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Seeing Is Believing and Vice Versa

Does the conduct of a scientific experiment, once science has advanced beyond the descriptive or natural history stage, require of the investigator anything more than a refined version of the qualities expected of a good witness in court? That is to say, does the conduct of a scientific experiment involve anything more than the careful and detailed observation of a certain set of phenomena by the use of certain instruments? We suppose that the answer is no if the scientist testifies only about those events that he sees directly with his own two eyes. But then you do not have science, only the description of some pieces of equipment. When the report turns to the *results* of an experiment, then something more is involved. Since there is sometimes the temptation to regard an experiment simply as the precise observation of a certain set of phenomena, it may be worth while to remind ourselves of what is also required.

This distinction between ordinary testimony and the report of the results of a scientific experiment was emphasized by Pierre Duhem (1861–1916), a French physicist who is known today primarily for his contributions to the history and philosophy of science. After making this distinction, Duhem went on to examine the meaning of doing an experiment. To understand his conclusions it is not necessary to refer to the very latest developments in experimental inquiry. It will be sufficient for us to consider, as does Duhem, the relationship between what a novice might see upon first entering a physics laboratory stocked with ordinary pieces of equipment and what a physicist might report about his own activities there.

Suppose that our novice upon entering the laboratory spies a tangent galvanometer. He might say that he sees insulated copper wire wrapped around a circular frame in the center of which is suspended a small steel bar. He might also comment that the direction of the bar is indicated by a pointer that can be read against a scale. But our physicist in reporting his own activities probably would make no reference to the small bar or to the direction in which it is pointing. He would say that he is measuring the intensity of the electric current flowing in the copper wire. To bridge the gap, however, between his own report and the testimony of the novice, the physicist might add that he is bringing the reading of the pointer on the scale into a certain formula. But if the physicist continues his efforts at explanation he will find himself giving a course in electromagnetic theory, for the formula is a consequence of the fundamental laws of that discipline and its full understanding requires that one first understand those laws.

All of which means that there is a lot of homework to be done before one becomes a scientist. But to do an experiment requires something more than mere study. There is the simple circumstance that not every event that the novice observes has the set of phenomena under investigation as its cause. To distinguish those events arising from the set of phenomena under investigation from those created or mutilated by the workings of the instrument requires the use of the theory that the novice has just learned. But in addition to learning the theory, the novice must also accept it as true. For if he regards the theory as false he will have no basis on which to distinguish between appearance and reality, and if he regards a rival theory as true he will make the distinction in a different way. In addition to the precise observation of a set of phenomena, the conduct of an experiment also requires the interpretation of those phenomena. If seeing is believing, then so also is believing seeing.—J.T.