

Why Eclipse Experiments?

This book is about the practice and ephemeris of the Victorian era. It focuses on solar eclipse expeditions that carried telescopes and spectroscopes to the mountains of Africa, the mountains of Japan, the Galapagos and islands in the Caribbean and the Pacific. The sun was hidden by the moon for as long as seven minutes. These expeditions had considerable scientific importance, but they were also part of the of-the-mill astronomy, which is usually done at an observatory, at the blackboard, or more recently at a computer station. Still, some Victorian astronomers were interested in explaining why a reader might share their passion. The way I follow a long tradition, for books are often written with an apologia. Almost exactly a century ago, a scientist felt obliged to defend his book *Remarkable Eclipses*. He explained, “someone will exclaim, ‘What, are there not enough already?’ The author can only reply, ‘No, not one!’”¹

There are fewer books written about eclipses today, but the topic is not so little. It is my aim in this chapter to explore what science can learn from this topic. Certain expeditions received more notice in their day, and those led by the likes of geographers like Sir Richard Burton, John Hanning Speke, and Henry Walter Bates, are better known. They are the main actors in my story. Compared to these, the expeditions of the 19th century and whose impact was measured over decades (and whose lives, as so often happened), eclipse expeditions were put up with sleepless nights, long journeys, problems with assistants, nightmarish conditions, getting good food in the field, but not with diseases and none with death.

Year	Area visible
1842	Scandinavia
1851	Europe
1860	Spain
1868	India
1870	Spain and Mediterranean
1871	India, Ceylon, Australia
1875	Far East
1878	United States
1882	Egypt
1883	South Pacific
1886	Caribbean
1889	South America, West Africa
1893	West Africa
1896	Scandinavia, Russia, Japan
1898	India
1900	United States, Southern Europe
1901	Sumatra
1905	Spain, Egypt

But these events still have the power even if they are not so well known or experienced. Eclipse expeditions produce reports and artifacts, making it possible to reconstruct life in the field, observational practices, and the details of fieldwork in considerable detail. Photographs, agendas, minutes of meetings, correspondence with local and foreign governments, observing notes, transcripts of speeches, drafts of reports, newspaper articles, popular magazines, scientific journals, photographs; drawings of eclipses; and photographs of expeditions, scientists and assistants at work, instruments, and the sun—these materials fill file cabinets and drawers in detail every aspect of expeditionary work. The conditions were so heavily documented was a testament to the importance of solar astronomy they were a big deal. Astronomy was an important part of Victorian science, so this was also a highly organized one. By water

parties, and sent expectations out into the world about its structure and behavior, and into the organization and politics of Victorian science.

Eclipse expeditions are also interesting because they reveal Victorian imperial culture and values, and the relationship between Victorian field sciences. Planners used eclipse expeditions and science to imperialism, and our connections of such connections should make us keenly aware of the connections articulated in earlier times. But reports of eclipse expeditions, and memoirs also lay bare the relationship between science and colonial culture that either were not commonly known as to be overlooked. The relationship is so different from the grand expeditions of the past—in their duration, size, funding—also is a challenge to our understanding of what scientific fieldwork was, and new light on those kinds of better-known expeditions.

Most of my story deals with expedition planning, the British scientific societies, the Royal Astronomical Society of London, and British Association for the Advancement of Science. Occasionally I will mention amateur scientists, but I spend little time on them for several reasons. First, the expeditions were more important scientific expeditions, with serious and advanced observers, and had access to money, official favors, and all the other things that made them easier. Sources also dictate this focus: of the many sources, half a dozen archives, while independent sources are limited to a handful of published memoirs. For similar reasons, I say little about the role of women on expeditions. Women were not in eclipse fieldwork, but they did appear in the sources to deserve some discussion; however, British sources show a steadfast silence on the roles women played. I mention a couple of diary entries and brief recollections that do not document the experiences of natives, sometimes listed as assistants or guards. As for indigenous people, they receive much derision and fear on the part of British sources that describe the experience of eclipse expeditions of view. This is especially unfortunate, because the experiences of watching an eclipse—and of watching natives watch an eclipse—would have been an important part of only one way, from European to native.

time discussing spectroscopic observations. Instead, I have chosen to concentrate on strategies and technologies astronomers used and photographs of eclipses.

Historiographic

Three scholarly literatures constitute this book: the diverse body of work related to technology studies (STS); the no less varied literature on technology and science; and the more focused and unified literature on technology and empire.

SCIENCE AND TECHNOLOGY STUDIES

Science and technology studies is a loosely defined field of articles unified by the contention that science is a process of “social construction” influenced by social and cultural forces—traditionally considered to be “neutral” to science.⁴ One strand of this literature is the study of scientific work, which set of differences between the world of the laboratory is quite different from those of philosophers. Those differences are often manifested by scientific controversies, during which participants challenge tacit assumptions, wrangle over methodological issues, and debate the rules by which arguments will be seen as legitimate. Presented most famously by members of the history of science, developed historical and contemporary studies of science, Thomas Kuhn, Robert Merton, and others have shown. Their most notable achievement has been to show how economic, and cultural “interests” play a role in the development of good and bad science. In the mid-1980s, Steve Hacking’s *Leviathan and the air-pump* and Martin Strehler’s *controversy* announced a synthesis of these approaches. The emergence of a new style of scholarship in the late 1980s, since, the field has continued to diversify and broaden. Applied and subjects opened up for investigation. The field has been more influential than the emergence of a new research area, and the reconstruction in

enacts work as a key technique for and science.⁶ These studies often emphasize work over the social or cognitive. Labors have both received attention on these grounds—stripped by instruments—the subject of the producers of scientific data, the group that experiment meet. Studies of practice have focused on technicians, assistants, artists, and administrative members of the research enterprise, the background.⁷ Another group has applied and literary theory to science, arguing (or) that practice and discourse are of overriding importance in the development of scientific ideas. More recently, in the constructivist tradition, the overtones of practice have changed in yet a different way. The emphasis has moved to the “construction” side of the phrase, to how ideas are factored and negotiated through practice, to how they are defined by interests and ideologies.⁸ This approach was debated in the 1970s and 1980s—how to study scientific ideas—and sets out instead to study the conditions of works: how people work through epistemological difficulties, and theoretical conundrums, and how what seems trustworthy. It also pays greater attention to the constraints imposed by nature on scientific practice and the social conditions and use of the term “constraint” is still a

This book is part of the emerging “practice studies.”¹⁰ Its desire to recapture the details of practice along with the messy details of its practice is a departure from traditional social constructivism. In their quest to understand social interests on science, the Edinburgh group has taken the task of reconstructing the emotional and intellectual conditions of discovery. Perhaps, in order to establish a more robust program, it seemed as necessary to move beyond the traditional turned science into an adventure as it was to move beyond accounts that reduced it to an exercise in rationality. The alternative voice with a more rigorously analytical approach, critics, who protest that “externalist” approaches downplay the difficulty with which new ideas are discovered. Some have gone even further and argue that the conditions of science make forces like ideology and po-

thought of as customizing science rather than the ordinary work that scientists do. The social constructivist program's not about nature to social order and ideology bought by sacrificing a sense of what it is to handle a new instrument in the observatory in the field, master a difficult technique, or suffer a failure. Carefully crafted microstudies have constructed the emotional or psychological dimensions of scientific life for practitioners and observers. My own feelings about doing research are not the only ones we ignore this aspect of science at our own expense I feel in libraries and archives, the distractions and diversions to work, the agony of waiting, and the pleasure I enjoy after solving a problem all explain why I became a scholar, and why I live the life of the mind in the face of mixed professional success. Research is an addiction, not just a job. I'm certain that you would have understood my feelings.

Passions, like social interests, are hard to link to intellectual commitments or research instrument or technique. Popular accounts of scientific moments, the excitement of the experience of discovery show that this can be done by looking at the work of Ginzburg, Joan Scott, and others suggest that *mentalites* might reveal links between scientists' worlds. The effort to uncover the connections between social, political, and scientific ideas requires social and emotional considerations. Now the influence of emotions in shaping science has been established. We need our accounts the feeling and flavor of scientific life, our passion, and worry that scientists feel a need for their work to be taken seriously, because they offer clues about the relationship between identity and research. We need to bring "actants" with living and feeling people into the relationship between social life, culture, and work that we build a richer and more complete picture of scientific life.

VISUAL REPRESENTATION IN SCIENCE

The literature on visual representation in science is a book. The subject of visual representation

upsurge in popularity in the last decade, to the study of instruments and practices: ten designed to generate visual records. This practice underwrote a broad view of scientific analysis of a wide range of visual materials by practitioners.¹³ Visual records have also seem well suited to revealing the construction of scientific knowledge. Visual representations are “ordered, shaped, and filtered . . . as social actions” expressing a relationship between server and nature, between instruments and observations. The process of making pictures involves “a view of the world” in which social interests can be seen.

The importance of imaging techniques in the history of eclipse expeditions is obvious. One of the primary tasks of observers was to record the appearance of the sun during an eclipse. Much of my analysis follows the history of the genre on visual representation; there are two main issues with special vigor, and that define the book. First, the late nineteenth century is the period when the shift from drawing to photographing many natural phenomena to machines the observing and recording of the natural world. The story is not a simple one: the virtues of photography were not as clear during the shift as they are now. I am constructing the details of this shift in eclipse expeditions, how scientists weighed the merits of different techniques, and how the gulf between human observation and machine developed. Second, I argue for the importance of the material life of pictures. Contrary to the tenet that pictures are a visual equivalent of words or ideas, separate from the way they appear, this book argues that one must consider the studio, the lithographer's stone, and the printing process, and how images take their shape. Following the history of the genre, that we leave the field, and follow pictures as they are assembled into composites, and printed. It also considers the interplay between printing technologies and the development of the printer's shop could be seen in the thought about and used instruments in the

The relationship between science and imperialism has been the subject of rich studies in the last few decades. The nineteenth century saw the development of universities, divided into disciplines, conducted in universities and observatories, supported by governments and publicized by scientific societies and journals. The century also saw the dramatic expansion of European colonial domination of most of Africa, India, and Asia. The history of London, Paris, Berlin, Brussels, or Washington and imperialism asks how these two processes intersected. Scientists put knowledge at the service of imperialism. Opportunities created by imperial policies were essential resources for European expansion. As Erickson's *The Tools of Empire* argued convincingly, technology were essential resources for European expansion into Africa and Asia. A variety of scholars have explored the public history of science in this context. Some of this work was patterned after the history of British and European science, and examined the careers of scientists in the colonies, developed research and articulated service roles for science in the colonies. Others studied disciplines, such as geology, that were not transplants from the metropole but a response to local needs.¹⁶ Edward Said's work in cultural studies and subaltern studies (see his essays) to probe the ways in which fields of knowledge were used by colonial peoples and territories.¹⁸ Finally, a number of studies have examined non-Westerners' responses to imperialism.

Victorian eclipse expeditions traveled to the tropics, ordered by British imperialism, the expansion of European systems and economies, and the diffusion of European culture. Expeditions thus provide excellent opportunities in which scientists forged connections between science and imperial interests, and used colonial resources to study the two issues in depth. First, the intersection of colonial culture intersected, and the work of scientists and social lives of British colonial administrators affected life in the field. The documents and journals, with vivid comparisons of British and indigenous

which highlight the perceived (or assumed) European and non-European peoples. Second, this work provides us with an opportunity to explore the connections between the expansion of railroad and telegraph networks, secondary jurisdictions, colonial economic and scientific practices, and the practice of science in the field. Indeed, this work made it possible for astrophysical fieldwork to flourish. The connections between science and imperialism, the alignment of political programs, the structural changes, and the ideas that define the European self and other are traced into instruments, and mapped into

Organization

The book is organized as follows. Chapter 1 discusses the history of eclipse expedition planning and organization, and the social and cultural context in which that work took place. Chapter 2 is about observing methods and instruments used by eclipse parties set sail that we cannot understand without reference to eclipse planning. Further, the changes that transformed Victorian science also shaped the organization of professionalization and specialization of scientific disciplines, the growth of service roles, the increasing importance of government funding for scientific research, the composition of planning bodies, the organization of expeditions they assemble.

Chapter 3 follows expeditions into the field, and discusses about eclipse expeditions, and the literature that describes the pressures that shaped them, but its main focus is on the experience of fieldwork. This method is called "following the actors as they live." Here we follow eclipse parties as they plan, organize, and prepare themselves for the great expeditions, field sites, setting up camp, preparing instruments, and training volunteers and assistants was a central part. Notably, it was all described in great detail in the reports. No study of eclipse expeditions would be complete without a description of what it was like to stand in the field during the most dramatic events, and to make observations that were prevented from seeing it by clouds or rain.

Chapter 4 examines the history of vortices and the observations of the solar corona. The invention of photography is one of the most important events in the history of the nineteenth century; certainly this common reference point is one of the things that make the Victorian era so interesting. Eclipse observation taxed both astronomical observation and raised questions about the trustworthiness of photography that didn't exist in many fields. It is also interesting that reproducing photographs and drawings was almost as important as producing them in the nineteenth century. The distinction between original and reproduced images is a central theme in the history of science, but I have not discussed its importance.

Chapter 5 explores the deep links between science and the material culture of British imperialism. The Victorian era is an exceptional bricolage with countless connections to a significant portion of the globe, connecting continents by steamships, railroads, canals, telegraph lines, and communication systems. If Waterloo was won on the plains of Belgium, one might say that India, South Africa, China, and the rest of the world were won in the machine shops of Lambeth, the laboratories of Cambridge and the engineering systems that shaped and bound the empire together. The scientific systems only beginning to catalog and understand the world in the late Victorian empire also allowed the world to be divided into sessions and protectorates into spaces of scientific inquiry. This is nowhere better revealed than in the material culture of empire determined to take the world into the field and study the sun—to turn the world into a laboratory.