

# Chapter 9 The Natural Sciences

## Handout

### Excerpt from Chapter 1 of *The Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century* by David Salsburg

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It was a summer afternoon in Cambridge, England, in the late 1920s. A group of university dons, their wives, and some guests were sitting around an outdoor table for afternoon tea. One of the women was insisting that tea tasted different depending upon whether the tea was poured into the milk or whether the milk was poured into the tea. The scientific minds among the men scoffed at this as sheer nonsense. What could be the difference? They could not conceive of any difference in the chemistry of the mixtures that could exist. A thin, short man, with thick glasses and a Vandyke beard beginning to turn gray, pounced on the problem.

‘Let us test the proposition,’ he said excitedly. He began to outline an experiment in which the lady who insisted there was a difference would be presented with a sequence of cups of tea, in some of which the milk had been poured into the tea and in others of which the tea had been poured into the milk.

I can just hear some of my readers dismissing this effort as a minor bit of summer afternoon fluff. ‘What difference does it make whether the lady could tell one infusion from another?’ they will ask. ‘There is nothing important or of great scientific merit in this problem,’ they will sneer. ‘These great minds should have been putting their immense brain power to something that would benefit mankind.’

Unfortunately, whatever nonscientists may think about science and its importance, my experience has been that most scientists engage in their research because they are interested in the results and because they get intellectual excitement out of the work. Seldom do good scientists think about the eventual importance of their work. So it was that sunny summer afternoon in Cambridge. The lady might or might not have been correct about the tea infusion. The fun would be in finding a way to determine if she was right, and, under the direction of the man with the Vandyke beard, they began to discuss how they might make that determination.

Enthusiastically, many of them joined with him in setting up the experiment. Within a few minutes, they were pouring different patterns of infusion in a place where the lady could not see which cup was which. Then, with an air of finality, the man with the Vandyke beard presented her with her first cup. She sipped for a minute and declared

that it was one where the milk had been poured into the tea. He noted her response without comment and presented her with the second cup ...

### **The Cooperative Nature of Science**

I heard this story in the late 1960s from a man who had been there that afternoon. He was Hugh Smith, but he published his scientific papers under the name H. Fairfield Smith. When I knew him, he was a professor of statistics at the University of Connecticut, in Storrs. I had received my Ph.D. in statistics from the University of Connecticut two years before. After teaching at the University of Pennsylvania, I had joined the clinical research department at Pfizer, Inc., a large pharmaceutical firm. Its research campus in Groton, Connecticut, was about an hour's drive from Storrs. I was dealing with many difficult mathematical problems at Pfizer. I was the only statistician there at that time, and I needed to talk over these problems and my 'solutions' to them.

What I had discovered working at Pfizer was that very little scientific research can be done alone. It usually requires a combination of minds. This is because it is so easy to make mistakes. When I would propose a mathematical formula as a means of solving a problem, the model would sometimes be inappropriate, or I might have introduced an assumption about the situation that was not true, or the 'solution' I found might have been derived from the wrong branch of an equation, or I might even have made a mistake in arithmetic.

Whenever I would visit the university at Storrs to talk things over with Professor Smith, or whenever I would sit around and discuss problems with the chemists or pharmacologists at Pfizer, the problems I brought out would usually be welcomed. They would greet these discussions with enthusiasm and interest. What makes most scientists interested in their work is usually the excitement of working on a problem. They look forward to the interactions with others as they examine a problem and try to understand it.

### **The Design of Experiments**

And so it was that summer afternoon in Cambridge. The man with the Vandyke beard was Ronald Aylmer Fisher, who was in his late thirties at the time. He would later be knighted Sir Ronald Fisher. In 1935, he wrote a book entitled *The Design of Experiments*, and he described the experiment of the lady tasting tea in the second chapter of that book. In his book, Fisher discusses the lady and her belief as a hypothetical problem. He considers the various ways in which an experiment might be designed to determine if she could tell the difference. The problem in designing the experiment is that, if she is given a single cup of tea, she has a 50 percent chance of guessing correctly which infusion was used, even if she cannot tell the difference. If she is given two cups of tea, she still might guess correctly. In fact, if she knew that the two cups of tea were each made with a different infusion, one guess could be completely right (or completely wrong).

Similarly, even if she could tell the difference, there is some chance that she might have made a mistake, that one of the cups was not mixed as well or that the infusion was made when the tea was not hot enough. She might be presented with a series of ten cups and correctly identify only nine of them, even if she could tell the difference.

In his book, Fisher discusses the various possible outcomes of such an experiment. He describes how to decide how many cups should be presented and in what order and how much to tell the lady about the order of presentations. He works out the probabilities of different outcomes, depending upon whether the lady is or is not correct. Nowhere in this discussion does he indicate that such an experiment was ever run. Nor does he describe the outcome of an actual experiment.

Credit:

Salsburg, David. *The Lady Tasting Tea: How Statistics Revolutionized Science in the Twentieth Century*. New York: Holt, 2002 (print).