# Good to the Last Drop?
# Millikan Stories as ìCannedî Pedagogy

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Ullica Segerstrale examines the Millikan oil-drop experiment on a number of levels. The details of discrepancies between his published results and his laboratory notebooks are described. Specifically, he took data on more oil-drops than he actually reported, even though his paper stated that all oil-drops were included in his data analysis. Also discussed is the treatment of the Millikan story by various authors, and a concern is raised about the dangers of basing an ethical analysis on brief "canned" versions of a complex situation. Lastly, Segerstrale addresses the ethical implications of Millikan's data analysis, the extent to which such procedures are accepted in the scientific community, and their impact upon the scientific community. She asks, "Is the ethical accountability now increasingly required from science in principle attainable in a system which is so constructed that one gets rewarded for being a quick-and-dirty first rather than a conscientious second?"

**DISCUSSION**

Another interesting sidelight to the Millikan oil-drop experiment involves the viscosity of air, a quantity necessary for his calculations but, as it was later discovered, the source of a significant portion of his deviation from what is now the accepted value for the electronic charge. John Thomsen has pointed out (American Journal of Physics 36:368 (1968))that in Millikan's 1911 paper he mentioned that he had two other methods for finding e without relying on the viscosity of air. He rejected these approaches as being unnecessary. The question was posed in that 1968 note, "Are such modifications possible?" To date, no one has come forth with an answer.

It has been pointed out by Sharon Traweek in Beamtimes and Lifetimes (Cambridge, MA: Harvard University Press, 1988) that science is often presented in textbooks as a "history of saints". Well-known scientists are put on a pedestal. Perhaps the reaction of present day physicists to the issues raised by Millikan's oil-drop experiment are better understood in light of this observation. They were not so much defending Millikan's methods as they were his reputation as a "saint".

Why, if Millikan and so many others fudged their data, did their results hold up? How likely is it for wrong methods to give good results? One factor in the Millikan case is that Millikan was not after the "answer" but rather he was after reducing the error (and doubt about the theory's correctness). Would there have been any ethical problems if Millikan had in fact reported all of his data and then proceeded with the same data analysis?

Finally, some technical points were raised. First, many physicists would whole-heartedly agree with Millikan's dropping data associated with drops containing a net charge greater than 20-30 e (although arguably he should have reported having done so). Extracting the value of the elementary charge from such drops is problematic at best, given the equipment of his times. Secondly, it is misleading to imply that the fractional charge theory which Millikan was fighting has some credibility in light of the present theory of quarks. No generally accepted theory involving quarks also involves one being able to isolate a quark and thus being able to measure a fractional charge.

RETURN TO PROCEEDINGS TABLE OF CONTENTS

RETURN TO MARSHALL THOMSEN'S HOME PAGE