

Chance in Science: The Discovery of Electromagnetism by H.C. Oersted

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Abstract. Ignoring the role of chance in science distorts the nature of the scientific process. Teachers can address this issue by means of several in-depth historical case studies, such as the discovery of electromagnetism by Oersted. Oersted was led to his lecture experiment by logic (two new hypotheses), but its success from the first trial was largely due to chance. Reproducing Oersted's experiment in the classroom complements the story by allowing students to see for themselves the role of some accidental factors, such as the choice of materials and instruments. The message to students is that chance and logic go together in science.

Key words: history of science, discoveries in science, epistemology, serendipity in science, science teaching, electromagnetism, H.C. Oersted

1. Introduction

'Chance' seldom enters science textbooks, which is not surprising given that most of them are merely compendiums of laws and equations, the origin of which remains unknown. However, when a teacher is willing to address not only the results of discoveries but also the process of discovering, ignoring chance is inadvisable. Indeed, if a discovery is presented as merely a logical process, a curious student may ask of why the discoveries do not follow one another in an orderly way without incomprehensible gaps between them. Why, for instance, was electromagnetism discovered only in 1820, although all technical means and theories necessary for it were available as early as 1801?

Until recently, the history of science had not been of much help in this respect. A curious teacher could have found that chance played a role only in a few discoveries, named 'serendipitous' (Kohn 1989; Roberts 1989)). As a result, when presenting historical materials teachers preferred to use their limited classroom time to study more 'regular' features of discoveries than chance.

A division of discoveries into 'accidental' and 'regular (or theoretical)' implies that if chance is involved, there is no theory behind a discovery; or, conversely, if a scientist follows a certain idea, this precludes any role to chance. In fact, even a superficial examination reveals that real science does not operate according to this scheme. Stories are known of famous scientists discussing accidental moments in

their discoveries, which have never been labeled ‘serendipitous’. On the other hand, it is difficult to recall a discovery, in which a theory played no role at all.

This implies that when labeling discoveries ‘serendipitous’ or ‘theoretical’ people actually mean ‘mostly serendipitous’ or ‘primarily theoretical’. However, such a re-labeling would bring out in the open the ‘other’ factor, which had previously been silenced or ignored. This would leave a scholar with no choice but to study both factors and *prove* that one played a more important role than the other.

In fact, such a study is feasible if a proper methodology to examine the role of chance in science is available. One such methodology, developed by the author, is applied in this paper. It consists of the following steps:

1. Defining ‘accidental’ and ‘theoretical’.
2. Determining the meaning of the discovery as perceived by the discoverer.
3. Finding various factors, experimental and theoretical, that could have introduced elements of chance.
4. Evaluating, which role – positive or negative – each factor could have played in the process of discovery.

A prior application of this methodology to the discovery of radioactivity by Henri Becquerel proved to be fruitful, because it revealed more details of the involvement of both chance and logic than had been thought before (Kipnis 2000). Here, I intend to use this method with the discovery of electromagnetism by Hans Christian Oersted (1777–1851).

I have chosen this particular discovery for several historical and didactic reasons. First, a number of scholars have claimed that Oersted owed it to certain ideas. Second, it can be easily incorporated into a high-school physics curriculum. Finally, Oersted’s experiments are among those that can be repeated by students, which gives them an opportunity to understand the role of chance in a discovery through not only reading and discussion but also through experimentation.

One should bear in mind that this is not a comprehensive account of Oersted’s discovery. This paper is concerned only with issues relevant to the role of accident in it, primarily in his lecture experiment. It is necessary to remember that any historical analysis, however abundant the evidence, may lead only to tentative conclusions. This is even more true so in studying the role of chance, where evidence is indirect and the role of reconstructions is greater than usual. In such a situation, a plausibility of an analysis is judged by its results: if they offer new insights and can be applied to other cases, we deem the analysis successful.

2. Background

On July 22, 1820, Oersted mailed a four-page pamphlet in Latin ‘*Experimenta circa effectum conflictus electrici in acum magneticam*’ to a number of renowned scientists and institutions (Oersted 1820a, p. 214). He described there a new phenomenon: a magnetic compass placed below a wire deviated from its normal position every time when the wire connected both poles of a voltaic pile. Since