifts up the smaller piece. However the surface of the bigger wood conducts itself to the surface of the smaller, if both parts have similar figures = root 2: 1 since the masses themselves, and conducts the upwards propelling moving power = 2: 1. Since then the resistance of the water, if all the rest is the same, still adjusts the surface, thus might consider in conjunction with the moving power upwards to be the bigger part of wood not as much as by the smaller, and those might climb faster, since the mentioned masses are somewhat a hinderance to the resistance.

3.The mechanic also discoursed concerning the resistance of water, but not in the manner which we currently use the word: he meant, it resists, *as the more resists the less (ut maior gravitas minori).* If a round piece of wood is pressed in wax, and fills the cavity with water, weighing more than the wood, it will float, and a part of it remains above the water, of which the excess corresponds to the weight of water. If the piece of wood is not round but flat, it makes a bigger space, and floats more, thus, ships in shallow water have level bottoms.

4.Also a proposal to research the attractive power of magnets, and the like power of diamonds, which, as he would say, resist the attraction of magnets, and the power of other stones, in conjunction with their magnitude..

5.If one hundred pounds of earth which had been weighed with its plants and seeds growing from it, is put in a pot with the plants and seeds removed, and weighed again, then one would find that it had lost a little weight, and accordingly therefore, plants receive their weight mostly from water. If the ashes of herbs were weighed, the amount of weight the water has contributed would be revealed. The elements transform themselves partly to one another, as water becomes stone.. with the balance, earth, oil, salt.. will lead to much research.

6.Also the entire globes weight can be conjectured from the weight of a cubic inch because its circumference and diameter are known. *The philosopher thereby recollects, In maximo ista vix conscriberentur.* More understandings from these matters might have given other recollections.

7.Perhaps, said the philosopher, would one also come, through such subtle conjectures, to the weight of air? The mechanic responded thus: Much dry, pressed together wool is put into a bowl of a large balance, and in the other bowl stones of equal weight. That, in temperate air. The weight of the wool would be found to increase, or decrease, accordingly as the moisture or dryness of the air. That would lead to conjectures of the weather.

8.If one would weigh a thousand grains of wheat or barley, from fruitful fields and varying climates, then he would learn from this something about the force of the sun in these declinations. Also thus from mountains and in valleys, of the same geographic parallels, *(in eadem linea ortus et occalus).*

9.If a rock falls from a high tower, and water flowing from a pierced hole is collected during the time of the fall; then, doing the same with a piece of wood

of like magnitude, the philosopher believed that the differences of the weight of these three things would yield the weight of the air. The mechanic judged: repetitions from various equal sized towers, and of various times, would confer endless speculations. The air can be weighed yet easier, if one fills the same bellows equivalently for various times and at various places, the same motion observed through equal heights, and water which had flowed in this time from a waterclock is weighed.

10.To find the depth of the ocean, an approximate a procedure, which I have written in Puehler Geometrie Book I page 674. The power of men to weigh green wood, and its varying weight depending on its degree of warmness and the coldness, and its dryness and the humidness.

11. If the entire year through each day from the rising of the sun until it sets, water flowed from the water clock, and would be weighed, thus, from these recorded weights, the weight of the day of the month and hour of the day can also be conjectured; but on a short day these changes are uncertain. Thus the water could also be weighed, that flows in between two transits of a fixed star through the meridian, and that in between two risings of the sun, and further, concluding from the motion of the sun in the zodiac, the inequality of the motion of the sun itself. When the sun is rising on the equator, the water that flows in between the rise of its upper part to lower part provides the relation between the solar body to its sphere. Thus the mechanic will also need a water clock with the moon, with a lunar eclipse, to determine the relationship of the moon to the earths shadow.

12.If in March the certain weights of water, of wood, of air, were found, and compared with the weight of other years and the seasons, one would thereby deduce the bigger or smaller fertility, as from astronomical laws. If at the beginning of winter fish and creeping animals are found to be fat, a long and harsh winter is conjectured, because nature protects creatures against it. The weight of a bell, pipes, and the water that fills the pipes, gives the measure of the notes. Measure of circles and of squares, and all as regards spatial figures, also provides the truth, more easily through weight than other methods[1] So can one weigh up, how much, lines planes and bodies, taking up a certain space, and from such a measure like measures can be inferred.[2]

[1]Cusa elaborates that the ratios of polygons areas could be found by weighing the water that would fill up cylinders cut in the shape of those polygons.

[2]Kästner passes over Cusas discussion of harmony which has bigger meaning with regard to Keplers work, and the current investigation by Larry Hecht on the relation between harmonics and the moon model. I excerpt it here: *Layman:Experiments done with weight-scales are very useful with regard to music. For example, from the difference of the weights of two bells of consonant tone, it is known of which harmonic proportion the tone consists. Likewise, from the weight of music-pipes and of the water filling the pipes there is known the proportion of the octave, of the fifth, and of the fourth, and of all harmonies howsoever formable. Similarly, the [harmonic] proportionfrom the weight of mallets from whose striking on an anvil there arises a certain harmony, and from the weight of drops dripping from a rock into a pond and making various musical notes, and from the weight of flutes and of all musical instrumentsis arrived at more precisely by means of a weight-scale. Orator:So too, [as regards the harmonic proportion] of voices and of songs. Layman:Yes, all concordant harmonies are, in general, very accurately investigated by means of weights. Indeed, the weight of a thing is, properly*

The Philosopher recognized: a book in which such measurements were collected, would be very instructive, to be conveyed everywhere. And the mechanic closed: yes, if you care for me.

speaking, a harmonic proportion that has arisen from various combinations of different things.