

ALI F. ABUTAHA

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Dr. Gary D. Gordon  
Washington Grove, MD

Dear Gary:

I like to add to my response of yesterday that the accuracies in the Cavendish experiment are worse than you indicated. You mentioned how "*students probably get 1% accuracy, and accuracies of 0.01% can be achieved;*" and that, accordingly, temperature dependence would have been detected before.

Actually, only 5% accuracy can be achieved with modern university quality apparatus, and only in special tests. For example, the 1993 College/University Physics Apparatus catalog (Central Scientific Company, Illinois) says, "*You can get a more accurate result, within 5%, by waiting for the pendulum to attain its new equilibrium position (after about an hour) ...*" This means that less accuracies have been tolerated. Perhaps, Victor would remember whether 8%, 10% or 15% were acceptable when he instructed on the experiment.

Even the standards did not achieve 0.01% accuracy. For example, the last measurement (that I know) of  $G$  was made in 1940, and it was reported as  $6.6732 \pm 0.003 \times 10^{-8} \text{ cm}^3 \text{ g}^{-1} \text{ sec}^2$  (sic) [A New Determination of the Constant of Gravitation, P. R. Heyl and P. Chrzanowski, NBSJR, Volume 29, July 1942]. This is the currently used value for  $G$ . The accuracy of this measurement, as given by the tolerances, is nearly 0.1%!

There were differences in the results from the sets of two balls of gold, platinum and glass. The 1930 report notes that, "*It is evident that the gold ball results are much less reliable than either of the other sets.*" I would note that the accuracy for all six measurements was  $> 0.3\%$ .

It is likely that even the standards' accuracies could have been worse had temperature been allowed to vary, as with primitive heating or no air conditioning. In the standards tests, the temperature was constant:

"Far position, May 15-18, 1940 ... Temp. 24.1° C."

"Near position, May 22-24, 1940 ... Temp. 24.1° C."

Consider some of the statements made in the standards' reports:

- 1- "*The first thing that attracts attention in the results ... is the apparent difference with the nature of the material*" 1930 paper.
- 2- "*... an explanation of this variation on the basis of difference of material is not admissible.*" 1930 paper.

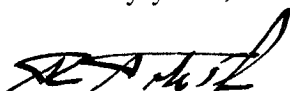
- 3- *"the mean values of the platinum and glass sets (of the 1930 tests) differed by an amount five times as great as the average departure from the mean in either set."* 1942 paper.
- 4- *"It will also be noted that the present results show the same peculiarity of pattern as did those in the 1930 paper."* 1942 paper.
- 5- *"The results with the hard-drawn filament differ from those with the annealed filament by an amount greater than can be accounted for by the departures from the mean."* 1942 paper.
- 6- *"It is difficult to explain this anomaly ... what is needed to account for the observed anomaly ... is a regular variation of such a nature as to be incredible."* 1942 paper.

The path to thermal equilibrium for different materials, from the molten state, is different. Could the *anomalies* and *peculiarities* be the result of thermal effects? Could the slight changes for reasonably constant mass be the result of slight temperature variations?

I am mindful of the episode you mentioned in our meeting about the individual who kept coming back with more evidence. This is a common experience. The above facts are officially unequivocal. But then, you might ask, how about the Eötvös experiment? Recently, several papers in the Physical Review Letters have questioned the accuracies of that experiment. And so on.

I think the most beautiful test of temperature-gravitation is free fall. But it takes a lot of thinking to see that bodies of different mass fall with the same acceleration (in vacuum) in a gravitational field because the bodies have the same temperature, and not because the effect of the mass is canceled with a mathematical step. I still hope to gain your support, and Victor's and others'.

Sincerely yours,



Ali F. AbuTaha

cc: Dr. Victor Slabinski