GALILEO'S EXPERIMENTS FROM THE TOWER OF PISA

MR. PARTRIDGE'S declaration (SCIENCE, Sept. 17, 1920) that "we do not know exactly what experiment Galileo performed" from the leaning tower of Pisa appears to me too sweeping. In the first place, Vincenzio Viviani, in his life of Galileo, speaks of "repeated experiments" not of one "experiment." A series of trials is what one would expect. It is highly improbable that Galileo would perform an experiment before a university assembly which he had not previously tried out. The historic data are as follows: (1) Viviani tells us that Galileo at the leaning tower of Pisa used "different weights"; (2) Galileo in his "De Motu" (probably written before he left Pisa) speaks of dropping wood and lead from a high tower; (3) In his "Dialogues concerning two new Sciences,"[1] Galileo lets Sagredo say:

> But I, Simplicio, who have made the test can assure you that a cannon ball weighing one or two hundred pounds, or even more, will not reach the ground by as much as a span ahead of a musket ball weighing only half a pound, provided both are dropped from a height of 200 cubits.

Later Salviati says that "the larger (iron ball) outstrips the smaller by two finger-breadths." On the remark of Simplicio that perhaps the result would be different if the fall took place "from some thousands of cubits," Salviati replies:

> If this were what Aristotle meant you would burden him with another error . . . since there is no such sheer height available on earth.

It is true that in the above "Dialogue" Galileo does not give the place of experimentation and does not mention the leaning tower. But what other locality in Pisa would have been as favorable? From the above data it follows that Galileo dropped different weights of a variety of materials and noticed which of them fell faster.

[1] Translation by H. Crew and A. De Salvio, New York, 1914, pp. 62, 65, "First Day."

That Viviani was in a position to speak with authority follows from the fact that soon after Galileo had published his "Dialogue concerning two New Sciences," 1638, Viviani became his pupil and was in close contact with him for three years, receiving instruction which began with the theory of moving bodies. Favaro[2] advances evidence which shows that Galileo and Viviani became quite intimate, Viviani admiring the old sage and Galileo treating the young man as if a son.

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JONATHAN EDWARDS ON MULTIDIMENSIONAL SPACE AND THE MECHANISTIC CONCEPTION OF LIFE

IF the Einstein conception of space is multidimensional and inclusive of the essential conceptions of time and place, then Jonathan Edwards, whom John Fiske characterized as the greatest mind of the Western World, may prove to be the spiritual father of this geometry. Thus wrote Jonathan Edwards:[1]

> Supposing that there are two Particles or Atoms of Matter perfectly equal and alike, which God has placed in different Parts of the Creation. . . . If they are perfectly equal and alike *in themselves*, then they can be distinguished or be distinct only in those Things which are called *Circumstances;* as Place, Time, Rest, Motion, or some other present or past Circumstances or Relations. . . . If God makes two bodies *in themselves* every Way equal and alike, and agreeing perfectly in all other Circumstances and Relations but only *their Place*, then in this only is there any Distinction and Duplicity. The Figure is the same, the Measure is the same, the Solidity and Resistance are the same, and every Thing the same, but only the Place. . . . The Difference of Place, in this (the former) Case,

[2] Antonio Favaro, "Amici e Corrispondenti di Galileo Galilei. XXIX. Vincenzio Viviani." Venezia, pp. 8–19.

[1] "A Careful and Strict Enquiry into the modern prevailing Notions of that Freedom of the Will which is supposed to be essential to Moral Agency, Vertue and Vice, Reward and Punishment, Praise and Blame," 1754, p. 243; "Of God's Placing differently Similar Particles."