

Charles Babbage, Ada Lovelace, and the Dawn of Computing

Instructor's Materials, v. 1

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Instructor's Materials

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Part 1: Role sheets

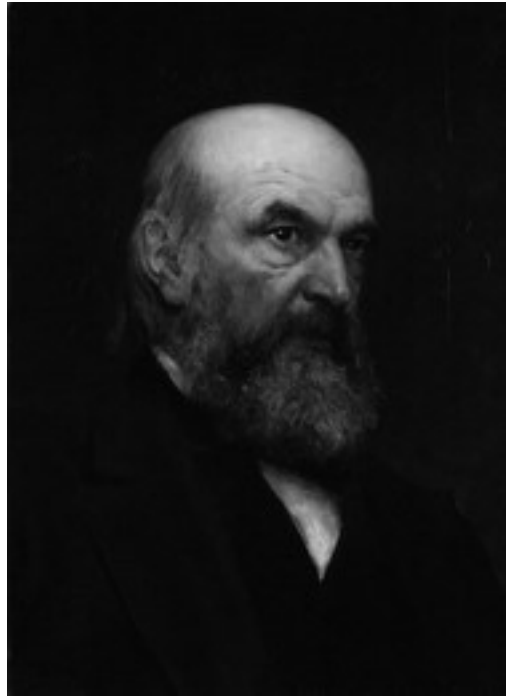
The following pages contain the role sheets for each of the characters in *Charles Babbage, Ada Lovelace, and the Dawn of Computing*. The gamemaster should distribute one role sheet to each student in the game at the outset of the game.

Individual role sheets

The individual role sheets are organized by faction. First are the role sheets for the pro-Babbage faction, then the sheets for the anti-Babbage faction, and finally the sheets for the indeterminates in the game.

Pro-Babbage roles

John Couch Adams



Office

You are John Couch (pronounced “cooch”) Adams, co-discoverer in 1846 of the planet Neptune. As of 1839, you are a Fellow at St. John's College, Cambridge.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born in 1819 on a farm near Launceston, Cornwall, in the far southwest of England. Your mother's uncle (and your namesake), John Couch, left his library to her. Through this library, you were exposed to your life's passion, astronomy. In your primary schooling you learned the classics and excelled in Greek, but you had to teach yourself mathematics. You were apparently successful in this venture, for you were able to perform the calculations to predict an annular eclipse (where the moon blocks out the sun, but not completely, so that a bright ring appears around the moon) in 1836. You then traveled to the predicted location and observed the occurrence.

Thanks to a small inheritance to you mother, and to your work tutoring students, you were able to afford to attend St. John's College, Cambridge, starting in 1839. Four years later you did so well on your

final exams that you graduated as Senior Wrangler, the top mathematics undergraduate at Cambridge. In 1843 you became a Fellow at St. John's (meaning you obtained a paid research position there -- similar to a "post-doc" position in American academia).

Your most important discovery for the purposes of this game began in 1841, when you decided to investigate

... the irregularities of the motion of Uranus ... in order to find out whether they may be attributed to the action of an undiscovered planet beyond it. [OR05]

In 1845, through quite a lot of complex, arduous mathematics, you were able to come up with a prediction for where the new planet Neptune would be found if someone looked for it with a telescope. You gave this information to the directory of the Cambridge University Observatory, James Challis, and he, in turn, provided you with a letter of introduction to George Airy, the Astronomer Royal. You went to see Airy at Greenwich twice, but as you had not made an appointment, you were unable to see him. Failing to secure an in-person meeting, you left your data at Greenwich for Airy.

Airy apparently read your letter, but he had a question for you regarding your data, and sent the question to you in another letter. Airy wondered "whether the errors of the radius vector would be explained by the same theory that explained the errors of longitude." [LB86]. You felt that the question was about a trivial matter, and so you never replied. You assumed that Challis and / or Airy would have notified other astronomers in the United Kingdom about your predictions, so that someone would train their telescope to your prediction location and see if the new planet existed. However, neither Challis nor Airy told anyone, and therefore no astronomers in the UK were looking for the new planet.

In June 1846, the French Astronomer Urbain Le Verrier published a prediction of the planets location, and in September 1846 a German astronomer at the Berlin Observatory was the first to view Neptune.

In this game you are young -- not yet out of undergraduate school until game session (GS) 6 -- and emblematic of a new breed of "men of science." Rather than being a landed gentleman with enough time, talent, and money to pursue science as a hobby, you represent a new generation of professional "scientists." You are mild-mannered and deferential, almost to a fault, and so you must take care to exhibit these traits during your GS 7 debate with Airy regarding the priority of the discovery of the planet Neptune.

Objectives

You have two main objectives in this game. First, you want your pro-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of Babbage's engines.

Secondly, you want to convince the world that you should be considered a co-discoverer of Neptune, if not the sole discoverer. In concert with this objective, you should convince other players in the game that your calculations would have been completed even sooner if you had had access to one of Babbage's computing engines -- i.e., argue for your faction even when you are talking about the priority

of Neptune. Although you are not a fellow of the Royal Society, other members of your faction are. If you can convince a FRS to introduce a resolution to the Royal stating that you should be considered co-discoverer of Neptune, *and if* the Royal passes the resolution, you win the game, regardless of the performance of the pro-Babbage faction.

Secret: You should *not* let your faction colleagues know that you win if the resolution is introduced and passed.

Responsibilities

As John Couch Adams, you have responsibilities to your pro-Babbage faction, to defend your priority in the discovery of Neptune, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the pro-Babbage faction

As a member of the pro-Babbage faction, you should do whatever you can to help the faction win the game; this is also obviously in your best interest, since one of the ways for you to win the game is for your faction to triumph. Early in the game, you can help your faction by being a vocal proponent of Babbage, in the settings where this is appropriate (i.e., not during Royal Society meetings, since you are not a FRS). You can ask good questions or make brief podium speeches to help propel your faction to victory.

The primary way you can help your faction is to make an excellent speech during GS 6, convincing other players that you are a rightful co-discoverer of Neptune, and that you would have discovered the new planet even earlier if one of Babbage's machines had been available to speed up the calculations.

Regarding the priority of Neptune and the usefulness of a calculating engine

During GS 6, you will make a speech asserting that you were the first to discover Neptune, through the calculations you delivered to Airy. Your calculations were completed before those of Le Verrier. More importantly to one of the main ideas of this game, you should also make the case that, had one of Babbage's Difference Engines been available, you would have been able to make the calculations even more quickly, thus ensuring that Neptune would be discovered by Britain and not by France. This argument will illustrate how Babbage's invention could be practical and also could bring scientific glory to Great Britain.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game.

Since you are not a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Mechanic’s Institute, GS 2 or 5. Coordinate with your faction leader (Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the government, the nobility, or the Royal Society, your formal powers in the game are very limited. This does not mean you are not a valuable member of your faction, or that you cannot win the game. You can earn IPs for yourself and / or your faction, by asking incredibly insightful questions of the opposing faction and by making an effective case regarding the discovery of the planet Neptune.

Assignments

Your main writing assignment is a written version of your GS 6 speech, due at the beginning of GS 6. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As a member of the “men of science” community, you have important relationships with the main ideas, texts, and other characters in the game.

With ideas

You are a very capable mathematician, and so you are able to easily grasp the concepts behind Babbage's computing engines, and you also can see their importance. Of course, the amount your

calculations regarding Neptune would have been accelerated with one of the machines is an excellent example.

You are not, however, a typical MOS. You are young and not a landed gentleman, and so you do not have large reserves of money to allow you to pursue science as a hobby. You earn your living by pursuing the study of the natural world. This informs your opinions on two of the major issues in the game. You believe it is appropriate and proper to be a professional man of science, rather than simply a wealthy, talented amateur. In addition, since you would never be able to fund major scientific research by yourself, you are in favor of the British government funding all kinds of scientific research, including the development of Babbage's engines.

With texts

Since you are young in this game, you have not had much of an opportunity to become intimately involved with the core texts, nor have you published yet yourself.

With other roles

Although you have a mild and deferential manner, and have much respect for Airy (and even Le Verrier), you and Airy disagree about the priority of Neptune and about whether Babbage's Difference Engine would have made any difference in the discovery of the planet.

You also do not share much common ground -- other than faction affiliation, where appropriate -- with the older members of the MOS community. You respect their work, but it is hard for you to relate to them personally; your up-from-the-bootstraps background bears little resemblance to the life of leisure of the landed gentry MOS members.

With your faction

Although you are not a politician or a FRS, you are a valuable member of your faction. You have something the faction needs: a concrete example, showing harm to Britain's reputation arising from the lack of one of Babbage's computing engines. One of the engines would have sped up your calculations, moving forward the timetable for the discovery of Neptune, and therefore securing scientific glory for the nation. As it stands, the glory of the discovery of Neptune went to France instead. This is not a theoretical harm, not a ship that might have crashed due to faulty navigational tables, not a minor inconvenience caused by a few mistakes in published logarithms. You are the only person in this time frame that can show a concrete, detrimental impact due to the lack of a working Difference or Analytical engine.

Strategy advice

While you have an excellent case to make for building Babbage's engines, make sure you do not talk about the discovery of Neptune until the proper year -- that is, not until GS 6. Before that, you should be an active, but polite, questioner of the anti-Babbage faction, and perhaps make a podium speech or two in support of your faction.

When the time to discuss Neptune comes, you should emphasize the harm to Britain's scientific reputation due to France being first to view Neptune. Communicate how useful one of the engines

would have been in your quest for the planet, making clear that Britain would have gotten there first had your calculations been sped up. Of course, you should also argue that you deserve co-discoverer credit, since your calculations were started so early. Also, try to get one of your FRS faction members to introduce a resolution to the Royal Society in GS 6 or 7, stating this. If the Royal passes this resolution, you win the game regardless of whether your faction wins.

Secret: You should *not* let your faction colleagues know that you win if the resolution is introduced and passed.

To learn more

[Bal90] Sir Robert Stawell Ball. *The Story of the Heavens*. Cassell & Company, Ltd., London, 1890. Available on Google Books

[LB86] John E. Littlewood and Béla Bollobás. *Littlewood's Miscellany*. Cambridge University Press, 1986

[OR05] J. J. O'Connor and E. F. Robertson. Adams biography. <http://www-groups.dcs.st-and.ac.uk/~history/Biographies/Adams.html>, February 2005

Summary of your individual victory objectives

You win the game if either of the following takes place:

- Your pro-Babbage faction wins the game, by securing government funding for the development of Babbage's engines in at least two out of three of the funding opportunities, or
- **Secret:** A resolution is passed by the Royal Society naming you as the rightful co-discoverer or discoverer of Neptune.

Portrait of John Couch Adams FRS, by Sir Hubert von Herkomer, from the National Portrait Gallery, St Martin's Place, London; <http://www.npg.org.uk/collections/search/person/mp00026/john-couch-adams?search=sas&sText=john+couch+adams>

Charles Babbage FRS



Office

You are Charles Babbage, British polymath (a person whose expertise spans a significant number of different subject areas) and inventor of the Difference and the Analytical Engines. You are also a member of the "Men of Science" (MOS) community in the game. You are a man of science, or natural philosopher, of the old kind -- a man whose wealth and social position have allowed you to pursue your mathematical, engineering, economic, and scientific interests. You have also been the leading proponent in England of applying mathematics and science to industry and commerce.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction, although you are not the leader of the faction. In fact, your job in the faction could be considered sabotage; you are responsible for taking certain actions that will work against the best interests of your faction. Having said that, you are prohibited from defecting from your faction during the game.

Secret: Do not tell the members of your faction -- or anyone else, for that matter -- of your counter-productive responsibilities.

Biography

You are “the child of two revolutions: industrial revolution in Britain, and political and social revolution in France.” [Hym85] You were born on December 26th, 1791, in Walworth, Surrey, England; in the present day, Walworth is a part of greater London. Your father was a banker named Benjamin Babbage, and your mother was Betsy Plumleigh Teape. Although he was from a wealthy family, your father was proud that he had made most of his fortune on his own.

You were educated at a variety of private boarding schools, showing an early interest and immense talent in mathematics and the creation of mechanical devices. You attended Trinity College, Cambridge starting in October 1810.

When you arrived at Cambridge, you were aghast at the state of mathematics there. You had hoped to converse with and learn from the Cambridge mathematics professors, but upon your arrival you were much more mathematically learned than any of the current faculty. Thankfully, you had access to mathematical works from the continent via the Cambridge library, and so were able to further your knowledge in that way.

At Cambridge, you, John Herschel, and others formed the Analytical Society. The society was dedicated to improving the state of mathematics and Cambridge, and then in the whole of Britain. Your primary goal -- which the Analyticals succeeded in achieving -- was to switch Britain from Newton's calculus notation to Leibniz's notation, which was in use in France and the rest of Europe. Your mathematical approach to science, industry, and all things, was cemented during your time with the Analyticals.

During the time span covered by this game, you and your close friends are politically liberal and perhaps even slightly radical.

Thanks to your work on modernizing the state of mathematics in Britain, among other factors, you were elected as a Fellow of the Royal Society in 1816. Between 1815 and 1820 you performed a large volume of important work in pure mathematics, mostly in the theory of functions.

However, during this early post-Cambridge period you had a difficult time finding paid employment, for a variety of reasons. You applied for mathematical professorships first at Haileybury, the East India College, and then at the University of Edinburgh in Scotland. Although eminently qualified, you did not receive either position, most likely because of your family's nonconformist past and your liberal political leanings. In 1824 you were invited by some acquaintances to partner with them in the formation of a new life insurance company, called the Protector. You produced some very good actuarial tables, but unfortunately the company never came to fruition. You were worried about the financial security of your family -- having married Georgina Whitmore in 1814 -- until the death of your father in 1827. The inheritance you received from your father allowed you to live quite comfortably, and also to pursue your mathematical and scientific interests. Unfortunately, later in 1827 your wife, and your youngest son also died, leaving you devastated.

In 1828, while you were touring Europe as a way to take your mind of your losses, you were named as the Lucasian Professor of Mathematics at Cambridge. The Lucasian Chair is perhaps the most prestigious academic position that one can hold anywhere in the world; Isaac Newton held the chair for 33 years in

the seventeenth century, and Stephen Hawking held it for 30 years in the twentieth. You replaced Sir George Biddell Airy, who had bested you for the chair just two years prior in 1826.

You twice ran for Parliament during the period of our game, first in 1832. You ran as a Whig, a candidate of reason and reform. You were not elected in either campaign, however.

Aside from your intellect, one of your greatest gifts is the ease with which you are able to mix, mingle, and converse with people from every class in society. You have “immense personal charm and boundless vitality,” and are “equally at ease with intelligent working men, country clergymen, men of science, at court, or at the dining tables of the aristocracy.” [Hym85] The parties you hold at your house at 1 Dorset Street, London, are legendary. John Herschel, William Whewell, Florence Nightingale, Lord Tennyson, Michael Faraday, Charles Darwin, Charles Dickens, Ada Lovelace, and the Duke of Wellington are just some of the luminaries that have attended your soirées. An invitation to one of your Saturday evening parties is one of the most coveted social achievements in London society. In fact, this game begins with one of your parties in GS 1.

You have done productive work in many different areas, but the consuming passion of your life has been your Difference, and later your Analytical, engines. The idea of creating a Difference Engine to mechanize the production of numerical tables first came to you in 1821 or 1822. The idea excited you so much that you became physically ill. In 1823 you received £1,700 from the British government to begin the construction of your first Difference Engine. A fragment from this project, constructed by Joseph Clement, is the only tangible outcome of the Difference Engine project to date as our game begins in 1828. The Difference Engine fragment sat in your drawing room at 1 Dorset Street for many years; it was a popular attraction among the learned guests at your parties.

The construction of these machines is very, very expensive; certainly beyond your means. This, plus the benefits the nation would reap if they were constructed, have led you and those in your faction to seek out government funding for the project.

Objectives

Your objectives in this game are somewhat complicated. You want your pro-Babbage faction to win the game, of course; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of one of your Engines.

Secret: However, the actions you are required to take during the game could certainly be considered sabotage against your own faction, making it more difficult for your faction (and therefore yourself) to win the game. During GS 4, you will make a speech that is strongly critical of the Royal Society, and the content and tenor of this speech should come as a surprise to everyone, *especially* those in your faction. Your GS 4 speech reflects the 1830 publication of your work *Reflections on the Decline of Science in England, and on Some of its Causes* [Bab30], which was stridently critical of the political cronyism in the Royal (amongst other complaints).

You obviously cannot tell anyone in the game of your actions beforehand, nor discuss your motivations for them at any time before the game post-mortem. You must come off as a gregarious, friendly person, an ardent supporter of your Engines, and as a person of great integrity.

Responsibilities

As Charles Babbage, you have responsibilities to preside over your party during GS 1, responsibilities to your pro-Babbage faction, a duty to point out the flaws you perceive in the Royal Society, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Conducting GS1, your Dorset Street party

You host a party at your Dorset Street residence to begin the game. As host, you are responsible for making sure that the activities and speeches scheduled for GS 1 all happen. The activities for GS 1, and their order, are:

- Ice breaker. Players will spend a few minutes playing a Georgian-era party game to begin the game. The GM will provide a handout describing the game, how it should be played, and how players can win IPs in the party game.
- PM speech by Lord Frederick John Robinson, Viscount Goderich. Robinson, the current PM, will outline the priorities and goals his government will have while he is in office.
- Speech on algebra by William Frend. Frend will make a speech on how he believes algebra should be taught to undergraduate students.
- Speech on the current state of mathematics in Britain by Mary Somerville. Somerville will highlight the improvements in the state of mathematics in the UK, flowing from the Analytical Society.
- Speech introducing the Difference Engine fragment by John Herschel. Herschel will introduce the Difference Engine fragment, describing its purpose, history, and so on.
- At the end of the session the gamemaster will conduct the persuasiveness metric poll of the indeterminates.

During any non-scheduled time in the session, the *podium rule* is in effect. The podium rule states that any character wishing to speak should approach the podium and wait to be recognized by the presiding officer (you). You must make sure that you are fair to anyone who wishes to speak, even those that are not in your faction. Characters are encouraged to ask questions of presenters, at the discretion of the presiding officer, but they should not make speeches to the class without approaching the podium.

Speak with the GM before GS 1 about the party, so that you are well prepared for the conduct of the session.

Responsibilities to the Pro-Babbage Faction

As a member of the pro-Babbage faction, other than the “sabotage” elements (described in the Objectives section above, and also below), you should do whatever you can to help the faction win the game. The main way you can help your faction is to work hard to understand how the Difference and Analytical Engines work, and especially work hard to be able to explain why constructing either machine would be beneficial. You should constrain your vision to the benefits of performing mathematical calculations more quickly and with more accuracy.

Regarding the Flaws in the Royal Society

Secret: During GS 4, you will make a presentation to the Royal Society summarizing your criticisms of the Society you published in your 1830 in *Reflections on the Decline of Science in England, and on Some of its Causes* [Bab30]. You must be harshly critical of the current status of the society during this presentation. You should study this document to understand what your criticisms of the Royal should be.

Also, this presentation must be a surprise to everyone in the game, including those in your faction.

Accordingly, do not confer with anyone, other than the game-master, regarding your presentation before you make it during GS 4.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction leader (Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the government, nor a member of the nobility, you have no formal power to make decisions regarding your machines -- or anything else, for that matter. But, because of

your connections and socializing with nobility and Whig politicians, you may be able to exert some informal influence on them.

You are an influential fellow of the Royal Society (FRS), and if the Royal is asked to take up the matter of your machines, you can help steer the society to recommend that the government provide more funding for development and construction. Of course, after your presentation in GS 4, you and your faction's influence within the Royal Society may be diminished.

Your greatest power in the game -- other than your secret, pseudo-sabotage responsibilities -- is to be an expert on the Difference and Analytical engines, and their value in terms of the way they could speed up the calculation of complex mathematical equations.

Assignments

Your main writing assignment is a written version of your GS 4 speech. The paper is due at the beginning of GS 4. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 6, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 7, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a member of the last generation of the old-school “men of science” community, i.e., a wealthy gentleman with enough time, talent, and money to pursue your scientific interests at your leisure. Although you do not have anything against him personally, this puts you somewhat at odds with younger men of science like John Couch Adams. Men like Adams do not have large sums of money to pursue scientific studies as a hobby, rather, they do science for a living -- science is their profession as well as their passion. If you are among the last of the wealthy, amateur scientific gentlemen, Adams and his colleagues are among the first of the professional scientists.

Other men of science of your generation might look down upon the new, professional scientists, begrudging them their social status. You, however, do not; you have a reputation as a man who can carry on a conversation with anyone from nobility to the educated working man.

Regarding the idea of the government funding large-scale scientific and engineering projects, you are clearly in favor of the practice. You believe from the core of your being that your Difference and Analytical Engines will be useful for scientists and engineers in the Kingdom. At the same time, you know that their construction is well beyond your ability to pay; there is no way for you to privately fund the

project. You believe that it is in the best interest of the British government to fund the development of the engines.

With texts

As a true polymath, you have studied widely and published in many different fields. Within the time period of this game, you have published on the actuarial tables used by life insurance companies (*A Comparative View of the Various Institutions for the Assurance of Lives*, 1826), on the problems in the Royal Society (*Reflections on the Decline of Science in England, and on Some of Its Causes*, 1830), on operations research (*On the Economy of Machinery and Manufactures*, 1835), on religion (*The Ninth Bridgewater Treatise*, 1835), and on mathematics (*Table of the Logarithms of the Natural Numbers from 1 to 108000*, 1841).

Interestingly, what you have *not* published on is your Difference or Analytical Engines. The only detailed work describing how one of your engines operates to be published contemporaneously is Menabrea's article in *Scientific Memoirs, Sketch of the Analytical Engine invented by Charles Babbage ... with notes by the translator* (1843), translated into English and annotated with voluminous notes by your dear friend, Ada Lovelace. The lack of published work about your Engines may make it more difficult for others in the MOS community to fully understand the importance of your ideas.

With other roles

You met John Herschel when you were both students at Cambridge. You, Herschel, and several others formed the Analytical Society there, and have been fast friends ever since.

You are also fast friends with I. K. Brunel. An example of your friendship happened in 1838. You devised an ingenious method to test the smoothness of ride on Brunel's "wide gauge" Great Western Railway. At the time, the nascent railway system in Britain used tracks of two different widths, or "gauges," making it difficult for people or goods to move across the kingdom via rail. The controversy was called the "war of the gauges." Babbage outfitted a special railway car, called a dynamometer car, filled with instrumentation. The car measured the speed of the car, the frequency and intensity of the car's shaking, and so on. (Think of a dynamometer car as the equivalent of a modern jetliner's "black box.") Data from your dynamometer car helped convince the government to make Brunel's seven-foot railway gauge the standard in the southwest of England.

You have a special relationship with Augusta Ada King-Noel, Countess of Lovelace (a.k.a. Ada Lovelace). You first were introduced to Ada by Mary Somerville at one of your Dorset Street parties. Ada was young and beautiful, but also she was exceptionally intelligent and mathematically gifted. She understood the operating concept and purpose of your Difference Engine almost immediately after seeing the Difference Engine fragment at your party. She gained more information about the Difference Engine from one of Dionysius Lardner's lectures. You arranged for Ada to take more advanced mathematical tutoring from Augustus De Morgan of the University of London. Later, she became a trusted collaborator on your Analytical Engine project. She translated one of the few published papers on the Analytical Engine from Italian into English, and added her own notes to the article in the process. Her voluminous notes -- three times the length of the original article -- showed that she had a vision of what the

machine truly do, beyond mere calculation of mathematical formulae. You consider Ada to be the “high priestess of the Analytical Engine,” and your “enchanted math fairy.”

With your faction

The “special” -- and secret -- relationship with your faction is outlined in the Objectives and Responsibilities sections above. Remember that you are an important member of the faction, nonetheless. You are one of the few people in the game that really, truly understand the importance of your Difference and Analytical engines. As such, you are important to the faction as someone who can persuade the indeterminates that your engines are important and should be funded by the government.

Strategy advice

You have the most difficult role in this game. As a player acting out the role of Charles Babbage in the game, you know that the actions you are required to take in the game (harshly criticizing the Royal Society) are counter-productive to your faction. Of course, Babbage himself did not see his actions that way; he was simply stating what he saw as the correct take on the Royal Society.

Accordingly, even though you know as an actor that your actions are self-defeating in terms of the game, you cannot allow that knowledge to seep through in to your portrayal of Babbage in the game. You must perform your duties in the game and be an enthusiastic advocate for your Difference and Analytical Engines even though you may be fighting a losing battle.

To learn more

[Bab30] Charles Babbage. *Reflections on the Decline of Science in England, and on Some of its Causes*. B. Fellowes and J. Booth, London, 1830. Available via Google Books

[Hym85] Anthony Hyman. *Charles Babbage, Pioneer of the Computer*. Princeton University Press, Princeton, N. J., 1985.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins if the British government decides to fund your Difference or Analytical Engines on at least two of the three funding decision opportunities.

Daguerreotype portrait of Charles Babbage FRS, by Antoine Claudet, from the National Portrait Gallery, St Martin's Place, London; <http://www.npg.org.uk/collections/search/portrait/mw00253/Charles-Babbage>

Isambard Kingdom (I. K.) Brunel FRS



Office

You are Isambard Kingdom (I. K.) Brunel. Although small in stature, you are a giant figure in British engineering and industrialization. You are an accomplished mechanical and civil engineer in the U.K. -- perhaps the most accomplished. Your work includes the Thames Tunnel, the Great Western Railway, and the S. S. Great Western, one of the first two steamships to successfully cross the Atlantic ocean from the U.K. to New York.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born on April 9th, 1806, in Portsmouth, on the south coast of England. Your father, Marc Isambard Brunel, was another incredibly accomplished engineer and also a friend of Charles Babbage. Your mother, Sophia Kingdom, was the daughter of a Royal Navy contractor; she met your father while studying French in Rouen, France. Your father recommended you for entry to the French École Polytechnique engineering school -- for no such schools yet existed in Marc Brunel's adopted Britain -- in

1822, but as a “foreigner” you were not accepted. Instead you apprenticed with Abraham-Louis Breguet in France and then returned to England.

Since your return, you have had a profound impact on the state of engineering, industrialization, and public transportation in Britain. You helped your father complete the Thames Tunnel project, in spite of almost dying during a collapse and subsequent flood. You were instrumental in the creation of the Great Western Railway, the first railway linking London to the southwest and west of England and most of Wales. You also built the S. S. Great Western, the second steamship to cross the Atlantic (and the first to do so with a comfortable reserve of coal in her bunkers), and the S. S. Great Eastern, an iron-hulled steamship that utilized a propeller in addition to her paddle-wheels. These accomplishments are joined by other, perhaps more mundane, designs and constructions, including the Clifton Suspension Bridge. You are elected as a Fellow of the Royal Society (FRS) in 1830.

Objectives

You have one main objective in the game. You want your pro-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As I. K. Brunel, you have a responsibility to preside over the lectures at the Mechanic's Institute during GS 5, responsibilities to your pro-Babbage faction, a responsibility to show that government funding of engineering is worthwhile, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibility to Preside Over GS 5

You will preside over the second set of lectures at the Mechanics Institute, which take place during GS 5. As the presiding character, you are responsible for making sure that the activities and speeches scheduled for GS 5 all happen. The activities for GS 5, and their order, are:

- PM speech by Sir Robert Peel, 2nd Baronet. Peel, the newly-elected PM, will outline the priorities and goals his government will have while he is in office.
- Joseph Clement will speak regarding his work with Babbage on the Difference Engine
- Your speech regarding the Thames Tunnel and the value of government spending for large scientific and engineering projects. See below for more details regarding your speech.
- Ada Lovelace will speak on the analytical engine
- IP spending. Individuals, factions, and the PM spend IPs, adding them to one of the three stacks shown in the GS 5 decision stack table in Chapter 3 of the gamebook.

- The PM, Sir Robert Peel, 2nd Baronet, will make his decision as to the government funding the Difference Engine, in accordance with the GS 5 decision stack.
- At the end of the session the gamemaster will conduct the persuasiveness metric poll of the indeterminates.

During any non-scheduled time in the session, the *podium rule* is in effect. The podium rule states that any character wishing to speak should approach the podium and wait to be recognized by the presiding officer (you). You must make sure that you are fair to anyone who wishes to speak, even those that are not in your faction. Characters are encouraged to ask questions of presenters, at the discretion of the presiding officer, but they should not make speeches to the class without approaching the podium.

Speak with the GM before GS 5 about the lectures at the Mechanics Institute, so that you are well prepared for the conduct of the session.

Responsibilities to the Pro-Babbage Faction

As a member of the pro-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. Early in the game, you can help your faction by being a vocal proponent for Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

The second way you can help your faction win the game is to convince others that it is appropriate for the British government to provide substantial funding for large-scale scientific and engineering projects. Your primary opportunity to do this is your speech in GS 5, described in the next section.

Regarding the Value of Government Funding for Science and Engineering Projects

As the game starts in 1828, your father Marc's Thames Tunnel project, to construct an underwater tunnel under the Thames river in London, is in its third year. The project was initially privately funded via a group of investors who formed the Thames Tunnel Company. Your father's chief engineer became ill as a result of the putrid sewer gas leeching into the tunnel from the river, and you took over the project in 1826. In 1828, you barely survived the second flooding of the tunnel, and, beset by financial problems, the tunnel was walled off and work halted. Tunneling resumed in 1835 and was complete in 1841. All told, the cost was £454,000 to dig the tunnel and £180,000 to fit it out. £246,000 of the total was a loan from the British Treasury.

During GS 5, you are to present a speech defending the Thames Tunnel as a good investment of Treasury money, with the implication that Treasury investment in one of Babbage's machines would likewise be a good investment.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The

secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. "Brilliant!" "Yes, of course! I see now!" "Aha!" Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Royal Society, after you are made a FRS, GS 4, 6, or 7. Coordinate with your faction leader (Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the government, nor a member of the nobility, you have no formal power to make decisions regarding Babbage's machines -- or anything else, for that matter. However, as of 1830, you are an influential fellow of the Royal Society (FRS), and if the Royal is asked to take up the matter of Babbage's machines, you can help steer the society to recommend that the government provide more funding for development and construction.

Assignments

Your main writing assignment is a written version of your GS 5 speech, due at the beginning of GS 6. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the "winning" PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a very capable engineer, and so you are able to easily understand the way Babbage's computing engines work. However, the mathematics behind their workings and the true degree of their usefulness may elude you.

You are not, however, a typical MOS. You are young, and not a landed gentleman, and so you do not have large reserves of money to allow you to pursue engineering as a hobby. You earn your living by

creating grand, useful things: tunnels, railways, steamships, bridges, and the like. Accordingly, you believe it is appropriate and proper to be a professional man of science, rather than simply a wealthy, talented amateur. In addition, since the Thames Tunnel relied on government funding, you are obviously in favor of the British government funding engineering and scientific endeavors, *if* they are likely to produce useful outcomes. Although you may not fully grasp Babbage's mathematical vision for the Difference and Analytical Engines, you take him at his word and are in favor of government support for the projects.

With texts

Engineering was very much a working-man's occupation in the time frame of this game, and as such, engineers did not write papers or books. Unlike the mathematicians and scientists in the game (Babbage, Herschel, Adams, and even Lovelace and Somerville), you have not written any publications on your work.

With other roles

Like your father, you are fast friends with Charles Babbage. An example of your friendship happened in 1838. Babbage devised an ingenious method to test the smoothness of ride on your "wide gauge" Great Western Railway. At the time, the nascent railway system in Britain used tracks of two different widths, or "gauges," making it difficult for people or goods to move across the kingdom via rail. The controversy was called the "war of the gauges." Babbage outfitted a special railway car, called a dynamometer car, filled with instrumentation. The car measured the speed of the car, the frequency and intensity of the car's shaking, and so on. (Think of dynamometer car as the equivalent of a modern jetliner's "black box.") Data from Babbage's dynamometer car helped convince the government to make your seven-foot railway gauge the standard in the southwest of England.

Although you are on the same faction, and hold broadly the same opinions regarding the big ideas in the game, you have an adversarial relationship with the scientific populist Dionysius Lardner. On several occasions, Lardner has very publicly criticized your great engineering projects; worse, his criticisms have all been scientifically unsound. For example, when you were supervising construction of the Box Tunnel for the Great Western Railway, which included a one-foot decrease in elevation for every 100 feet of length, Lardner performed some (erroneous) mathematics and concluded that if a train lost its brakes in the tunnel, it would emerge from the other end traveling at a speed in excess of 120 miles per hour. You rightfully pointed out that Lardner had forgotten to factor in friction and air resistance; in fact, a runaway train would exit the tunnel at something like 40 miles per hour, scarcely faster than its normal speed. Lardner also said your S. S. Great Western, the second steamship to cross the Atlantic, was more likely to voyage to the moon than it was to make the crossing safely. The ship steamed into New York harbor in April 1838, with 200 tons of coal still in her bunkers, proving just how wrong Lardner's claims were.

In 1830, the president of the Royal Society, Davies Gilbert, was asked to evaluate designs for a proposed bridge over the River Avon in Bristol. He selected your design for a suspension bridge. Construction was started in 1831, but riots in Bristol caused the project to be abandoned. Work was not started again until 1864.

You have no love for the bureaucracy of the government; you feel the interests of Britain would best be served if the government did not interfere. Of course, your experience with the Thames Tunnel also has convinced you that, unfortunately, government funds are sometimes a necessary evil in order for progress to take place.

With your faction

Although you are not a member of the nobility or the government, you are a valuable member to your faction. First, you are a FRS, and so you can work to convince the other Fellows to vote in favor of Babbage and his Engines when the subject arises.

Secondly, you have something the faction needs: a concrete example, showing the benefits of government funding of a large-scale engineering project, namely, the Thames Tunnel. You are one of the few people in this time frame that can show concrete benefits to the nation from a publicly funded engineering project. In your GS 5 speech, you should draw parallels between the success of the Thames Tunnel and the projected success of the Difference or Analytical Engines if their construction is funded by the government.

Strategy advice

To keep with the timeline of the game, you should refrain from playing up the success of the Thames Tunnel project until your speech in GS 5. The Tunnel was not complete until 1843, and before that time, the project was something of a laughing stock with the public and a sore point with you. Before GS 5, you should be a solid friend and supporter of Babbage; you can speak to the engineering feasibility of the project, based on your mechanical engineering expertise. You can be an active questioner of the anti-Babbage faction, and perhaps make a podium speech or two in support of your faction.

To learn more

[Das12] Mike Dash. The Epic Struggle to Tunnel Under the Thames.

<http://www.smithsonianmag.com/history/the-epic-struggle-to-tunnel-under-the-thames-14638810/>, 2012

[Ken16] Maev Kennedy. Brunel's Thames Tunnel (and Accidental Brothel) Becomes New Arts Space.

<https://www.theguardian.com/stage/2016/apr/15/brunel-thames-tunnel-arts-space-grand-entrance-hall>, 2016

[Mus16] The Brunel Museum. The Thames Tunnel. <http://www.brunel-museum.org.uk/history/the-thames-tunnel/>, 2016

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins if the British government decides to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Image of I. K. Brunel in front of the launching chains for the S. S. Great Eastern in 1857, from Wikimedia Commons. URL: <https://commons.wikimedia.org/wiki/File:IKBrunelChains.jpg>

Andrew Crosse



Office

You are Andrew Crosse, an amateur man of science best known for your experiments with electricity. Your experiments with very large voltaic piles, which discharged with exceptionally large reports, led to you being known in your neighborhood as the “thunder and lightening man.” Mary Shelly, the author of the novel *Frankenstein*, is an acquaintance, and her husband Percy Bysshe Shelley attended one of your lectures on atmospheric electricity in 1814; this may or may not have helped to influence the famous novel.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born on July 17, 1784, at your father's estate, Fyne Court, in Sedgemoor, southwest of Bristol. Your parents were Richard Crosse and Susannah Mary Porter; your father was the sheriff of your home county, Somersetshire. Your father was also interested in the study of science, counting Benjamin Franklin and Joseph Priestley amongst his friends. So, when you started to show interested in the study of natural phenomena, especially electricity, both he and your mother encouraged your studies.

You attended Brasenose College, Oxford, starting in 1802 and graduating in 1805. You intended to study law and enter the bar, but after returning home to Fyne Court, you devoted yourself to your

experiments with electricity and electro-chemistry full time. You converted the music hall of your home into a laboratory for your experiments. Soon you had wires strung on the trees around the estate and a 50-jar voltaic pile. A voltaic pile is an electrical battery, the first batter capable of producing a continuous current through a circuit. Many of your experiments involved charging and then rapidly discharging the pile, resulting in a crack “as loud as those of a cannon.” These experiments led you to be known as the “thunder and lightening man” to your neighbors.

Your experiments have not been without controversy. In 1836, during some electrocrystallization experiments, you observed some tiny mites appearing within the experimental apparatus, in conditions which you judged inhospitable to life. A newspaper heard of the incident and published a story about it, dubbing the mites *Acarus crossii*. More newspapers reprinted the story, and some were under the impression that you claimed to have created the mites. This did not sit well; you received letters accusing you of blasphemy for claiming to have created life, and some of the letters included death threats. To make the controversy worse, other scientists claimed to have conducted the same experiment and repeated the results! In fact, you never did claim to have created the mites. You assumed that mite eggs were in the potash solution before you passed the electrical current through it, and somehow managed to survive the experience to hatch.

Objectives

You have one main objective in the game. You want your pro-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Andrew Crosse, you have responsibilities to your pro-Babbage faction, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Pro-Babbage Faction

As a member of the pro-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. Early in the game, you can help your faction by being a vocal proponent for Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are not a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Mechanic’s Institute, GS 2 or 5. Coordinate with your faction leader (Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the government, the nobility, or the Royal Society, your formal powers in the game are very limited. This does not mean that you are not a valuable member of your faction, or that you cannot win the game. You can earn IPs for yourself and / or your faction, by asking incredibly insightful questions of the opposing faction and by making an effective case in your speeches that Babbage's engines deserve government funding.

Assignments

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a member of the last generation of old-school “men of science” community, i.e., a wealthy gentleman with enough time, talent, and money to pursue your scientific interests at your leisure. Although you do not have anything against him personally, this puts you somewhat at odds with younger men of science like John Couch Adams. Men like Adams do not have large sums of money to pursue scientific studies as a hobby; rather, they do science for a living -- science is their profession as well as their passion. If you are among the last of the wealthy, amateur scientific gentlemen, Adams and his colleagues are among the first of the professional scientists.

Regarding the idea of the government funding large-scale scientific and engineering projects, you are in favor of the practice. If there is a precedent set of funding scientific research, you might be able to convince the government to fund your work as well. So, if only for selfish reasons, you support the funding of Babbage's computing engines.

With texts**With other roles****With your faction****Strategy advice****To learn more**

[Cro57] Mrs. Cornelia A. H. Crosse. *Memorials, Scientific and Literary, of Andrew Crosse, the Electrician*. Longman, Brown, Green, Longmans, & Roberts, London, 1857. Available via Google Books

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins if the British government decides to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Andrew Crosse, by an unknown artist;

https://en.wikipedia.org/wiki/Andrew_Crosse#/media/File:Andrew_Crosse.jpg

Michael Faraday FRS



Office

You are Michael Faraday, an extremely influential English scientist. Your studies have focused on chemistry and electricity, specifically the fields of electromagnetism and electrochemistry. You are an excellent experimentalist and have a knack for explaining complicated scientific concepts in easy-to-understand language. As one measure of your influence on modern science and technology, the unit used to measure electrical capacitance, the *farad*, is named in your honor. You are the first scientific celebrity in Great Britain, and probably the leading scientist of your generation.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born on September 22, 1791, in Newington Butts, Surrey, near London, to working-class, nonconformist parents. Your father, James, was a blacksmith. Children of your class received only basic education, as they were expected to find work in the factories or take an apprenticeship and become craftsmen. Therefore, an intelligent and curious child such as yourself had to educate himself. You were

able to do this largely during your apprenticeship with a bookbinder. You were able to read widely at the bookbinder's, developing a special interest in science and electricity in particular.

In 1812 you managed to acquire tickets to attend lectures by the renowned chemist Sir Humphry Davy. You took copious notes, compiled them into a 300-page book, and sent the book to Davy, who was impressed and supportive of your budding scientific ambitions. In 1813, when Davy's eyesight was damaged while working with a volatile chemical, he hired you on as his assistant. It has been said that Davy's greatest discovery was Faraday.

While Davy respected your scientific abilities and valued your contributions to his work, he was a member of the nobility are you are not. So, when you accompanied Davy on a continental European tour between 1813 and 1815, you traveled as Davy's valet. Davy's wife, in particular, did not consider you an equal. She forced you to ride outside their coach, made you eat with the other servants, and generally made your life during the tour miserable.

Your scientific accomplishments by the time our game starts are already very impressive. You performed an experiment showing how magnetic fields effect electric current in 1821, liquefied chlorine in 1823, isolated benzene in 1825, and made important discoveries regarding alloys of iron in 1826. In 1827, you succeeded Davy as a professor at the Royal Institution of Great Britain. Your achievements were so numerous and so important that you were named Fellow of the Royal Society on August 1st, 1824. You will win the Royal's most prestigious award, the Copley Medal, twice: first in 1832 and then again in 1838.

You have worked so diligently on your studies -- particularly trying to determine what electricity is and how it flows through certain materials -- that your body seemingly gave out in 1839. For six years, you performed virtually no creative science. But, starting in 1845, you were able to resume your work.

Throughout your life, your nonconformist Christian faith as a member of the Sandemanian denomination was very influential. Your childhood home served as the third Sademanian "church" in London, as the denomination spread from Scotland to England in the 1760s. Your church teaches that the accumulation of personal wealth does not fit within the teachings of the Bible. For religious reasons, you turned down a knighthood, twice refused to be considered for president of the Royal Society, and refused to help with the production of chemical weapons for the Crimean war. Before your death in 1867, you also turned down the opportunity to be interred in Westminster Abbey with the likes of Isaac Newton; instead, your body was buried in the nonconformist section of a cemetery in north London.

Your strong faith has at least one practical implication in terms of the game: if other players at any time lead the group as a whole or in some part in prayer, you must quietly refuse to participate. The Sademanian faith holds that praying with someone from another denomination is unlawful.

Objectives

You have one main objective in the game. You want your pro-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Michael Faraday, you have a responsibility to introduce a resolution to the Royal Society recommending that the government fund construction of Babbage's Difference Engine, responsibilities to your pro-Babbage faction, and a "secret language" responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding a pro-Babbage resolution

During GS 3, the Royal Society will debate whether or not to recommend that the government fund the development of Babbage's Difference Engine. You are to introduce a resolution saying that the Royal recommends that the government fund Babbage. Your speech should explain why you think this is appropriate; work with your faction (in particular with your faction leader, John Herschel) to make sure you include all of your faction's arguments for funding Babbage's device.

Responsibilities to the Pro-Babbage Faction

As a member of the pro-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. Early in the game, you can help your faction by being a vocal proponent for Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Regarding the "secret language" of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language."

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. "Brilliant!" "Yes, of course! I see now!" "Aha!" Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction leader

(Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the government, nor a member of the nobility, you have no formal power to make decisions regarding Babbage's machines -- or anything else, for that matter. However, as of 1824, you are an influential fellow of the Royal Society (FRS), and if the Royal is asked to take up the matter of Babbage's machines, you can help steer the society to recommend that the government provide more funding for development and construction.

Assignments

Your main writing assignment is a written version of your GS 3 speech, due at the beginning of GS 3. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a very capable and distinguished scientist, and so you are able to understand the broad strokes of how Babbage's computing engines could be of value. However, you are not a distinguished mathematician, and so the mathematics behind their workings and the true degree of their usefulness may elude you.

You are not, however, a typical MOS. You are not a landed gentleman, and you do not have large reserves of money to allow you to pursue science as a hobby. Your “commoner” status was only confirmed by the behavior of Davy's wife during your European tour of 1813 -- 1815. You have, through your God-given talent, worked your way up in the scientific world. Accordingly, you believe it is appropriate and proper to be a professional man of science, rather than simply a wealthy, talented amateur. Your religion's take on personal wealth also causes you to consider those MOS members who are independently wealthy with some suspicion.

Regarding the idea of the government funding large-scale scientific and engineering projects, you are in favor of the practice. If there is a precedent set of funding scientific research, you might be able to convince the government to fund your work as well. So, if only for selfish reasons, you support the funding of Babbage's computing engines.

With texts

As the pre-eminent scientist of the time, you have published several books. During the time frame of the game, your works include the following:

- *Chemical Manipulation, Being Instructions to Students in Chemistry*, 1827.
- *Experimental Researches in Electricity, Vol I*, 1837.
- *Experimental Researches in Electricity, Vol II*, 1844.

With other roles**With your faction****Strategy advice****To learn more****Summary of your individual victory objectives**

You win the game if your faction wins. Your faction wins if the British government decides to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Michael Faraday FRS, by Thomas Phillips, from the National Portrait Gallery, St Martin's Place, London; <http://www.npg.org.uk/collections/search/portrait/mw02170/Michael-Faraday?LinkID=mp01529&search=sas&sText=michael+faraday&role=sit&rNo=1>

Sir John Frederick William Herschel, 1st Baronet KH FRS



Office

You are Sir John Frederick William Herschel, British polymath (a person whose expertise spans a significant number of different subject areas). You are a member of the “Men of Science” (MOS) community in the game. You are a man of science, or natural philosopher, of the old kind -- a man whose wealth and social position have allowed you to pursue your mathematical, astronomic, chemical, photographic, biological, and other scientific interests. You are a fellow of the Royal Society (FRS), and a First Baronet of the Royal Guelphic Order.

Since you are named a Baronet of the Royal Guelphic Order in 1831, you are entitled to the honorific “Sir” in the 1846 game sessions. Before that, you are simply John Herschel.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and the leader of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born in Slough, Buckinghamshire (a few miles west of London), on March 7, 1792, to the astronomer William Herschel and his wife Caroline. You studied at Eton and then at St. John's College, Cambridge. You excelled at mathematics (and other subjects) at Cambridge, graduating as Senior

Wrangler, the top mathematics undergraduate, in 1813. After Cambridge, you worked with your father, building a powerful telescope and making several important astronomical observations. You were elected as a Fellow of the Royal Society (FRS) in 1813, and your work in astronomy earned you the Copley Medal from the Society in 1821. You were made a Knight of the Royal Guelphic Order in 1831.

At Cambridge, you, Charles Babbage, and others formed the Analytical Society. The society was dedicated to improving the state of mathematics and Cambridge, and then in the whole of Britain. Your primary goal -- which the Analyticals succeeded in achieving -- was to switch Britain from Newton's calculus notation to Leibniz's notation, which was in use in France and the rest of Europe.

Objectives

You have one main objective in the game. You want your pro-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As John Herschel, you have responsibilities as the leader of the pro-Babbage faction, to introduce the Difference Engine fragment during GS 1, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Pro-Babbage Faction

Introduction of the Difference Engine Fragment

During GS 1, after the introductory party games and the PM's speech are complete, you are to give a speech that introduces the Difference Engine fragment that Babbage keeps in his home.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse

the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction members so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the government, nor a member of the nobility by heredity, you have no formal power to make decisions regarding Babbage's machines -- or anything else, for that matter. But, because of your connections and socializing with nobility and politicians, you may be able to exert some informal influence on them.

You are an influential fellow of the Royal Society (FRS), and if the Royal is asked to take up the matter of Babbage's machines, you can help steer the society to recommend that the government provide more funding for development and construction.

Assignments

Your main writing assignment is a written version of your GS 1 speech, due at the beginning of GS 1. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the "winning" PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a member of the last generation of the old-school "men of science" community, i.e., a wealthy gentleman with enough time, talent, and money to pursue your scientific interests at your leisure. Although you do not have anything against him personally, this puts you somewhat at odds with younger men of science like John Couch Adams. Men like Adams do not have large sums of money to pursue scientific studies as a hobby, rather, they do science for a living -- science is their profession as well as their passion. If you are among the last of the wealthy, amateur scientific gentlemen, Adams and his colleagues are among the first of the professional scientists.

Regarding the idea of the government funding large-scale scientific and engineering projects, you are in favor of the practice. If there is a precedent set of funding scientific research, you might be able to convince the government to fund your work as well. So, if only for selfish reasons, you support the funding of Babbage's computing engines.

With texts

With other roles

You met Charles Babbage when you were both students at Cambridge. You, Babbage, and several others formed the Analytical Society there, and have been fast friends ever since.

One of your most important works, *A preliminary discourse on the study of natural philosophy*, was published in 1831 in Dionysius Lardner's *Cabinet cyclopaedia*, and so you have a close relationship with Lardner.

With your faction

Strategy advice

To learn more

Summary of your individual victory objectives

Portrait of Sir John Frederick William Herschel, 1st Bt, by Julia Margaret Cameron, from the National Portrait Gallery, St Martins Place, London; URL:

<http://www.npg.org.uk/collections/search/portrait/mw07487/Sir-John-Frederick-William-Herschel-1st-Bt?LinkID=mp02165&search=sas&sText=john+herschel&role=sit&rNo=5>

Dionysius Lardner FRS



Office

You are Dionysius Lardner, a member of the Royal Society and a professor at University College in London. You are one of the first people to be called a scientific journalist, and editor of a 133-volume encyclopedia of science, the *Cabinet Cyclopaedia*. You are a dynamic lecturer and a very effective popularizer of scientific topics, and in this game you are responsible for lecturing on Babbage's Difference Engine, among other things.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born in 1793 in Dublin, Ireland, the son of solicitor (a legal practitioner qualified to give general legal advice and conduct legal proceedings, as opposed to a barrister, a lawyer who works in higher-level courts). Your father wanted you to follow in his legal career footsteps, but you instead entered Trinity College (a.k.a. the University of Dublin) in 1812. After your graduation in 1819 you began to write and lecture on mathematical and scientific subjects. In the year the game begins (1828), you have just been named professor of natural philosophy and mathematics at University College in London.

You have also just been selected as a Fellow of the Royal Society (FRS). You have a remarkable knack for explaining complicated mathematical and scientific concepts in terms that ordinary people can understand, which has made your books and lectures quite popular.

On an unfortunate personal note, you have something of a penchant for having affairs with married women. Your first occurred during the 1820s, and a second affair with the wife of a Royal Army captain will cause you to flee England, along with your paramour Mary Spicer Heaviside, for the relative safety of Paris in 1840. For the purposes of this game, you will not leave for France until after the last game session, which takes place in 1846.

Objectives

You win the game in one of two ways. First, you win if your faction wins: if any one of Babbage's calculating / computing engines receives further funding from the British government. In addition, you have a second victory condition that is not connected to the success of your faction. If you are able to make at least two bad arguments in the first five game sessions (see below), document them for the game master, without getting caught by the other players in the game, you win.

Responsibilities

As Dionysius Lardner, you have the responsibility to preside over the lectures at the Mechanic's Institute during GS 2, responsibilities to your faction, the responsibility to explain the Difference Engine and its importance, a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game, and a critical thinking skills responsibility that is yours alone. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibility to Preside Over GS 2

You will preside over the first set of lectures at the Mechanics Institute, which take place during GS 2. As the presiding character, you are responsible for making sure that the activities and speeches scheduled for GS 2 all happen. The activities for GS 2, and their order, are:

- PM speech by Field Marshal Arthur Wellesley, Duke of Wellington. Wellington, the newly-elected PM, will outline the priorities and goals his government will have while he is in office.
- The Duke of Sussex will speak on the virtues of *laissez-faire* economic policies
- Captain Swing will speak on the plight of Britain's farmers, and on the dangers of automation in general
- Your speech regarding the value of the Difference Engine. See below for more details regarding your speech.
- Andrew Crosse will speak on ???
- Any remaining time in the game session should be used for open-floor debate

- At the end of the session the gamemaster will conduct the persuasiveness metric poll of the indeterminates.

During any non-scheduled time in the session, the *podium rule* is in effect. The podium rule states that any character wishing to speak should approach the podium and wait to be recognized by the presiding officer (you). You must make sure that you are fair to anyone who wishes to speak, even those that are not in your faction. Characters are encouraged to ask questions of presenters, at the discretion of the presiding officer, but they should not make speeches to the class without approaching the podium.

Speak with the GM before GS 2 about the lectures at the Mechanics Institute, so that you are well prepared for the conduct of the session.

Responsibilities to the Pro-Babbage Faction

As a member of the pro-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. You can do this by making an excellent, persuasive case for the Difference Engine in GS 2. Later in the game, you can help your faction by being a vocal proponent for Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Regarding the Difference Engine

You are responsible for presenting a lecture outlining the workings of Babbage's proposed Difference Engine during GS 2. You should briefly explain how the engine would work, and then argue why the machine is so vital to Great Britain. For this, you should especially emphasize the importance of accurate navigational tables to the British Empire. Minor errors in these tables might result in several shipwrecks a year – dreadful costs for such seemingly unimportant numerical errors! The accidents prevented by accurate navigational tables would surely more than make up for the cost of developing Babbage's amazing Difference Engine.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Critical Thinking Skills: Presenting Bad Arguments

Secret: You are this game's "Bad Argument Bradley," a character assigned to make several arguments that are, well, bad. Other characters in the game are supposed to be on the lookout for such faulty thinking, and will call you out if they detect your bad arguments. As you read above, you can win the game regardless of whether any of Babbage's engines is completed, if you are able to pass two or more of your bad arguments by your colleagues without being detected. So, you must carefully choose your arguments and make them with skill.

For example, you might make a "straw man" argument. In such an argument, you put forth an often extreme, easy-to-defeat argument that sounds like something your opponents might say, but that they have not, in fact, used as an argument. Then, you tear apart the straw man. This makes it look like you are soundly defeating your opponent, when in fact all you are doing is destroying an argument that they never made at all.

Some other types of bad arguments that you might try are [Alm13]:

- **False dilemma** "An argument that presents a limited set of two possible categories and assumes that everything in the scope of the discussion must be an element of that set."
- **Slippery slope** "An argument that attempts to discredit a proposition by arguing that its acceptance will undoubtedly lead to a sequence of events, one or more of which are undesirable."
- **Equivocation** "An argument that exploits the ambiguity of language by changing the meaning of a word during the course of an argument and using the different meanings to support and ill-founded conclusion."

See the "To Learn More" section below for some resources you could use to learn more about bad arguments and how to make them.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction leader (Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the government, nor a member of the nobility, you have no formal power to make decisions regarding Babbage's machines -- or anything else, for that matter. However, you do have the power of persuasion; through your GS 2 lecture, and your other impromptu speaking and interactions, you should do your best to make the Difference Engine appear to be an absolute necessity for the nation. You are also a member of the Royal Society, so if the Royal ever takes up discussion about the engines, you can attempt to convince your peers that they should support construction of Babbage's machines.

Assignments

Your first writing assignment is a written version of your GS 2 speech, due at the beginning of GS 2. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Your second writing assignment, due no later than the beginning of the post-mortem session, is a short paper documenting the bad arguments you made during the game to this point. For each bad argument you make, include which bad argument tactic you employed, along with a definition of the tactic, and what game session you used the technique. This should be submitted to the GM only.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You have lectured and written very widely on the subjects of science and mathematics, with subjects ranging from pure science and mathematics (e.g., *The Encyclopaedia of Pure Mathematics* (1847)) to applied science and engineering (e.g., *The Steam Engine Explained and Illustrated: With an Account of its Invention and Progressive Improvement, and its Application to Navigation and Railways; Including also a Memoir of Watt* (1840)).

Interestingly, while your lectures regarding the Difference Engine were accurate, important, and influential, you have often been quite wrong regarding scientific topics. To cite only one example, when I. K. Brunel was building the Box Tunnel for the Great Western Railway, which included a one-foot decrease in elevation for every 100 feet of length, you performed some (erroneous) mathematics and concluded that if a train lost its brakes in the tunnel, it would emerge from the other end traveling at a speed in excess of 120 miles per hour. That is not true at all; you forgot to factor in air resistance and friction. You have made several other rather large and very public scientific errors, which you can read about in your role-specific readings.

That being said, you are clearly in favor of the development of Babbage's computational engines. You are also in favor of applied science, and in opposition to those who think that science should be a purely abstract field, separate from and not beholden to practical concerns.

With texts

With other roles

You know Babbage personally and have a mostly friendly and cordial relationship with him. Babbage has, on occasion, called you to account regarding your scientific mistakes -- he has called you “the prince of humbugs” -- but (unlike I. K. Brunel) he has mostly done so in a “best construction” manner.

Your lecture on the Difference Engine, along with seeing the engine fragment at Babbage's party, are extremely influential to Ada Lovelace. Inspired by these two experiences, Ada becomes Babbage's “enchanted math fairy” and “high priestess of the Analytical Engine.”

Although you both are members of the same faction, and hold broadly the same opinions regarding the big ideas in the game, you have an adversarial relationship with the engineer Isambard Kingdom (I. K.) Brunel. This stems from your unfounded and erroneous criticisms of several of Brunel's great engineering projects, including the Box Tunnel of the Great Western Railway (see above) and whether or not the steamship S. S. Great Western would be able to successfully cross the Atlantic ocean. (You said it would not be able to cross -- more likely to voyage to the moon, you said -- due to the extreme friction of the water against the hull; in fact, it crossed the Atlantic and sailed into New York harbor quite successfully.) Unlike Babbage, Brunel does not hold back when he calls you on the carpet regarding your scientific errors.

With your faction

Strategy advice

To learn more

[Alm13] Ali Almossawi. *An Illustrated Book of Bad Arguments*. The Experiment, New York, NY, 2013.

[Con14] Ciaran Conliffe. Dionysius Lardner, Scientific Populist - HeadStuff. <http://www.headstuff.org/2014/07/dionysius-lardner-scientific-populist/>, 2014.

Summary of your individual victory objectives

You can win the game in two ways:

- You win the game if your faction wins. Your faction wins the game if the British government decides to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.
- You win the game if you are able to make, and document in your second writing assignment, at least two flawed arguments during the first five game sessions, without getting caught.

Portrait of Dionysius Lardner from the National Portrait Gallery, St Martin's Place, London; URL: <http://www.npg.org.uk/collections/search/portrait.php?search=ap&npgno=1039&eDate=&lDate=>

Augusta Ada King-Noel, Countess of Lovelace



Office

You are Augusta Ada King-Noel, Countess of Lovelace, the only legitimate daughter of the “mad, bad, and dangerous to know” romantic poet, Lord Byron. Due to your gender, you are an unofficial or clandestine member of the “Men of Science” (MOS) community. You are a natural philosopher of the old tradition -- one whose station in life has allowed you the time and means to study mathematics as a hobby.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You are the only legitimate child of your father, the “mad, bad, and dangerous to know” romantic poet, Lord Byron. You were born in London on December 10th, 1815. Unhappy in the marriage, your mother, Lady Anne Isabella Milbanke Byron, sent your father packing shortly after you were born. You have no memory of Lord Byron, although his death in Greece when you were eight had a profound impact on you.

Your mother was quite concerned that you might have inherited your father's wild, hedonist proclivities. She was worried that you might become, in her words, “poetical” -- moody, unpredictable, and promiscuous -- like Byron. So, to fight against these tendencies, she decided to combat any poetical proclivities with poetry's natural enemy, mathematics. [Pad15] Accordingly, you were tutored in mathematics from a very early age. It was quite unusual at the time for a young aristocratic woman to receive such an education, but you seemed to thrive on this learning. Two of your early tutors, William Frend and Mary Somerville, are also characters in this game.

As it turns out, you are very intelligent and have a natural gift for languages and mathematics. You met one of the most influential people in your life, Charles Babbage, at one of his famous Dorset Street parties. You were only 17 at the time, but your tutor Mary Somerville took you to the party and made introductions with Babbage for you. You clicked with Babbage immediately, and even more so once you saw the fragment of his Difference Engine at the party. Unlike many of those that attended Babbage's parties, you immediately grasped the operating principle and importance of the machine. You learned more about the Difference Engine by attending one of Dionysius Lardner's popular lectures on the machine.

Babbage, who calls you his “high priestess of the Analytical Engine” and his “enchanted math fairy,” arranged for you to have more advanced mathematical tutoring from one of his friends, Augustus De Morgan, a professor at the University of London.

Your collaboration with Babbage reached its apex when he conceived of another kind of calculating machine, the Analytical Engine. Whereas the Difference Engine was intended to automatically produce mathematical tables, the Analytical Engine was to be much more capable. It is recognized today as a prototypical general-purpose computer.

One of the only contemporary publications regarding the Analytical Engine was written by the Italian engineer Luigi Federico Menabrea, for a Swiss journal. You proposed to Babbage that you could translate the article into English, and he agreed, also suggesting that you add some notes of your own to the article. You tackled this task with much enthusiasm, producing a set of notes that were three times as large as the article itself. The article was published in Scientific Memoirs in 1843. Your notes show that you understood the potential of the Analytical Engine more than anyone, even more than Babbage himself. Rather than thinking only in terms of the automation of mathematics, you speculated on the use of the Analytical Engine for processing letters and symbols, and perhaps even for the production of music. You used the initials “A. A. L.” as the byline for your notes, to hide the fact that they were written by a woman.

Objectives

You have one main objective in the game. You want your pro-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Ada Lovelace, you have responsibilities to your faction, to explain the Analytical Engine and its importance, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Pro-Babbage Faction

As a member of the pro-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. Early in the game, you can help your faction by being a vocal proponent for Babbage and his calculating engines. Before GS 5, during game sessions that *do not* take place at the Royal Society, you can ask good questions and make short podium speeches to help propel your faction to victory.

As a woman, you are not allowed to formally speak at the Royal Society. However, you can confer with your faction members to discuss strategy, etc.

Regarding the Analytical Engine

You are responsible for presenting a lecture outlining the workings of Babbage's proposed Analytical Engine during GS 5. You should briefly explain how the engine would work, and then argue why the machine is so vital. You must try to convey that the Analytical Engine would be able to produce mathematical tables, as the Difference Engine was intended to, but would be both a simpler machine and simultaneously much more powerful. The Analytical Engine could also be used to process letters, characters, and symbols, and might even be able to produce music!

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are not a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Mechanic's Institute, GS 2 or 5. Coordinate with your faction leader (Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are a woman, even though you are a member of the nobility, you have no formal power to make decisions regarding Babbage's machines -- or anything else, for that matter. However, you do have the power of persuasion; through your GS 5 lecture, and your other impromptu speaking and interactions, you should do your best to make the Difference Engine (before GS 5) and the Analytical Engine (after GS 5) appear to be an absolute necessity for the betterment of the nation and of the discipline of science in general.

Assignments

Your main writing assignment is a written version of your GS 5 speech, due at the beginning of GS 5. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the "winning" PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a clandestine member of the last generation of the old-school "men of science" community, i.e., a wealthy member of the nobility with enough time, talent, and money to pursue your scientific interests at your leisure. Of course, as a woman, you are a very unusual member of the community. You and Mary Somerville are exceptions to the norm at the time.

Although you do not have anything against him personally, your "old school" status puts you somewhat at odds with younger men of science like John Couch Adams. Men like Adams do not have large sums of money to pursue scientific studies as a hobby, rather, they do science for a living -- science is their profession as well as their passion. If you are among the last of the wealthy, amateur scientific gentlemen, Adams and his colleagues are among the first of the professional scientists.

Regarding the idea of the government funding large-scale scientific and engineering projects, you are in favor of the practice. You can see that there are much greater applications for the Analytical Engine than everyone, Babbage included, envisions.

With texts

Your notes on Menabrea's article [Men43], published in 1843, are critical to our modern understanding of Babbage's Analytical Engine. They form the only contemporaneous published description of the Engine.

With other roles

You have a special, close relationship with Charles Babbage, who calls you his “high priestess of the Analytical Engine” and his “enchanted math fairy.”

Mary Somerville and William Frend were influential mathematical tutors in your youth.

You learned more about the workings and importance of the Difference Engine by attending one of Dionysius Lardner's Mechanic's Institute lectures on the device.

With your faction**Strategy advice****To learn more**

[Men43] Luigi Ferico Menabrea. Sketch of the Analytical Engine Invented by Charles Babbage, Esq. *Scientific Memoirs*, iii, 1843. Available via Google Books.

[Pad15] Sydney Padua. *The Thrilling Adventures of Lovelace and Babbage: With Interesting & Curious Anecdotes of Celebrated and Distinguished Characters, Fully Illustrating a Variety of Instructive and Amusing Scenes; as Performed within and without the Remarkable Difference Engine, Embellished with Portraits and Scientific Diagrams*. Pantheon Books, New York, NY, 2015.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government decides to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Augusta Ada King-Noel, Countess of Lovelace, by William Henry Mote, after Alfred Edward Chalon, from the National Portrait Gallery, St Martins Place, London; URL: <http://www.npg.org.uk/collections/search/portrait/mw39468/Augusta-Ada-King-ne-Byron-Countess-of-Lovelace?LinkID=mp50509&search=sas&sText=lovelace&role=sit&rNo=3>

Mary Somerville



Office

You are Mary Fairfax Greig Somerville, Scottish polymath (a person whose expertise spans a significant number of different subject areas). Due to your gender, you are an unofficial member of the “Men of Science” (MOS) community. You are very unusual for the time, however, as you have published several very influential papers and books. You are a natural philosopher of the old tradition -- one whose station in life has allowed you the time and means to study astronomy and mathematics as a hobby.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and of the pro-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You are one of seven children born to your father, Vice-Admiral Sir William George Fairfax, and his second wife, Margaret Charters. You were born on December 26th, 1780, while your father was at sea. At the time, families saw no need to formally educate their daughters, and so you received virtually none. Your mother taught you to read, and you were sent to a few boarding schools for girls. However, these schools were intended not for traditional education, but rather to teach girls the “ladylike” skills such as needlepoint, piano, and painting.

Nevertheless, as a young girl you endeavored to educate yourself, reading as much as you could at home. Your immediate family actively discouraged your studies, believing that the physiology of a woman was simply not up to the arduous task of deep thought; as your father thought, "... the strain of abstract thought would injure the tender female frame." [Pat08] This was, again, a common concept at the time. Your mother especially believed it, blaming her encouragement of your older sister's studies for her death at age ten. Nonetheless, you persevered and continued studying. You did find adults who encouraged you here and there; an uncle helped you learn Latin, the artist Alexander Nasmyth turned you on to Euclid's classic work *Elements*, and one of your younger brother's tutors helped you to study algebra.

You married the Russian naval officer Captain Samuil Samuilovich Greig in 1804, and moved to London when he secured an appointment there as the Russian Consul. The marriage was not happy, and Samuil did not approve of your studies, but you had two sons together before Greig died in 1807.

On your return to Scotland, you found friends and acquaintances who supported your burgeoning pursuit of astronomy and mathematics. In particular, professors John Playfair and William Wallace were very influential. With their encouragement, you earned a silver medal in a mathematical problem-solving contest conducted by *Mathematical Repository*.

In 1812 you married again, to hospital inspector William Somerville, who fully supported and encouraged your intellect, and in 1816 you moved back to London. Your husband was elected as a Fellow in the Royal Society of London in 1817, and through him you became part of the thriving scientific community of the city. You are friends with many of the other characters in the game, including Airy, Babbage, Herschel, and Lovelace.

In a feat virtually unprecedented at the time, you published a well-received article in the *Proceedings of the Royal Society*, entitled *The magnetic properties of the violet rays of the solar spectrum*, in 1826. You have published several other papers and books, as well. Befitting your progressive status as a female polymath, you were inducted into several scientific societies: the Royal Irish Academy and the Société de Physique et d'Histoire Naturelle de Genève (the Society of Physics and Natural History of Geneva) in 1834, and the Royal Astronomical Society in 1835.

Objectives

You have one main objective in the game. You want your pro-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government decides, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Mary Somerville, you have responsibilities to your faction, to explain the sorry state of in mathematics in Great Britain during GS 1, and a "secret language" responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Pro-Babbage Faction

As a member of the pro-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. You can do this first by making an excellent speech during GS 1 about the state of mathematics in Great Britain (see below). Then, later in the game, you can help your faction by being a vocal proponent for Babbage and his calculating engines. During game sessions that *do not* take place at the Royal Society, you can ask good questions and make short podium speeches to help propel your faction to victory.

As a woman, you are not allowed to formally speak at the Royal Society. However, you can confer with your faction members to discuss strategy, etc.

Regarding the state of mathematics in Great Britain

During GS 1, sometime after the Georgian party game icebreaker, you will make a speech regarding the state of mathematics in Great Britain. You should include information about how backwards the kingdom was until very recently. You can draw on Babbage and Herschel's experiences with the Analytical Society at Cambridge, and how they pulled the UK into sync with the rest of Europe as to the notation used for calculus -- Newton's or Leibniz's. You can also draw on the published works of another character in the game, William Frend, whose algebra textbook is shockingly backwards (e.g., it is an algebra text that refuses to admit the possibility or utility of negative numbers). You should then talk about some of the advances in mathematics that are now being made in the UK.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are not a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Mechanic’s Institute, GS 2 or 5. Coordinate with your faction

leader (Herschel) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are a woman, even though you are a well respected scientist and mathematician, you have no formal power to make decisions regarding Babbage's machines -- or anything else, for that matter. However, you do have the power of persuasion; through your GS 1 lecture, and your other impromptu speaking and interactions, you should do your best to make the Difference Engine (before GS 5) and the Analytical Engine (after GS 5) appear to be an absolute necessity for the betterment of the nation and of the discipline of science in general.

Assignments

Your main writing assignment is a written version of your GS 1 speech, due at the beginning of GS 1. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in British science during the early to mid-1800s, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are an unofficial member of the last generation of the old-school “men of science” community, i.e., a wealthy member of high society with enough time, talent, and money to pursue your scientific interests at your leisure. Of course, as a woman, you are a very unusual member of the community. You and Ada Lovelace are exceptions to the norm at the time.

Although you do not have anything against him personally, your “old school” status puts you somewhat at odds with younger men of science like John Couch Adams. Men like Adams do not have large sums of money to pursue scientific studies as a hobby, rather, they do science for a living -- science is their profession as well as their passion. If you are among the last of the wealthy, amateur scientific gentlemen, Adams and his colleagues are among the first of the professional scientists.

Regarding the idea of the government funding large-scale scientific and engineering projects, you are in favor of the practice.

With texts

You have written several important articles and books regarding astronomy and mathematics. You worked on a translation and annotation of Laplace's *Mécanique Céleste* that grew to such size that John

Herschel recommended that you publish your work as a book, and this work, *The Mechanism of the Heavens*, was first published in 1831. Your next work, *The Connection of the Physical Sciences*, was published in 1834. The sixth edition of this book, in 1842, influenced John Couch Adams to begin his search for the planet Neptune.

With other roles

You, along with William Frend, have served as a mathematics tutor for Ada Lovelace, as her mother, Anne Isabella Byron, attempted to prevent her from becoming too “poetical” like her father, Lord Byron. Lady Anne hoped that the power of mathematics would be strong enough to overcome any hedonistic tendencies Ada inherited from Byron. You took Ada to one of Babbage's Dorset Street parties, where she first met him and saw his Difference Engine fragment.

During his 1834 - 1835 term of office as Prime Minister, Sir Robert Peel awarded you a £200 yearly pension, an amazing recognition of your intellectual worth to the United Kingdom. In 1837, another PM, William Lamb, increased the amount to £300 per year. That is an amount equivalent to more than \$40,000 in 2017 dollars.

The sixth edition of your book *The Connection of the Physical Sciences*, published in 1842, was very influential on another character in the game, John Couch Adams. In your book, you noted that the planet Uranus was orbiting in a manner different from the prediction, and speculated that there might be another planet, further beyond Uranus, whose gravitational pull was causing the odd behavior. Adams read this, and, through much arduous calculation, predicted where the as-yet-unseen planet should be located. Adams will discuss the discovery of Neptune during GS 7; before that, it is inappropriate to talk about the planet.

With your faction

Strategy advice

To learn more

[Fre96] William Frend. *Principles of Algebra*. G. G. and J. Robinson, London, 1796. Available via Google Books.

[OR99] J. J. O'Connor and E. F. Robertson. Somerville biography. <http://www-history.mcs.st-andrews.ac.uk/Biographies/Somerville.html>, November 1999.

[Pat08] Elizabeth C. Patterson. Somerville, Mary Fairfax Greig. <http://www.encyclopedia.com/science/dictionaries-thesauruses-pictures-and-press-releases/somerville-mary-fairfax-greig>, 2008.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government decides to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Mary Somerville by Mary Dawson Turner (n_ee Palgrave), from the National Portrait Gallery, St Martins Place, London; URL: <http://www.npg.org.uk/collections/search/portrait/mw13110/Mary-Somerville?LinkID=mp04193&search=sas&sText=mary+somerville&role=sit&rNo=4>

Anti-Babbage roles

George Biddell Airy FRS



Office

You are George Biddell Airy, FRS. You are a member of the Men of Science (MOS) community, and (starting in 1835) the Astronomer Royal, but you are not in favor of the British government spending money from its treasury to support the construction of Babbage's Difference or Analytical Engines.

The following definition is important to this role: curmudgeon (n): a person (especially an old man) who is easily annoyed or angered and who often complains.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community, and the leader of the anti-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

If your personal story took place in the United States rather than in the United Kingdom, it would likely be cited as an instance of the “rags-to-riches” American dream. Through hard work and education you have been able to significantly raise your standing in society.

You were born on July 27th, 1801, in Alnwick, Northumberland, in the far north of England. Your father, William Airy, was originally a farmer, but through hard work and education, he was able to become a civil servant, specifically, a tax inspector. In 1813 your father lost his job, however, and you went to live

with your uncle, Arthur Biddell. Biddell was an educated man with a personal library containing many books on science, which you studied intently. With your uncle's financial help, and by entering as a sizar (an undergraduate receiving financial aid from the university and obligated to perform menial servant duties in return), you were able to attend Trinity College, Cambridge starting in 1819. You were the top of your first-year class, and winner of the Smith's prize in your final year of 1823. The Smith prize is awarded to top research students in mathematics and theoretical physics. It can be argued that your academic success was as much about your tremendous memory and organizational skills, rather than any innate mathematical gift.

Whatever the root of your success, however, it has continued. After graduation, you earned a fellowship at Trinity and stayed on as a professor there. A mere three years later in 1826 you were named as the 10th Lucasian Professor of Mathematics at Cambridge. The Lucasian Chair is perhaps the most prestigious academic position that one can hold anywhere in the world; Isaac Newton held the chair for 33 years in the seventeenth century, and Stephen Hawking held it for 30 years in the twentieth. The other primary candidate for the chair was Charles Babbage; your defeat of Babbage set the stage for your ongoing conflicts with the polymath.

In the year our game begins, 1828, you have left the Lucasian Chair for another position as Plumian Professor of Astronomy at Cambridge and Director of the Cambridge Observatory. Your motivation for leaving the prestigious chair was financial: the new position, along with being a member of the Board of Longitude, brought in enough money that you were able to convince the father of your fiancé, Richarda Smith, to allow your marriage to commence. In 1835 you will become Astronomer Royal, taking you away from Cambridge and to the Royal Observatory at Greenwich. You will hold this position until your retirement in 1881.

You will win the Royal Society's Copley medal in 1831, and be selected as a Fellow of the Royal in 1836. You will eventually serve as president of the society for two years starting in 1871.

Your time as Astronomer Royal is illustrative of your personality. While there, you could not tolerate the idea of younger scientists thinking for themselves, and so the Observatory did not train any new astronomers during your tenure.

Your successor in the Lucasian Chair, selected on your departure from Cambridge in 1828, was Charles Babbage.

Objectives

You have one main objective in the game. You want your anti-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As the leader of the anti-Babbage faction, your chief responsibility is to make sure that your faction is effective in preventing any of Babbage's Difference or Analytical Engines from receiving further funding from the British government. You also have a responsibility to debate the priority of the discovery of

Neptune, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Importantly, you have a responsibility to be a curmudgeon, especially being on the lookout for faulty arguments and “weasel words.” Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Anti-Babbage Faction

Regarding the Priority of the Discovery of Neptune

During GS 6, you will debate John Couch (pronounced “cooch”) Adams, regarding the discovery of Neptune in 1846. Based on calculations he'd been working on for years, Adams predicted where a yet-undiscovered planet would be found. Adams will claim that not only did you needlessly delay a telescopic search for Neptune, losing priority in the discovery to the French, but that his calculations could have been completed much more quickly had one of Babbage's Difference Engines been available to do the computations.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Being a curmudgeon

In keeping with your curmudgeon-ness, you are basically responsible for being cranky, and not liking anything. You should keep watch for “weasel words,” i.e., words or statements that are intentionally ambiguous or misleading. Depending on the context, and whether there is any quantification used, the following words might be weasel words: helps, supports, is useful, better, improved, effective, efficient, seems, appears, many, most, and so on.

You are also responsible for calling out bad arguments. For example, someone might make a “straw man” argument. In such an argument, the perpetrator puts forth an often extreme, easy-to-defeat argument that sounds like something his or her opponents might say, but that they have not, in fact,

used as an argument. Then, the perpetrator tears apart the straw man. This makes it look like the user of the technique is soundly defeating his or her opponent, when in fact all they are doing is destroying an argument that the opponents never made at all.

Some other types of bad arguments that you might try are [Alm13]:

- False dilemma “An argument that presents a limited set of two possible categories and assumes that everything in the scope of the discussion must be an element of that set.”
- Slippery slope “An argument that attempts to discredit a proposition by arguing that its acceptance will undoubtedly lead to a sequence of events, one or more of which are undesirable.”
- Equivocation “An argument that exploits the ambiguity of language by changing the meaning of a word during the course of an argument and using the different meanings to support and ill-founded conclusion.”

See the “To Learn More” section below for some resources you could use to learn more about bad arguments and how to make them.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Royal Society, after you have been made a FRS: GS 6 or 7. Coordinate with your faction members so you can make a speech with the maximum impact for your faction.

Powers

As a “man of science,” but not a member of the nobility by heredity, nor of the government, your official powers to make things happen are quite limited. However, you are the Astronomer Royal (as of 1835, at least), and in that capacity members of the government consult you on all sorts of scientific matters. So, your opinion carries weight. As leader of the anti-Babbage faction, your organizational skills will be an invaluable asset.

Assignments

Your main writing assignment is a written version of your GS 6 speech, due at the start of GS 6. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in nineteenth-century British science and mathematics, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are not an “old-school” MOS. You are not a landed gentleman, and so you do not have large reserves of money to allow you to pursue science as a hobby. You earn your living by pursuing the study of the natural world. This informs your opinions on two of the major issues in the game. First, you believe it is appropriate and proper to be a professional man of science, rather than simply a wealthy, talented amateur.

With texts

You have published extensively, with over 500 papers and 11 books, such as *Trigonometry* (1825) and *Gravitation* (1834), to your name. Engineering, sometimes characterized as applied science, is one of your many interests outside of astronomy and mathematics. In fact, you were able to use your engineering schools to renovate many of the instruments at Greenwich. Also, you tend towards applied mathematics rather than theoretical, really seeing no use in the study of mathematics for its own sake.

With other roles

Even in your days as a schoolboy, you have been known, frankly, as something of a snob. As an adult, you have a sarcastic manner and are known as a harsh disciplinarian to the employees of the Royal Observatory. As for roles in this game, you have clashed repeatedly with Charles Babbage. Aside from the hard feelings between you regarding the Lucasian Chair, your first public disagreement came in 1832 when you clashed over a telescope in 1832. In 1842 you made your opinion known regarding Babbage's Difference Engine: “worthless.” Later, in 1854, you supported the narrow gauge railway track system while Babbage supported the wide gauge tracks used by his friend I.K. Brunel.

With your faction

Strategy advice

To learn more

[Alm13] Ali Almossawi. *An Illustrated Book of Bad Arguments*. The Experiment, New York, NY, 2013.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Sir George Biddell Airy KCB PRS, by Lock & Whitfield, from the National Portrait Gallery, St Martin's Place, London; [URL:http://www.npg.org.uk/collections/search/portrait/mw124114/Sir-George-Biddell-Airy?LinkID=mp56451&search=sas&sText=airy&role=sit&rNo=8](http://www.npg.org.uk/collections/search/portrait/mw124114/Sir-George-Biddell-Airy?LinkID=mp56451&search=sas&sText=airy&role=sit&rNo=8)

Revered William Buckland DD FRS



Office

You are the Reverend Doctor William Buckland, DD FRS, a clergyman, theologian, geologist, paleontologist, and occasional opportunistic cannibal. You are a Canon of Christ Church, Oxford, Fellow of the Royal Society of London, and a member of the Men of Science (MOS) community.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and the anti-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born on March 12, 1784, in Axminster, Devon, in the southwest of England, to the Anglican clergyman Charles Buckland and his wife Elizabeth. You may have acquired your interest in fossils early in your childhood, as you accompanied your father on countryside walks past the quarries near Axminster. The work in the quarries exposed many fossils, and you collected them.

In 1801 you were awarded a scholarship to attend Corpus Christi College, Oxford, where you were to study for the ministry. By 1808, you earned your Bachelor's degree, your Master's degree, were ordained as an Anglican priest, and were named as a Fellow (i.e., a professor) at Corpus Christi College. Also during this period, you explored widely in the United Kingdom, touring portions of England, Scotland, Wales, and Ireland in search of geological formations and fossils. In 1813 you were appointed reader in

mineralogy at Corpus Christi, replacing one of your former professors, John Kidd, when he retired. In this capacity you lectured on geology and paleontology, and you were good at it. Your lectures became very popular.

One of your major areas of investigation dealt with the biblical account of the flood, and its connection to geological formations and fossils. At the time, the common thought about fossils was that they were the remains of creatures killed during the flood. This idea, however, was becoming harder and harder to reconcile as men of science learned more about geology. First, it was starting to become apparent that the Earth was much, much older than the literal interpretation of the biblical creation account. Secondly, you realized that the duration of the flood would not have been long enough to lay down all the rock strata where fossils were being found. For these reasons, you formed your catastrophism theory, otherwise known as “gap creationism.” In this theory, an indeterminate amount of time had elapsed since God created the universe, and there had been several sequential creations and extinctions of the creatures of the Earth.

You were named a Fellow of the Royal Society of London in 1818, and in 1822 you were awarded the Royal's Copley Medal for your work on the fossilized hyenas you investigated in Kirkland Cave, Yorkshire.

In 1824, you announced the discovery of a *Megalosaurus* (“great lizard”) fossil, and thus published the first account of a dinosaur.

In 1825, you were made Canon (priest) of Christ Church, Oxford, in reward for your intellectual accomplishments.

You are somewhat -- more that somewhat, actually -- eccentric. You often do your field work, searching for fossils, while wearing your full academic regalia. You are known to lecture to your classes from horseback. When you are not on horseback, you enliven your lectures by enacting the movements of the dinosaurs you are so familiar with. The pinnacle of your eccentricities is zoöphagy, however.

Zoöphagy simply means the tendency to feed on animals. You take this concept to the extreme, claiming to have eaten at least one bite of *every* animal! Your least favorite were the mole and the bluebottle fly. Your taste for literally all kinds of meat goes farther yet. According to Augustus Hare, whilst at a dinner party in France,

“Talk of strange relics led to mention of the heart of a French King [Louis XIV] preserved at Nuneham in a silver casket. Dr. Buckland, whilst looking at it, exclaimed, ‘I have eaten many strange things, but have never eaten the heart of a king before’, and, before anyone could hinder him, he had gobbled it up, and the precious relic was lost for ever.” [BK12]

Objectives

You have one main objective in the game. You want your anti-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As William Buckland, you have a responsibility to introduce a resolution to the Royal Society that does not support the funding of Babbage's Difference Engine, responsibilities to your anti-Babbage faction, and a "secret language" responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding an anti-Babbage resolution

During GS 3, the Royal Society will debate whether or not to recommend that the government fund the development of Babbage's Difference Engine. You are to introduce a resolution saying that the Royal Society does not recommend that the government fund Babbage. Your speech should explain why you think this is appropriate; work with your faction (in particular with your faction leader, George Biddell Airy) to make sure you include all of your faction's arguments against funding Babbage's device.

Responsibilities to the Anti-Babbage Faction

As a member of the anti-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. During the game, you can help your faction by being a vocal opponent of Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Regarding the "secret language" of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language."

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. "Brilliant!" "Yes, of course! I see now!" "Aha!" Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction leader (Airy) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

As a “man of science,” but not a member of the nobility by heredity, nor of the government, your official powers to make things happen are fairly limited. However, you are an influential member of the Royal Society, and in that capacity members of the government consult you on all sorts of scientific matters. So, your opinion carries weight.

Assignments

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in nineteenth-century British science and mathematics, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are not an “old-school” MOS. You are not a landed gentleman, and so you do not have large reserves of money to allow you to pursue science as a hobby. You earn your living by pursuing the study of the natural world. This informs your opinions on two of the major issues in the game. First, you believe it is appropriate and proper to be a professional man of science, rather than simply a wealthy, talented amateur.

With texts

With other roles

With your faction

Strategy advice

To learn more

[BK12] Aaron Birk and Robert Krulwich. Who Wants To Eat Jelly_sh Omelets? Dolphin Meatballs? Mouse-On-Toast? These Guys. <http://www.npr.org/sections/krulwich/2012/09/27/161874316/who-wants-to-eat-jellyfish-omelettes-dolphin-meatballs-mouse-on-toast-these-guys>, September 2012.

[Bro66] W. H. Brock. The Selection of the Authors of the Bridgewater Treatises. *Notes and Records of the Royal Society of London*, 21(2):162{179, 1966.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Revered William Buckland DD FRS, by Thomas Phillips, from the National Portrait Gallery, St Martin's Place, London; <http://www.npg.org.uk/collections/search/portraitLarge/mw00890/William-Buckland?LinkID=mp00625&search=sas&sText=william+buckland&role=sit&rNo=0>

Joseph Clement



Office

You are Joseph Clement, an extremely capable toolmaker, draftsman, engineer, and industrialist. In the mid-1820s, you are hired by Charles Babbage to construct his Difference Engine.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the Men of Science MOS community. Since Babbage hired you to work on his Difference Engine, you begin the game as a member of the pro-Babbage faction.

Secret: However, in 1833 (i.e., starting in GS 5) you will transition to being member of the anti-Babbage faction. *The fact that you will switch between factions is not public knowledge, and should not be shared with anyone else!*

Biography

You were born in 1779 in Great Ashby, Westmoreland County, in the northwest part of England. Your father was a hand-loom weaver, but for a working man he was remarkably intelligent, curious, and well-versed in natural philosophy. He loved to study the local insect life around your house. He also was mechanically gifted, having built his own lathe, which he used to create his own mechanical devices. You have inherited these traits from your father, and they have served you well.

You have not had much in the way of formal education beyond basic instruction in reading and writing at the local school. You have, however, been able to teach yourself very effectively. Your father intended you to follow him as a weaver, but hand-loomers were falling out of use due to the introduction of the Jacquard Loom, and so you tried your hand at several different careers. You first worked as a thatcher (one who installs and repairs the thatched roofs of buildings) and then as a slater (one who installs and repairs slate tiles on the sides of buildings). Since both of these trades were seasonal, and since you inherited your father's curiosity, you spent much of your off time with the local blacksmith, learning to forge and otherwise work with metal. A cousin loaned you some books on mechanics, which caused you to change trades once again. Soon thereafter you created your own lathe. You used the lathe to create musical instruments such as flutes and bagpipes, a microscope for your father, and a refracting telescope.

Giving up slating, you next found work in a nearby factory making Jacquard Looms, then the same occupation in another factory in Carlisle, then on to more varied mechanical work in Glasgow. In Glasgow you learned the trade of draftsmanship from Peter Nicholson. After a time in Glasgow you moved to Aberdeen where your skills and reputation grew. Ultimately in 1813 you moved to London, where you found employment in Alexander Galloway's mechanical shop. From there you went to work in John Bramah's shop (and just in time, for the ever perilous cast-iron roof on Galloway's shop collapsed, killing nine men). In 1817 your reputation had grown enough for you to set up your own successful mechanical engineering shop in London.

Your reputation for quality work and inventiveness are such that, whenever someone has an idea for something to be mechanized, they seek you out to build it. This led Babbage to employ you as the only engineer capable of building his Difference Engine.

Objectives

You have two main objectives in the game. First, you have to spend the first five game sessions as a convincing member of the pro-Babbage faction. Then, starting in GS 5, you become a member of the anti-Babbage faction, and you will give a speech detailing your reasons for switching sides. Your switch should be a surprise to everyone, so you must fit in with the pro-Babbage faction until your defection.

Secondly, you want your ultimate faction, the anti-Babbage faction, to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Joseph Clement, you have a responsibility to your anti-Babbage faction, and a "secret language" responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Anti-Babbage Faction

Your chief responsibility to the anti-Babbage is when you switch factions at the beginning of GS 5. At the beginning of the session, you will make a speech detailing why you have left the employ of Charles Babbage. Then you will become a member of the anti-Babbage faction, earning an IP for the faction in the process.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are not a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Mechanic’s Institute, GS 2 or 5. Coordinate with your current faction leader (Herschel for GS 2 or Airy for GS 5) and the other members of your current faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are a member of the working class, even though you are a well-respected engineer, you have no formal power to make decisions regarding Babbage’s machines -- or anything else, for that matter. However, you are an important element of the game! Firstly, your defection to the anti-Babbage faction during GS 5 earns that faction an IP, which is very valuable. Secondly, your speech explaining why you left Babbage’s employ, if done well, can be very convincing, showing that Babbage’s refusal to fix the specifications for the Difference Engine would result in a “money-pit” project for the government.

Assignments

Your main writing assignment is a written version of your GS 5 speech, due at the beginning of GS 5. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in nineteenth-century British science and mathematics, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are not an “old-school” MOS. You are a working man, not a landed gentleman, and so you do not have large reserves of money to allow you to pursue science as a hobby. You earn your living by making things. This informs your opinions on two of the major issues in the game. First, you believe it is appropriate and proper to be a professional man of science, rather than simply a wealthy, talented amateur.

Regarding government funding of Babbage's engines, you don't have an issue with the concept in abstract terms. However, in this particular case, your opinion is that the government has already spent enough money on what is likely to be a doomed project.

With texts

Engineering was very much a working-man's occupation in the time frame of this game, and as such, engineers did not write papers or books. Unlike the mathematicians and scientists in the game (Airy, Buckland, Frend, and even Lovelace and Somerville), you have not written any publications on your work.

With other roles

With your faction

Strategy advice

To learn more

[Roe16] Joseph Wickham Roe. *English and American Tool Builders*. Yale University Press, New Haven, CT, 1916. Available via Google Books.

[Smi64] Samuel Smiles. *Industrial Biography: Iron-Workers and Tool-Makers*. Ticknor and Fields, Boston, MA, 1864. Available via Google Books.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Early Victorian Portrait Study of aWorking Man, <http://www.pbcfineart.co.uk/017-4/>

William Frend



Office

You are William Frend, unitarian clergyman, political radical, and author of an Algebra textbook, *Principles of Algebra* [Fre96]. You have been one of Ada Lovelace's mathematics tutors.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the anti-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You are one of the oldest characters in this game. You were born on November 22, 1757, in Canterbury in southeast England. Your father, George Frend, was a businessman and mayor of the city. He intended that you would follow in his footsteps as a trader, and so he sent you to be educated for that profession. You studied at the King's School in Canterbury, and also abroad in France and in Quebec. However, on your return from North America, you felt called to be ordained in the Church of England, and so you enrolled at Christ's College, Cambridge, to prepare for the ministry. While there you also demonstrated significant mathematical talent, graduating as second wrangler (second-best mathematics undergraduate) and winning the Smith's prize in mathematics. You became a priest in the Church of England in 1783.

However, you did not remain in the church for long. In 1787 you left the Church of England to become a Unitarian. This was problematical, as nonconformists were discriminated against, in both official and unofficial ways, at this time in the UK. For example, you were working towards a Master's degree at Cambridge, but nonconformists were barred from being candidates for the degree. You were relieved of your duties as a tutor at the university in 1788.

You took your disagreements with the Church of England to a new level in 1792, when you published *Peace and Union recommended to the Associated Bodies of Republicans and Anti-republicans*, a book that was harshly critical of church. Due to the book, you were put on trial before the university senate, convicted, and banished from the university in 1793.

After Cambridge, you moved to London, where you supported yourself by teaching and by writing. In 1796 you published your textbook on algebra, *Principles of Algebra*. During this time you also served as a private tutor to several influential people, including Ada Lovelace.

You are politically liberal, perhaps even radical, and a noted campaigner for the reform of the poor laws, for increased taxation of the rich and a progressive income tax, and against slavery, amongst other causes.

Objectives

You have one main objective in the game. You want your anti-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As William Frend, you have a responsibility to reject “new” mathematics, and general responsibilities to your anti-Babbage faction. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Anti-Babbage Faction

As a member of the anti-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. Even after your GS 1 speech, you can help your faction by being a vocal opponent of Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Regarding the invalidity of “new” mathematics

Near the beginning of GS 1, you will make a speech largely based on your introduction to your algebra text, *Principles of Algebra*. In your text, you endorse some very strange ideas, such as rejecting the existence or utility of negative numbers. Based on the information in the text, you should make the case that teaching “algebra” in your way would be more effective for students of mathematics.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are not a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Mechanic's Institute, GS 2 or 5. Coordinate with your faction leader (Airy) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Since you are not a member of the nobility, nor the government, and you are a nonconformist, you have not formal power to make decisions regarding Babbage's machines -- or anything else, for that matter. You can still win the game, however! You will have to collaborate with your faction to help steer your faction strategy towards a victory. In addition, you can earn IPs for yourself and your faction by making excellent speeches, asking insightful questions, and so on.

Assignments

Your main writing assignment is a written version of your GS 1 speech, due at the beginning of GS 1. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the "winning" PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in nineteenth-century British science and mathematics, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are more of a radical political figure during this game than a true member of the "Men of Science" (MOS) community, so the more complex points of contention regarding Babbage's machines may escape you. This also means you do not have a personally motivated opinion about what a man of science should be. I.e., should he be a wealthy, landed gentleman with enough time, talent, and wealth to pursue the study of nature as a hobby? Or, should he be a professional, an intelligent working man who earns his living by doing science? If you had to choose, your liberal leanings would probably lead you to the latter opinion.

Regarding government support for large-scale scientific projects such as Babbage's computing machines, you are not in favor of the practice. You feel that the government should focus more on aiding the poor and the unfortunate, rather than giving money to wealthy gentlemen so they can pursue their scientific hobbies.

With texts

As the author of *Principles of Algebra*, you have had an influence (for better or worse!) on many mathematicians in Britain. You are also widely published on what we would today term social justice issues.

With other roles

Ada Lovelace's mother, Lady Anne Isabella Byron, hired you as a mathematics tutor for her daughter. Lady Byron feared that Ada would take after her father, the poet Lord Byron; that Ada might become “poetical,” shorthand for hedonistic and promiscuous. Lady Byron hoped to combat poetry with its natural enemy, mathematics, and that is where you enter the picture.

With your faction

Strategy advice

In the game, your GS 1 speech serves to illustrate the sorry state of mathematics in Britain around the turn of the nineteenth century. Your points of view are very foreign to students today, and may seem comically incorrect. So, you will need to work hard to learn about Frend's ideas and to present them in the most convincing way possible. Also remember that, in a sense, your GS 1 speech serves as a foil for other characters who want to talk about the recent advances in mathematics in the UK. Even though your ideas are incorrect from a modern point of view, you could still earn an IP for your speech if you do an excellent job.

To learn more

[Fre92] William Frend. *Peace and Union recommended to the associated bodies of Republicans and Anti-Republicans*. P. C. Croft, 1792.

[Fre93] William Frend. *An account of the proceedings in the University of Cambridge, against William Frend, M.A. Fellow of Jesus College, Cambridge, for publishing a pamphlet, intitled Peace and union, &c: Containing the proceedings in Jesus College, the trial in the Vice-Chancellor's Court, and in the Court of Delegates*. Printed by B. Flower, 1793.

[Fre96] William Frend. *Principles of Algebra*. G. G. and J. Robinson, London, 1796. Available via Google Books.

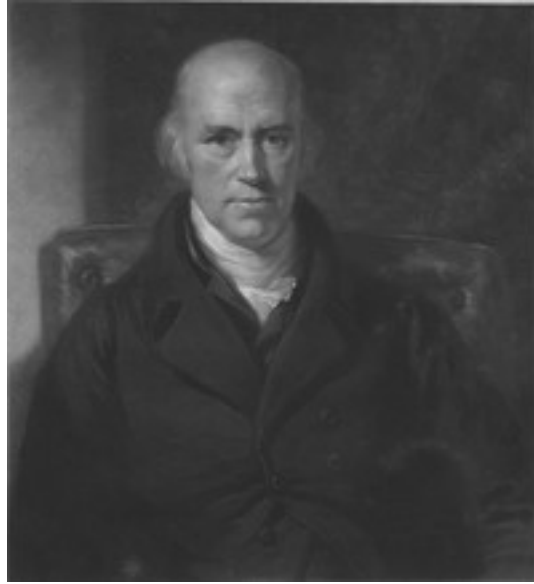
[Gun54] Henry Gunning. *Reminiscences of the University, Town, and County of Cambridge from the Year 1780*. George Bell, 1854. Available via Google Books.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of William Frend, by Andrew Birrell, after Silvester Harding, from the National Portrait Gallery, St Martin's Place, London; <http://www.npg.org.uk/collections/search/portraitLarge/mw41861/William-Frend?LinkID=mp57779&search=sas&sText=william+frend&role=sit&rNo=0>

Davies Gilbert PRS



Office

You are Davies Gilbert PRS, British botanist, geologist, mathematician, civil servant, politician, author, and from 1827 through 1830, president of the Royal Society of London. You are also well known for publishing collections of Christmas Carols.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and the anti-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born Davies Giddy on March 6, 1767, in Penzance, Cornwall county in the extreme southwest of England. Your father was the Reverend Edward Giddy, curate (assistant to the vicar or priest) of St. Erth church there, and your mother was Catherine Davies. You received a good education at home from your father, at the local grammar school, and from the Reverend Malachy Hitchins, computer and comparer at the Greenwich Royal Observatory. Hitchins recommended you to for entry into mathematician Benjamin Donn's Mathematical Academy. After the Academy, in 1786 you went up to Pembroke College, Oxford; you graduated with a Master of Arts degree in 1789.

You married Mary Ann Gilbert in 1808, and changed your surname from Giddy to Gilbert in 1817, so that you could inherit the estate of your wife's father Thomas Gilbert, who had no male heir.

Your civil service career began in 1792, as you served as the High Sheriff of Cornwall county for two years. Then, in 1804, you were elected to parliament, serving as MP for two Cornwall boroughs, first for Heston from 1804 through 1806, and then for Bodmin from 1806 through 1832.

You were elected as a Fellow of the Royal Society of London on November 17, 1791. As our game starts, you are president of the society, having succeeded Sir Humphry Davy at the post in 1827.

Objectives

You have one main objective in the game. You want your anti-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Davies Gilbert, you have a responsibility to conduct several meetings of the Royal Society of London, a responsibility to make a speech about the history and accomplishments of the Society, responsibilities to your anti-Babbage faction, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibility to Conduct Royal Society Meetings

As president of the Royal Society, you are responsible for conducting the game sessions that occur at the Society, during game sessions 3 and 4. As the presiding officer, you are required to make sure that the scheduled agenda items -- speeches, resolutions, etc. -- all happen on schedule. The activities for GS 3 and 4, and their order, are:

- GS 3: Recommendation regarding the Difference Engine.
 - Faraday introduces a resolution supporting funding the Difference Engine
 - Buckland introduces a resolution against funding the Difference Engine
 - Open debate regarding which resolution to support
 - FRS voting on the resolutions
 - IP spending. Individuals, factions, and the PM spend IPs, adding them to one of the two stacks shown in the GS 3 decision stack table in Chapter 3 of the gamebook.
 - The PM, Field Marshal Arthur Wellesley, Duke of Wellington, will make his decision as to the government funding the Difference Engine, in accordance with the GS 3 decision stack.
 - At the end of the session the gamemaster will conduct the persuasiveness metric poll of the indeterminates.
- GS 4: Celebrating the Royal Society.

- PM speech by Lord Charles Grey, 2nd Earl Grey. Grey, the newly-elected PM, will outline the priorities and goals his government will have while he is in office.
- Your speech about the history and accomplishments of the Royal Society. See below for more details regarding your speech.
- Charles Babbage will speak about the Royal Society.
- Any remaining time in the game session should be used for open-floor debate
- At the end of the session the gamemaster will conduct the persuasiveness metric poll of the indeterminates.

During any non-scheduled time in the session, the *podium rule* is in effect. The podium rule states that any character wishing to speak should approach the podium and wait to be recognized by the presiding officer (you). You must make sure that you are fair to anyone who wishes to speak, even those that are not in your faction. Characters are encouraged to ask questions of presenters, at the discretion of the presiding officer, but they should not make speeches to the class without approaching the podium.

An extra complexity for you as the presiding officer for Royal Society meetings is that only members with FRS status are allowed to publically speak during sessions that take place at the Society. See the table in Part Three of the gamebook for details on who is a FRS, and when they achieve this status. Characters that are not FRS may confer with their factions and other characters, but they are not allowed to ask questions of presenters nor speak from the podium.

Speak with the GM before GS 3 about these sessions at the Royal Society, so that you are well prepared for the conduct of the session.

Responsibility to Celebrate the Royal Society

At the beginning of GS 4, you will make a speech in which you will celebrate the Royal Society. You will cover the history of the society and highlight the tremendous advancements in science that have been sponsored by the Society. You know there are rumblings of discontent in the Society lately, with certain members feeling that it has become more of a wealthy gentleman's club rather than an institution devoted to the advancement of society. So, you should make sure to include recent achievements due to the society as well as those further in the past.

Responsibilities to the Anti-Babbage Faction

As a member of the anti-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. In the game sessions before and after your GS 4 speech, you can help your faction by being a vocal opponent of Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction leader (Airy) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

As a member of the government and the president of the Royal Society until GS 5, you are a very powerful individual in the game. In particular, as Royal Society president, you have the power to shape the agenda of the Society's meetings. To represent your political power, you begin the game with an IP. You may use the IP as you wish, spending it in GS 3, 5, or 7, at your discretion.

Assignments

Your main writing assignment is a written version of your GS 4 speech, due at the beginning of GS 4. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in nineteenth-century British politics, science, and mathematics, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a member of the last generation of the old-school “men of science” community, i.e., a wealthy gentleman with enough time, talent, and money to pursue your intellectual interests at your leisure. Although you do not have anything against him personally, this puts you somewhat at odds with

younger men of science like John Couch Adams. Men like Adams do not have large sums of money to pursue scientific studies as a hobby, rather, they do science for a living -- science is their profession as well as their passion. If you are among the last of the wealthy, amateur scientific gentlemen, Adams and his colleagues are among the first of the professional scientists.

Regarding the idea of the government funding large-scale scientific and engineering projects, you are not in favor of the practice. Generally speaking, you are very conservative and are not in favor of government spending beyond what is absolutely necessary. For example, you have spoken in Parliament against the mass education of the poor.

With texts

Although you are a well-connected member of the MOS community, and are a competent natural philosopher yourself, you do not have much of a publication record in science.

With other roles

As president of the Royal Society, you have had the responsibility of choosing the authors for the eight Bridgewater Treatises, a collection endowed with £8,000 by the late Earl of Bridgewater. Bridgewater's will directed the president of the Royal Society should select authors to:

... write, print, and publish one thousand copies of a work On the Power, Wisdom, and Goodness of God, as manifested in the Creation; illustrating such work by all reason able arguments, as for instance the variety and formation of God's creatures in the animal, vegetable, and mineral kingdoms; the effect of digestion, and thereby of conversion; the construction of the hand of man, and an infinite variety of other arguments; as also by discoveries ancient and modern, in arts, sciences, and the whole extent of literature. [Bri36]

You selected one of your faction members, William Buckland, to author one of the volumes, *Geology and Mineralogy considered with reference to Natural Theology*, published in 1836.

In 1830, you evaluated several designs for a proposed bridge over the River Avon in Bristol, and from amongst those designs, you selected the suspension bridge design proposed by I. K. Brunel. Construction was started in 1831, but riots in Bristol caused the project to be abandoned. Work was not started again until 1864.

With your faction

Strategy advice

To learn more

[Bri36] Bridgewater, F.H.E. *The Bridgewater Treatises on the Power, Wisdom and Goodness of God, as Manifested in the Creation. Treatise I-VIII.: Geology and mineralogy considered with reference to natural theology, by William Buckland. 2d ed.* The Bridgewater Treatises on the Power, Wisdom and Goodness of God, as Manifested in the Creation. Treatise I-VIII. W. Pickering, 1836. Available via Google Books.

[Bro66] W. H. Brock. The Selection of the Authors of the Bridgewater Treatises. *Notes and Records of the Royal Society of London*, 21(2):162{179, 1966.

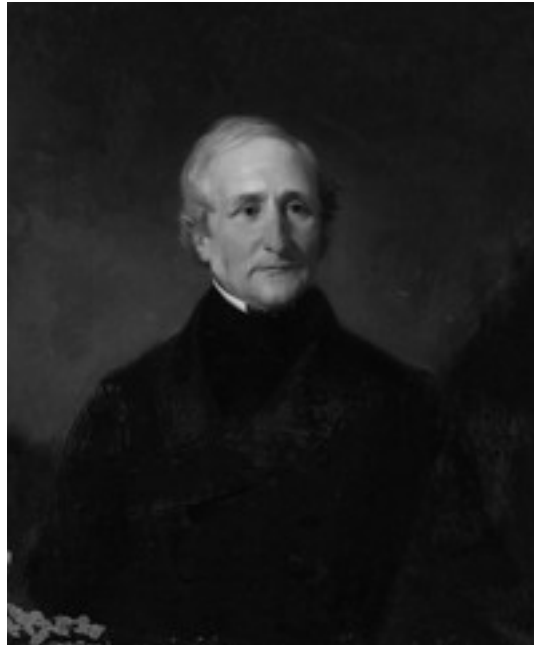
[Mil04] David Phillip Miller. Oxford DNB article: Gilbert, Davies. <http://www.oxforddnb.com/view/article/10686>, 2004.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Davies Gilbert, PRS, by Samuel Cousins, after Henry Howard messotint, from the National Portrait Gallery, St Martins Place, London; URL: <http://www.npg.org.uk/collections/search/portraitLarge/mw36987/DaviesGilbert?LinkID=mp01770&search=sas&sText=davies+gilbert&role=sit&rNo=6>

Edward Sabine FRS



Office

You are Edward Sabine, FRS, Irish military man, geologist, and astronomer. You served as the on-board astronomer on expeditions to attempt to discover the Northwest Passage under Sir John Ross in 1818 and again under Sir William Edward Parry in 1819 and 1820.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the MOS community and the anti-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born on October 14, 1788, in Dublin, Ireland to Joseph Sabine and his wife Sarah Hunt. Your family was prominent in Ireland, and your elder brother, Joseph, was a barrister who also dabbled in natural science; he was elected as a Fellow of the Royal Society in 1799. You did primary schooling west of London in Marlow, England, and in 1803 entered the Royal Military Academy in Woolwich (now a part of London). In December of that year, you were commissioned as a 2nd lieutenant in the Royal Artillery, and by 1813 you had achieved the rank of captain.

You saw combat during the War of 1812. In May 1813, you set sail for Halifax, Nova Scotia aboard the packet ship Manchester. On the voyage, Manchester was attacked by the American privateer Yorktown. You distinguished yourself admirably during the battle, but ultimately the Manchester was captured and

you were taken prisoner. You were held for a month before being released; after that, you continued to Halifax and then on to Quebec. You were placed in charge of an outpost there and fought against the Americans as they tried to invade Canada. The war ended in 1815, and you returned to England in 1816. Arriving there, you were classified as a *supernumerary* , i.e., an officer in excess of the needs of the army, and so you were allowed to pursue your scientific interests. Your main interests were magnetism, astronomy, and ornithology. In 1818, you were elected as a Fellow of the Royal Society (FRS).

Based on a recommendation from the Royal Society, you were named as the astronomer for John Ross' expedition to discover the Northwest Passage in 1818. You made extensive observations at different latitudes of the period of a swinging pendulum; this data allowed scientists to improve their understanding of the shape of the earth. You also performed numerous experiments measuring the earth's magnetic field and observed and cataloged the birds seen on the voyage. Ross apparently saw a mirage that he interpreted as snow-capped mountains at the end of Lancaster Sound in Canada, and so he determined that there could be no Northwest Passage. He had the expedition return to England against the advice of his junior officers, including you. To make matters worse, upon the expedition's return, the nephew of the expedition leader, John Clark Ross, who had assisted you in your scientific measurements during the voyage, claimed credit for your discoveries. It was years before you received the credit due you for the expedition.

Your second Arctic expedition sailed in May 1819, under the command of William Edward Parry. You performed more pendulum experiments during this voyage, and your work was so impressive that you received the Royal Society's highest award, the Copley Medal, in 1821 for the work.

In 1827 you were granted a leave of absence from the military, to serve as one of the secretaries of the Royal Society. In 1828 you were one of the three men of science named, based on the Society's recommendation, as advisors to the Admiralty. The other men chosen were Michael Faraday and Thomas Young.

Objectives

You have one main objective in the game. You want your anti-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Edward Sabine, you have responsibilities to your anti-Babbage faction, and a “secret language” responsibility you share with the other scientists, engineers, and mathematicians in the game. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibilities to the Anti-Babbage Faction

As a member of the anti-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. You can help your faction by being a vocal opponent of Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Regarding the “secret language” of engineering, mathematics, and science

Secret: To simulate the fact that many of the men making the decisions regarding the future of the Difference Engine did not understand the machine, what it was capable of doing, or its future potential, the members of the MOS community in this game share a limited secret language.”

Here is how it works: at least once per speech, members of the MOS community (such as yourself) are obligated to include one of the secret terms in the presentation, in as natural a manner as possible. (The secret terms are meaningless, but they -- hopefully -- sound plausible.) When MOS members of the same faction who are not speaking hear the secret term, they should make some outward show of understanding. “Brilliant!” “Yes, of course! I see now!” “Aha!” Vigorous head nodding. Something like that. Of course, including the secret terms in speeches and the resulting reactions must be done with straight faces, so that the non-MOS members do not catch on to the ruse. Also, you should not overuse the terms; they should be included only once or twice per speech. The secret terms and their meanings are provided in a separate handout from the GM.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction’s position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction leader (Airy) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

As a “man of science,” but not a member of the nobility by heredity, nor of the government, your official powers to make things happen are fairly limited. However, you are an influential member of the Royal Society, and in that capacity members of the government consult you on all sorts of scientific matters. So, your opinion carries weight.

Assignments

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in nineteenth-century British science and mathematics, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

You are a member of the last generation of the old-school “men of science” community, i.e., a wealthy gentleman with enough time, talent, and money to pursue your intellectual interests at your leisure. Although you do not have anything against him personally, this puts you somewhat at odds with younger men of science like John Couch Adams. Men like Adams do not have large sums of money to pursue scientific studies as a hobby, rather, they do science for a living -- science is their profession as well as their passion. If you are among the last of the wealthy, amateur scientific gentlemen, Adams and his colleagues are among the first of the professional scientists.

Regarding the idea of the government funding Babbage's machines, you are against the concept. Clearly, you are in no position to campaign against the concept of government-sponsored science in general -- your two voyages to find the Northwest Passage are proof. However, you believe your expeditions had a high probability of being useful to the nation for trade purposes, and you do not feel that Babbage's machines are likely to be anywhere near as useful.

With texts

With other roles

In 1825 you were part of a collaboration with Herschel on a project paid for by the French government, to determine the precise difference in longitude between the Paris and Greenwich observatories. So, even though you are in different factions during this game, you have a good professional relationship with Herschel. You should keep this in mind during the game so you can remain “in character.”

With your faction

Strategy advice

To learn more

[Lev82] Trevor H. Levere. SABINE, Sir EDWARD. http://www.biographi.ca/en/bio/sabine_edward_11E.html, 1982.

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of General Sir Edward Sabine, by Stephen Pearce, from the National Portrait Gallery, St Martins Place, London; URL: <http://www.npg.org.uk/collections/search/portrait/mw05559/Sir-Edward-Sabine?LinkID=mp03933&search=sas&sText=edward+sabine&role=sit&rNo=0>

Prince Augustus Frederick, Duke of Sussex, KG KT GCB FRS FRSA



Office

You are Prince Augustus Frederick, Duke of Sussex, the sixth son of “mad” King George III, who reigned from 1760 until 1820. In actuality, your father's insanity was such that your eldest brother, George, Prince of Wales, ruled as regent starting in 1810 and then ascended to the throne as George IV when your father died in 1820. You are the only surviving son of your father who did not have a military career. Although not a man of science, you do have an intellectual curiosity for biblical studies and the Hebrew language.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the anti-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

You were born to your father and his consort, Charlotte of Mecklenburg-Strelitz on January 27, 1773. You and some of your brothers (Prince Ernest and Prince Adolphus) were educated in Germany at the University of Göttingen.

While traveling in Italy, you met your future wife, Lady Augusta Murray. You wed in secret in Rome on April 4, 1793, and then again (without telling the officiates who you were) in England in December of that year. Neither of these secret marriages had the consent of the King, and therefore they were in violation of the Royal Marriages Act of 1772 and thus invalid. Your marriage was annulled in 1794, but

you continued to live with Lady Augusta until 1801. She received a “maintenance” allowance of £4,000 per year and retained custody of your children.

You made you a Knight of the Garter (KG) in 1786, and created you Duke of Sussex, Earl of Inverness, and Baron Arklow in November 1801. Even though you are not a man of science, and fitting the society's status as more of a gentleman's club than a thriving institute of science, you were elected as a Fellow of the Royal Society (FRS) in 1828.

Objectives

You have one main objective in the game. You want your anti-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Prince Augustus Frederick, Duke of Sussex, you have a responsibility to speak on the virtues of *laissez-faire* economics, to conduct several meetings of the Royal Society of London, and responsibilities to your anti-Babbage faction. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Responsibility to speak regarding *laissez-faire*

During GS 2, you are to speak on the principles of *laissez-faire* economics. Briefly, *laissez-faire* (French for “allow to do”) economics means that the government, as much as possible, does not interfere in the workings of the free market. *Laissez-faire* economic policy was popular in Great Britain in the 19th century. Your speech should cover the general concepts, and then focus on *laissez-faire* as it applies to government funding of scientific research. Your goal, of course, is to convince the indeterminates that *laissez-faire* is a good policy, and that it precludes ridiculous expenditures like funding Babbage's calculating machines.

Responsibility to Conduct Royal Society Meetings

You are responsible for conducting the second set of game sessions that occur at the Royal Society, during game sessions 6 and 7. As the presiding officer, you are required to make sure that the scheduled agenda items -- speeches, resolutions, etc. -- all happen on schedule. The activities for GS 6 and 7, and their order, are:

- GS 6
 - Edward Sabine will speak on ???
 - Speech by John Couch Adams regarding the discovery of the planet Neptune.
 - Speech by George Biddell Airy regarding the discovery of the planet Neptune.
 - Any remaining time in the game session should be used for open-floor debate

- At the end of the session the gamemaster will conduct the persuasiveness metric poll of the indeterminates.
- GS 7
 - PM speech by Lord John Russell, 1st Earl Russell. Russell, the newly-elected PM, will outline the priorities and goals his government will have while he is in office.
 - Open floor time for final debate
 - The gamemaster will conduct one final persuasiveness metric poll, and immediately announce which of the day's speakers will receive an IP.
 - IP spending. Individuals, factions, and the PM spend IPs, adding them to one of the two stacks shown in the GS 8 decision stack table in Chapter 3 of the gamebook.
 - Those with franchise (see the table in Part 3 of the gamebook) will vote on the winning PM; the winner will not be revealed until the postmortem.
 - The PM, Lord John Russell, 1st Earl Russell, will make his decision as to the government funding the Difference Engine, in accordance with the GS 8 decision stack.

During any non-scheduled time in the session, the *podium rule* is in effect. The podium rule states that any character wishing to speak should approach the podium and wait to be recognized by the presiding officer (you). You must make sure that you are fair to anyone who wishes to speak, even those that are not in your faction. Characters are encouraged to ask questions of presenters, at the discretion of the presiding officer, but they should not make speeches to the class without approaching the podium.

An extra complexity for you as the presiding officer for Royal Society meetings is that only members with FRS status are allowed to publically speak during sessions that take place at the Society. See the table in Part Three of the gamebook for details on who is a FRS, and when they achieve this status. Characters that are not FRS may confer with their factions and other characters, but they are not allowed to ask questions of presenters nor speak from the podium.

Speak with the GM before GS 6 about these sessions at the Royal Society, so that you are well prepared for the conduct of the session.

Responsibilities to the Anti-Babbage Faction

As a member of the anti-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. You can help your faction by being a vocal opponent of Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Royal Society, GS 3, 4, 6, or 7. Coordinate with your faction leader (Airy) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

As a member of the royalty and the president of the Royal Society after GS 5, you are a very powerful individual in the game. In particular, as Royal Society president, you have the power to shape the agenda of the Society's meetings. To represent your political power, you begin the game with an IP. You may use the IP as you wish, spending it in GS 3, 5, or 7, at your discretion.

Assignments

Your main writing assignment is a written version of your GS 2 speech, due at the beginning of GS 2. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the “winning” PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

As one of the key players in nineteenth-century British politics, you are connected in one manner or another with many of the ideas, texts, and people that are central to this game.

With ideas

With texts

With other roles

With your faction

Strategy advice

To learn more

Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Portrait of Prince Augustus Frederick, Duke of Sussex, by Guy Head, from the National Portrait Gallery, St Martins Place, London; URL: <http://www.npg.org.uk/collections/search/portraitLarge/mw06148/Prince-Augustus-Frederick-Duke-of-Sussex?LinkID=mp04375&search=sas&sText=duke+of+sussex&role=sit&rNo=0>

Captain Swing



Office

You are Captain Swing, an interesting character in the game in that you are not playing a person, but rather you represent a movement. Specifically, you represent the spirit and ideas of the farmers who participated in the “Swing Riots” across England in 1830 and 1831, starting fires and breaking threshing machines, protesting for increased wages, against restrictive Poor Laws, and against the increasing use of threshing machines in agriculture. All of these factors moved many of England's agricultural poor from being merely desperately poor to struggling for their very lives. Several of the threatening letters sent by the protesters were signed with the *nom de guerre* “Captain Swing.”

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

You are a member of the anti-Babbage faction. You are prohibited from defecting from your faction during the game.

Biography

As Captain Swing, you represent

... the most impressive episode in the English farm-labourers' long and doomed struggle against poverty and degradation. [HR14]

Agriculture in England at the time had a three-level division of labor. There were a few landowners, who owned vast tracts of land. The landowners employed a large body of tenant farmers to farm their land for them. Then tenant farmers, in turn, employed a much larger pool of wage earning agricultural

laborers that did the actual work. You represent this last class of people, as a host of factors pushed them to riot in 1830 and 1831.

Your group was not seeking a political revolution, but rather economic redress; you demanded higher wages, for more jobs, and for improvements in the Poor Law. You sought the return of your rights as “freeborn Englishmen,” i.e., the right to farm small plots of the commons, open areas which were being fenced off by the landowners. Before the enclosure of the commons, the rural poor were able to survive by virtue of the crops they could grow themselves in these spaces; once that was no longer possible, many found their very survival, not simply their livelihoods, threatened.

The Swing riots began in the August of 1830. The primary activity of the Swing rioters was to break up the threshing machines owned by the landowners, which the rioters blamed at least in part for the lower number of available agricultural jobs. (Threshers automate the process of threshing grain, i.e., the process of removing the ripened grain from the rest of the plant.) Other activities in the riots included arson and threatening letters. “Captain Swing” was the fictional name signed to many of the letters.

Objectives

You have one main objective in the game. You want your anti-Babbage faction to win the game; if the faction wins, you win. Your faction wins if the British government declines, on at least two of the three opportunities, to fund the development of Babbage's engines.

Responsibilities

As Captain Swing, you have a responsibility to talk about the plight of the farmers in the UK and the dangers of automation, and responsibilities to your anti-Babbage faction. Every character in the game also has a responsibility to make at least one additional brief podium speech during open debate periods.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding the plight of Britain's farmers

During GS 2 at the Mechanic's Institute, you will give a speech on the plight of the nation's farmers. In other words, your speech will summarize the issues that caused the Swing Riots of 1830 – 1831 (as stated in the “Counterfactuals” section of the gamebook, you will present during GS 2, which takes place in 1828; you may present as if the Swing Riots have already happened). After you have discussed the issues involved in the Swing Riots, you should extend the anti-automation concerns of the farmers to the Difference Engine. Remember that “computer” was a job description in this time period, and the Difference Engine would certainly put many computers out of work, just as threshing machines put the jobs of farmers in jeopardy.

Responsibilities to the Anti-Babbage Faction

As a member of the anti-Babbage faction, you should do whatever you can to help the faction win the game, so that you may also win. During game sessions that do not take place in the Royal Society, you

can help your faction by being a vocal opponent of Babbage and his calculating engines. You can ask good questions and make short podium speeches to help propel your faction to victory.

Podium speech responsibility

You must make at least one additional podium speech during the open debate periods in the game. Since you are not a FRS, you should plan on making a speech supporting your faction's position during one of the sessions that take place at the Mechanic's Institute, GS 2 or 5. Coordinate with your faction leader (Airy) and the other members of your faction so you can make a speech with the maximum impact for your faction.

Powers

Assignments

Your main writing assignment is a written version of your GS 2 speech, due at the beginning of GS 2. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write and submit privately to the GM a few paragraphs about each PM speech. The PMs make their speeches at the beginnings of GS 1, 2, 4, 5, and 7; your writing for each should contain your impressions of the speeches, so that you can decide who to vote for during the "winning" PM election at the end of GS 7. Your speech impressions should be submitted privately to the GM no later than the beginning of GS 2, 3, 5, 6, and the post-mortem session.

Relationships

With ideas

With texts

With other roles

With your faction

Strategy advice

To learn more

[HH13] John Lawrence Hammond and Barbara Bradby Hammond. *The Village Labourer, 1760-1832: A Study in the Government of England Before the Reform Bill*. Longmans, Green, and Company, 1913. Available via Google Books.

[HR14] Eric Hobsbawm and George Rudé. *Captain Swing*. Verso, 2014.

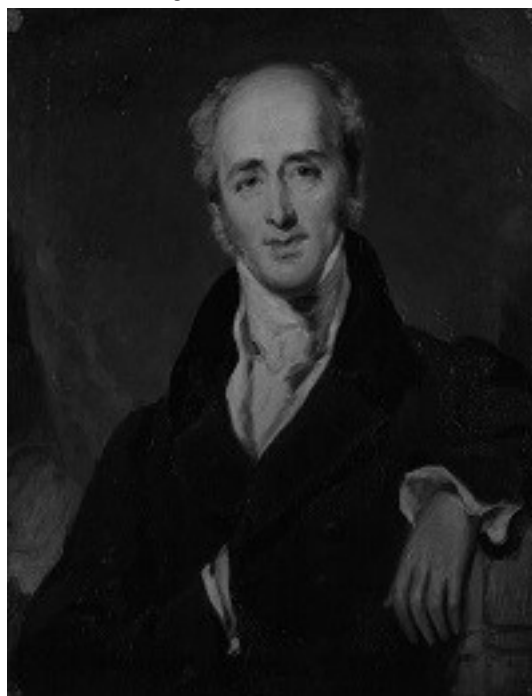
Summary of your individual victory objectives

You win the game if your faction wins. Your faction wins the game if the British government declines to fund either of Babbage's engines (the Difference Engine or the Analytical Engine), on at least two of the three funding decision opportunities.

Nineteenth century imagining of Captain Swing. <https://uptheossroad.files.wordpress.com/2016/07/f4-large.jpg>

Indeterminates

Lord Charles Grey, 2nd Earl Grey, KG PC



Office

You are Lord Charles Grey, 2nd Earl Grey, KG PC. You are a Whig MP, and you will serve as Prime Minister. You are also the namesake for Earl Grey tea.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

In this game you are an indeterminate. This means that you have no particular position regarding the central issues of the game. Some of those playing other characters in the game may belong to pro-Babbage or anti-Babbage factions, and it is up to them to convince you that their position is correct. You are free to decide on your own which faction to ultimately side with, within the boundaries of your political opinions, outlined below.

Biography

You were born on March 13, 1764, at your ancestral home, Howick Hall, in Fallodon, Northumberland, on the northeastern coast of England. You are the oldest surviving son of your parents, General Charles Grey KB, 1st Earl Grey, and Lady Elizabeth Grey, Countess Grey. Your primary education was at the Richmond School in North Yorkshire, and from there you studied at Eton and Trinity College, Cambridge. You were first elected to Parliament in 1786, when you were only 22. You quickly became a leader of the Whigs in the House of Commons.

You served as First Lord of the Admiralty for a few months in 1806, then when Charles James Fox died, you succeeded him as Leader of the House of Commons and the Foreign Secretary, under the Prime Minister Lord Grenville. In 1807, Grenville's government was dissolved when King George III blocked Catholic Emancipation legislation. Also in that year, you ascended into the House of Lords, succeeding your father. A series of Tory PMs followed until 1830, and you served as a leader of the Whig opposition during those years.

You become prime minister on November 22, 1830.

Objectives

You have one primary objective in the game: to win. You win the game if, during GS 7, the characters with a franchise vote for you as the PM who made the best presentation during the game.

Responsibilities

As Lord Grey, you have responsibilities to make a speech outlining the goals and priorities of your government when you take office as PM, to make crucial, informed decisions regarding funding for Charles Babbage's computational engine projects, and to be honest and attentive in your indeterminacy.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding Your Government's Priorities and Goals

Each PM will make a speech at the beginning of the game session corresponding to his rise to power. In the speech, the PM will outline the priorities and goals his government will have while he is in office. You become PM in 1830, and so your PM speech will take place at the start of GS 4.

Regarding the Difference and Analytical Engines

There will be three decisions regarding Babbage's Difference and Analytical Engines during the game: at the end of GS 3, 5, and 7. To one extent or another, the PM at the time will be free to decide what the government should do. So, if you are PM during one of these sessions, you will be tasked with making these decisions. If responsibility falls on you, you should make the decision you feel is best for the United Kingdom, as informed by your Whig politics and by the presentations and persuasions made by the other characters in the game.

Your Indeterminacy

Since you do not belong to any faction in this game, you are free to make decisions as you see fit. The factions should try to convince you that their positions are correct, and you should listen carefully to their arguments and other persuasions. Be swayed by those you find the most convincing. The only caveat is that you should try to stay true to your role as a Whig politician of the early 1800s.

Powers

As a MP, you are part of the governing body of the kingdom, and thus a powerful and important man. As a member of the Whig party, your words and influence are especially important to members of the

rising middle class and working people. When you serve as PM, you will have even more power, especially regarding the outcome of this game, for it is the PMs that will ultimately decide whether or not Babbage receives government monies to complete his Difference or Analytical Engines.

To represent your political power, you begin the game with an IP. You may use the IP as you wish, spending it in GS 3, 5, or 7, at your discretion.

Assignments

Your main writing assignment is a written version of your GS 4 speech, due at the beginning of GS 4. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write a few paragraphs about your vote in each persuasiveness metric poll. These polls, conducted by the gamemaster, take place at the end of each game session. The indeterminates (including you) are asked to vote for the presentation they thought was the most persuasive during the session. Your short paper will describe who you voted for in the persuasiveness metric poll, and why you voted for them. Each of these papers should be submitted privately to the gamemaster before the beginning of the next game session. For example, your paper about your vote in the GS 1 persuasiveness metric should be sent to the gamemaster no later than the start of GS 2.

Relationships

With ideas

With texts

With other roles

With your faction

Strategy advice

You are a Whig politician in Georgian Britain, so you should do some research on what the political stances of your party -- and the opposition party, the Tories -- were during that time.

You are known for two major legislative initiatives, the Reform Act of 1832 and the abolition of slavery in the British Empire. You also helped quell the Swing Riots of 1830 and 1831 and attempted to reform the Poor Law. Research these initiatives; you can use the information you find as material for your GS 4 speech.

To learn more

[gov16] gov.uk. Past Prime Ministers -- GOV.UK. <https://www.gov.uk/government/history/past-prime-ministers>, 2016.

Summary of your individual victory objectives

You win the game if, during GS 7, those with a franchise vote for you as the PM who gave the best PM speech during the game.

Portrait of Charles Grey, 2nd Earl Grey, from the National Portrait Gallery, St Martins Place, London;
URL: <http://www.npg.org.uk/collections/search/portrait/mw02743/Charles-Grey-2nd-Earl-Grey?LinkID=mp01912&search=sas&sText=Charles+Grey&role=sit&rNo=3>

Sir Robert Peel, 2nd Baronet, FRS, PC



Office

You are Sir Robert Peel, 2nd Baronet FRS PC. You are a Tory MP, and you will serve as Prime Minister.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

In this game you are an indeterminate. This means that you have no particular position regarding the central issues of the game. Some of those playing other characters in the game may belong to pro-Babbage or anti-Babbage factions, and it is up to them to convince you that their position is correct. You are free to decide on your own which faction to ultimately side with, within the boundaries of your political opinions, outlined below.

Biography

You were born in 1788 in Bury, Lancashire, in the northwest of England. Your father, Sir Robert Peel, 1st Baronet, was a wealthy cotton mill owner. His success as an industrialist brought wealth, political power (he was also an MP), and elevation to the title of Baronet. The fact that your father's money and title were so recently earned and bestowed sometimes leads to conflict with your Tory colleagues, who tend to represent more "old money" interests.

You were educated at the most aristocratic constituent college of Oxford University, Christ Church, where you earned a "double first," that is, extremely high achievement in both your first-year and final

exams. After graduating in 1808, you were first elected as MP for Cashel, Tipperary, in Ireland. Eventually you became MP for Oxford University.

You were elected as a Fellow of the Royal Society in 1822, even though you are not a “man of science.” This is emblematic of the nature of the Royal during these years -- membership had as much to do with who you were and who you knew as it did with your achievements in science.

You were named Home Secretary in 1822, serving under the government of Sir Robert Jenkinson, 2nd Earl of Liverpool. While in this position, you made important and long-lasting changes to the British justice system. You established the professional London Metropolitan police force (forever known as “Bobbies” in your honor), reformed the penal code to drastically reduce the number of crimes punishable by death, and more.

Given that you are a member of the Tory party, a political party chiefly closely aligned to the Church of England, it is not surprising that you have been very opposed to Catholic emancipation. What is surprising is that, in 1829, you helped to pass the Roman Catholic Relief Act, which removed many of the restrictions that were placed on Catholics by the Act of Uniformity in 1558. Your support for the act has not made you extremely popular with your Tory colleagues.

Perhaps fitting your indeterminate nature in the game, later in life you were involved in several other acts of Parliament that further distanced you from the Tories. Such acts banned women and children from working in mines, limited the hours women and children could work in factories, and repealed the Corn Laws, which had banned the import of foreign grain. You supported the repeal of the Corn Laws as a way to deal with the Irish Potato Famine of 1845 - 1849.

Objectives

You have one primary objective in the game: to win. You win the game if, during GS 7, the characters with a franchise vote for you as the PM who made the best PM speech during the game.

Responsibilities

As Sir Robert Peel, you have responsibilities to make a speech outlining the goals and priorities of your government when you take office as PM, to make crucial, informed decisions regarding funding for Charles Babbage's computational engine projects, and to be honest and attentive in your indeterminacy.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding Your Government's Priorities and Goals

Each PM will make a speech at the beginning of the game session corresponding to his rise to power. In the speech, the PM will outline the priorities and goals his government will have while he is in office. You become PM for a second time in 1841, and so your PM speech will take place at the start of GS 5.

Regarding the Difference and Analytical Engines

There will be three decisions regarding Babbage's Difference and Analytical Engines during the game: at the end of GS 3, 5, and 7. To one extent or another, the PM at the time will be free to decide what the government should do. So, if you are PM during one of these sessions, you will be tasked with making these decisions. If responsibility falls on you, you should make the decision you feel is best for the United Kingdom, as informed by your Whig politics and by the presentations and persuasions made by the other characters in the game.

Your Indeterminacy

Since you do not belong to any faction in this game, you are free to make decisions as you see fit. The factions should try to convince you that their positions are correct, and you should listen carefully to their arguments and other persuasions. Be swayed by those you find the most convincing. The only caveat is that you should try to stay true to your role a (albeit slightly liberal) Tory politician of the early 1800s.

Powers

As a MP, you are part of the governing body of the kingdom, and thus a powerful and important man. As a member of the Whig party, your words and influence are especially important to members of the rising middle class and working people. When you serve as PM, you will have even more power, especially regarding the outcome of this game, for it is the PMs that will ultimately decide whether or not Babbage receives government monies to complete his Difference or Analytical Engines.

To represent your political power, you begin the game with an IP. You may use the IP as you wish, spending it in GS 3, 5, or 7, at your discretion. You will make your decision regarding Babbage's engines at the end of GS 5, so you may wish to use your IP then.

In addition, you possess a special power: you are an indeterminate MP / PM and you are also a member of the Royal Society. As a FRS, you have a voice – and a vote – during game sessions that take place at the Royal. This is perhaps most important in GS 3, when the Royal must pass either a resolution that recommends funding for Babbage's Difference Engine or a resolution against such funding. As an indeterminate, you should vote for whichever side (pro- or anti-Babbage) that you feel has best persuaded you that their proposal is appropriate.

Assignments

Your main writing assignment is a written version of your GS 5 speech, due at the beginning of GS 5. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write a few paragraphs about your vote in each persuasiveness metric poll. These polls, conducted by the gamemaster, take place at the end of each game session. The indeterminates (including you) are asked to vote for the presentation they thought was the most persuasive during the session. Your short paper will describe who you voted for in the persuasiveness metric poll, and why you voted for them. Each of these papers should be submitted privately to the gamemaster before the

beginning of the next game session. For example, your paper about your vote in the GS 1 persuasiveness metric should be sent to the gamemaster no later than the start of GS 2.

Relationships

With ideas

With texts

With other roles

With your faction

Strategy advice

You are a Tory politician in Georgian Britain, so you should do some research on what the political stances of your party -- and the opposition party, the Whigs -- were during that time.

Despite being a Tory, your government was a milestone for social reform in Great Britain. In 1841 when you were elected for the second time, there was an economic recession in Britain. Your government moved more towards free trade practices, helping set the stage for a robust recovery. You should research the Mines Act of 1842, the Factory Act of 1844, the repeal of the Corn Laws in 1846, and the failed Irish Coercion Act of 1846; you can use the information you find as material for your GS 5 speech.

To learn more

[gov16] gov.uk. Past Prime Ministers -- GOV.UK. <https://www.gov.uk/government/history/past-prime-ministers>, 2016.

Summary of your individual victory objectives

You win the game if, during GS 7, those with a franchise vote for you as the PM who gave the best PM speech during the game.

Portrait of Sir Robert Peel, 2nd Baronet, from the National Portrait Gallery, St Martin's Place, London;
URL: <http://www.npg.org.uk/collections/search/portrait/mw04924/Sir-Robert-Peel-2nd-Bt?LinkID=mp03490&search=sas&sText=robert+peel&role=sit&rNo=1>

Lord Frederick John Robinson, 1st Earl of Ripon FRS PC



Office

You are Lord Frederick John Robinson, 1st Earl of Ripon, 1st Viscount Goderich, FRS PC. You are a Tory MP, and you will serve as Prime Minister.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

In this game you are an indeterminate. This means that you have no particular position regarding the central issues of the game. Some of those playing other characters in the game may belong to pro-Babbage or anti-Babbage factions, and it is up to them to convince you that their position is correct. You are free to decide on your own which faction to ultimately side with, within the boundaries of your political opinions, outlined below.

Biography

You were born on October 30, 1782, in London. Your parents were Thomas Robinson, 2nd Baron Grantham and his wife Lady Mary Jemima Grey Yorke. You were educated at Harrow in London and then at St. John's College, Cambridge.

You were first elected to the House of Commons in 1806, as MP for the Carlow Borough, Ireland. Beginning in 1807 you served another constituency as MP for Ripon, North Yorkshire, in north central England. You served as MP for Ripon until 1827.

You were one of the British party that negotiated the Treaty of Paris in 1814, at the end of the Napoleonic Wars. In 1815 you introduced the Corn Laws to parliament, which restricted the import of foreign grain. These laws chiefly benefited the agricultural landowners, while driving up the price of food, which had a drastic negative impact on the working poor. Protesters attacked your home after the Corn Laws passed, and two of them were killed when soldiers were called in to quell the protest.

You became PM in August 1827 when King George IV asked you to lead a coalition of moderate Tories and Whigs in a government.

Objectives

You have one primary objective in the game: to win. You win the game if, during GS 7, the characters with a franchise vote for you as the PM who made the best PM speech during the game.

Responsibilities

As Viscount Goderich, you have responsibilities to make a speech outlining the goals and priorities of your government when you take office as PM, to make crucial, informed decisions regarding funding for Charles Babbage's computational engine projects, and to be honest and attentive in your indeterminacy.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding Your Government's Priorities and Goals

Each PM will make a speech at the beginning of the game session corresponding to his rise to power. In the speech, the PM will outline the priorities and goals his government will have while he is in office. You become PM in 1827, and so your PM speech will take place at the start of GS 1.

Regarding the Difference and Analytical Engines

There will be three decisions regarding Babbage's Difference and Analytical Engines during the game: at the end of GS 3, 5, and 7. To one extent or another, the PM at the time will be free to decide what the government should do. So, if you are PM during one of these sessions, you will be tasked with making these decisions. If responsibility falls on you, you should make the decision you feel is best for the United Kingdom, as informed by your Tory politics and by the presentations and persuasions made by the other characters in the game.

Your Indeterminacy

Since you do not belong to any faction in this game, you are free to make decisions as you see fit. The factions should try to convince you that their positions are correct, and you should listen carefully to their arguments and other persuasions. Be swayed by those you find the most convincing. The only caveat is that you should try to stay true to your role as a Tory politician of the early 1800s.

Powers

As a MP, you are part of the governing body of the kingdom, and thus a powerful and important man. As a member of the Tory party -- the party that has ruled since 1807 -- your words and influence are

especially important to land owners and the nobility. When you serve as PM, you will have even more power, especially regarding the outcome of this game, for it is the PMs that will ultimately decide whether or not Babbage receives government monies to complete his Difference or Analytical Engines.

To represent your political power, you begin the game with an IP. You may use the IP as you wish, spending it in GS 3, 5, or 7, at your discretion.

In addition, you possess a special power: you are an indeterminate MP / PM and you are also a member of the Royal Society. As a FRS, you have a voice – and a vote – during game sessions that take place at the Royal. This is perhaps most important in GS 3, when the Royal must pass either a resolution that recommends funding for Babbage’s Difference Engine or a resolution against such funding. As an indeterminate, you should vote for whichever side (pro- or anti-Babbage) that you feel has best persuaded you that their proposal is appropriate.

Assignments

Your main writing assignment is a written version of your GS 1 speech, due at the beginning of GS 1. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write a few paragraphs about your vote in each persuasiveness metric poll. These polls, conducted by the gamemaster, take place at the end of each game session. The indeterminates (including you) are asked to vote for the presentation they thought was the most persuasive during the session. Your short paper will describe who you voted for in the persuasiveness metric poll, and why you voted for them. Each of these papers should be submitted privately to the gamemaster before the beginning of the next game session. For example, your paper about your vote in the GS 1 persuasiveness metric should be sent to the gamemaster no later than the start of GS 2.

Relationships

With ideas

With texts

With other roles

With your faction

Strategy advice

You are a Tory politician in Georgian Britain, so you should do some research on what the political stances of your party -- and the opposition party, the Whigs -- were during that time. You should also learn about the Corn Laws; even though they have already been in effect for a dozen years when our game starts, they are still a point of political contention.

You personally support the abolition of slavery and Catholic Emancipation. Your government hopes to change the way taxes are assessed, moving from indirect taxes to a property tax method, and you also

hope to be more conciliatory towards Ireland. You should research these issues; you can use the information you find as material for your GS 1 speech.

To learn more

[Blo12] Marjorie Bloy. Frederick Robinson, Viscount Goderich (1782-1859). <http://www.historyhome.co.uk/pms/goderich.htm>, 2012.

[gov16] gov.uk. Past Prime Ministers -- GOV.UK. <https://www.gov.uk/government/history/past-prime-ministers>, 2016.

Summary of your individual victory objectives

You win the game if, during GS 7, those with a franchise vote for you as the PM who gave the best PM speech during the game.

Portrait of Sir Frederick John Robinson, 1st Viscount Goderich, by Sir Thomas Lawrence, from the National Portrait Gallery, St Martin's Place, London; URL: <http://www.npg.org.uk/collections/search/portrait/mw05348/Frederick-John-Robinson-1st-Earl-of-Ripon?LinkID=mp03796&search=sas&sText=frederick+robinson&role=sit&rNo=0>

Lord John Russell, 1st Earl Russell KG GCMG PC



Office

You Lord John Russell, 1st Earl Russell KG GCMG PC. You are a Whig MP, and you will serve as Prime Minister.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

In this game you are an indeterminate. This means that you have no particular position regarding the central issues of the game. Some of those playing other characters in the game may belong to pro-Babbage or anti-Babbage factions, and it is up to them to convince you that their position is correct. You are free to decide on your own which faction to ultimately side with, within the boundaries of your political opinions, outlined below.

Biography

You were born on August 18, 1792, in Mayfair, Middlesex, which is now a wealthy area in the West End of London. Your father and namesake was the 6th Duke of Bedford, and your mother was the Honorable Georgina Byng, daughter of George Byng, 4th Viscount Torrington. The relatively high numbers associated with your parents' peerage titles -- 6th and 4th -- indicate that you were born into a very well-established, wealthy, land-owning family. Since you were not their first son, however, you were not

eligible to inherit your father's title or estate, and instead are provided with the courtesy honorific "Lord."

Your education was incomplete, relative to your peers. You were a premature, small, and sickly child, and therefore had to receive your primary education from tutors at home. You did attend the University of Edinburgh starting in 1809, but you never completed your degree. Despite your stature and ill health, you were a military man, receiving a commission as a Captain in the Bedfordshire Militia in 1810.

You were first elected MP for Tavistock in 1813 -- due to your father instructing those with a franchise in the town to vote for you. You soon took up reform causes in Parliament, and you served as Paymaster-General of His Majesty's Forces during Earl Grey's government, which began in 1830. You were one of the leading proponents for the Reform Act of 1832. You became the leader of the Whigs in the House of Commons in 1834. You served as Home Secretary in the late 1830s, and in this position you reformed criminal law. The most important part of this reform was the drastic reduction in the number of offenses which were punishable by death.

You became PM in 1846 after Peel's Irish Coercion Bill failed in parliament, causing him to resign.

Objectives

You have one primary objective in the game: to win. You win the game if, during GS 7, the characters with a franchise vote for you as the PM who made the best PM speech during the game.

Responsibilities

As Lord Russell, you have responsibilities to make a speech outlining the goals and priorities of your government when you take office as PM, to make crucial, informed decisions regarding funding for Charles Babbage's computational engine projects, and to be honest and attentive in your indeterminacy.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding Your Government's Priorities and Goals

Each PM will make a speech at the beginning of the game session corresponding to his rise to power. In the speech, the PM will outline the priorities and goals his government will have while he is in office. You become PM in 1846, and so your PM speech will take place at the start of GS 7.

Regarding the Difference and Analytical Engines

There will be three decisions regarding Babbage's Difference and Analytical Engines during the game: at the end of GS 3, 5, and 7. To one extent or another, the PM at the time will be free to decide what the government should do. So, if you are PM during one of these sessions, you will be tasked with making these decisions. If responsibility falls on you, you should make the decision you feel is best for the United Kingdom, as informed by your Whig politics and by the presentations and persuasions made by the other characters in the game.

Your Indeterminacy

Since you do not belong to any faction in this game, you are free to make decisions as you see fit. The factions should try to convince you that their positions are correct, and you should listen carefully to their arguments and other persuasions. Be swayed by those you find the most convincing. The only caveat is that you should try to stay true to your role as a Whig politician of the early 1800s.

Powers

As a MP, you are part of the governing body of the kingdom, and thus a powerful and important man. As a member of the Whig party, your words and influence are especially important to members of the rising middle class and working people. If you serve as PM, you will have even more power, especially regarding the outcome of this game, for it is the PMs that will ultimately decide whether or not Babbage receives government monies to complete his Difference or Analytical Engines.

To represent your political power, you begin the game with an IP. You may use the IP as you wish, spending it in GS 3, 5, or 7, at your discretion. You will make your decision regarding Babbage's engines at the end of GS 7, so you may wish to save your IP until then.

Assignments

Your main writing assignment is a written version of your GS 7 speech, due at the beginning of GS 7. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write a few paragraphs about your vote in each persuasiveness metric poll. These polls, conducted by the gamemaster, take place at the end of each game session. The indeterminates (including you) are asked to vote for the presentation they thought was the most persuasive during the session. Your short paper will describe who you voted for in the persuasiveness metric poll, and why you voted for them. Each of these papers should be submitted privately to the gamemaster before the beginning of the next game session. For example, your paper about your vote in the GS 1 persuasiveness metric should be sent to the gamemaster no later than the start of GS 2.

Relationships

With ideas

With texts

With other roles

With your faction

Strategy advice

You are a Whig politician in Georgian Britain, so you should do some research on what the political stances of your party -- and the opposition party, the Tories -- were during that time.

When playing your character, keep in mind some of the characteristics of Lord John Russell that helped define him and his administration to the British public: shyness, vanity, aloofness, and elitism.

Your government introduced reforms such as the Ten Hours Act. But, your government also inadequately dealt with the Irish Potato Famine, which lasted from 1845 through 1852. You should research these issues; you can use the information you find as material for your GS 7 speech.

To learn more

[gov16] gov.uk. Past Prime Ministers -- GOV.UK. <https://www.gov.uk/government/history/past-prime-ministers>, 2016.

[Par16] Jonathan Parry. Lord John Russell, later Earl Russell | History of government. <https://history.blog.gov.uk/2016/03/16/lord-john-russell-later-earl-russell/>, 2016.

Summary of your individual victory objectives

You win the game if, during GS 7, those with a franchise vote for you as the PM who gave the best PM speech during the game.

Portrait of John Russell, 1st Earl Russell, by Lowes Cato Dickinson, from the National Portrait Gallery, St Martins Place, London; URL: <http://www.npg.org.uk/collections/search/portrait/mw05516/John-Russell-1st-Earl-Russell?LinkID=mp03900&search=sas&sText=john+russell&role=sit&rNo=10>

Field Marshal Arthur Wellesley, 1st Duke of Wellington KG GCB GCH PC



Office

You are Field Marshal Arthur Wellesley, 1st Duke of Wellington, KG, GCB, GCH, PC. You are a Tory MP, and you will serve as Prime Minister.

[Note: this role sheet may contain information regarding your character from a broad span of time. The game sessions take place during specific years (1828, 1830, and 1846). For any given game session / year, you are responsible for making sure you do not include anything grossly anachronistic in your positions, either in speeches or in writing.]

Faction

In this game you are an indeterminate. This means that you have no particular position regarding the central issues of the game. Some of those playing other characters in the game may belong to pro-Babbage or anti-Babbage factions, and it is up to them to convince you that their position is correct. You are free to decide on your own which faction to ultimately side with, within the boundaries of your political opinions, outlined below.

Biography

You were born on May 1, 1769, in Dublin, Ireland, to the Earl and Countess of Mornington. You were educated in Brussels and in military school in Angers. In 1787 you were commissioned as an ensign in the British infantry. You served as *aide-de-camp* to Lord Buckingham in Ireland, and rose through the ranks (via your actions, and in two cases, by purchasing higher ranks), becoming a lieutenant colonel in 1793. You became a member of the Irish House of Commons in 1789.

You soon saw combat, however, fighting in the Netherlands in 1794. By 1796 you were a full colonel and on the way to see action in India. You returned in 1805 and were knighted by the king. In 1806 you became a member of the English House of Commons.

You are most famous, however, for your brilliant tactics during the Napoleonic Wars, including your defeat of Napoleon at Waterloo in 1815. On your return to England, you were given an estate in Hampshire and £400,000 (the equivalent of nearly \$38,000,000 in 2017 dollars). You served as Commander in Chief of the British army in France until 1818.

In 1828 you became Prime Minister.

Objectives

You have one primary objective in the game: to win. You win the game if, during GS 7, the characters with a franchise vote for you as the PM who made the best PM speech during the game.

Responsibilities

As the Duke of Wellington, you have responsibilities to make a speech outlining the goals and priorities of your government when you take office as PM, to make crucial, informed decisions regarding funding for Charles Babbage's computational engine projects, and to be honest and attentive in your indeterminacy.

Once you receive this role, you should schedule an appointment with the gamemaster as soon as possible, to discuss the role and clear up any uncertainties regarding your responsibilities or victory conditions.

Regarding Your Government's Priorities and Goals

Each PM will make a speech at the beginning of the game session corresponding to his rise to power. In the speech, the PM will outline the priorities and goals his government will have while he is in office. You first become PM in 1828, and so your PM speech will take place at the start of GS 2.

Regarding the Difference and Analytical Engines

There will be three decisions regarding Babbage's Difference and Analytical Engines during the game: at the end of GS 3, 5, and 7. To one extent or another, the PM at the time will be free to decide what the government should do. So, if you are PM during one of these sessions, you will be tasked with making these decisions. If responsibility falls on you, you should make the decision you feel is best for the United Kingdom, as informed by your Tory politics and by the presentations and persuasions made by the other characters in the game.

Your Indeterminacy

Since you do not belong to any faction in this game, you are free to make decisions as you see fit. The factions should try to convince you that their positions are correct, and you should listen carefully to their arguments and other persuasions. Be swayed by those you find the most convincing. The only caveat is that you should try to stay true to your role as a Tory politician of the early 1800s.

Powers

As a MP, you are part of the governing body of the kingdom, and thus a powerful and important man. As a member of the Tory party -- the party that has ruled since 1807 -- your words and influence are especially important to land owners and the nobility. When you serve as PM, you will have even more power, especially regarding the outcome of this game, for it is the PMs that will ultimately decide whether or not Babbage receives government monies to complete his Difference or Analytical Engines.

To represent your political power, you begin the game with an IP. You may use the IP as you wish, spending it in GS 3, 5, or 7, at your discretion. You will make your decision regarding Babbage's engines at the end of GS 3, so you may wish to use your IP then.

Assignments

Your main writing assignment is a written version of your GS 2 speech, due at the beginning of GS 2. This assignment should be made public to all the players via the document-sharing facility used by your class for the game.

Additionally, you will write a few paragraphs about your vote in each persuasiveness metric poll. These polls, conducted by the gamemaster, take place at the end of each game session. The indeterminates (including you) are asked to vote for the presentation they thought was the most persuasive during the session. Your short paper will describe who you voted for in the persuasiveness metric poll, and why you voted for them. Each of these papers should be submitted privately to the gamemaster before the beginning of the next game session. For example, your paper about your vote in the GS 1 persuasiveness metric should be sent to the gamemaster no later than the start of GS 2.

Relationships

With ideas

With texts

With other roles

With your faction

Strategy advice

You are a Tory politician in Georgian Britain, so you should do some research on what the political stances of your party -- and the opposition party, the Whigs -- were during that time.

Despite your conservative tendencies, you were instrumental in establishing King's College, London, and your administration saw through passage the Catholic Relief Act of 1829. Not everyone in your party was pleased with the passage of the act; the Tory Earl of Winchilsea was so upset he challenged you to a duel. You and he met in Bettersea fields. Winchilsea did not fire and you -- intentionally, you say -- missed. You should research these issues; you can use the information you find as material for your GS 2 speech.

To learn more

[gov16] gov.uk. Past Prime Ministers -- GOV.UK. <https://www.gov.uk/government/history/past-prime-ministers>, 2016.

Summary of your individual victory objectives

You win the game if, during GS 7, those with a franchise vote for you as the PM who gave the best PM speech during the game.

Portrait of Arthur Wellesley, 1st Duke of Wellington, by John Jackson, from the National Portrait Gallery, St Martins Place, London; URL: <http://www.npg.org.uk/collections/search/portrait/mw06659/Arthur-Wellesley-1st-Duke-of-Wellington?LinkID=mp04752&search=sas&sText=Wellesley&wPage=1&role=sit&rNo=20>

Faction Advisories

Part 2: Handouts

Role assignment questionnaire

Faction quiz and key

Other handouts

MOS Secret Language

The secret terms of the MOS labuage, and brief definitions that might be used to mollify any politician-type characters who ask for clarification, are:

Arithmeticious tetrahedrous No definition yet.

Asymptype A personality trait one approaches but does not quite achieve.

Calcugraphous A function that can be simultaneously expressed via Leibniz's "summa" notation and also graphically differentiated.

Hyperbolification No definition yet.

Hyperbollipse A four-dimensional croto-conic section.

Hyper symmetric irreducible configuration An arrangement of parts for a machine that are so precise that none can be removed and retain the structural integrity and beauty of the machine.

Infinction A one to one relation between two infinite sets

Normalized cofactor expansion of the Eulerian distribution No definition yet.

Patrrix A two dimensional array which spans the NxN autonomous space.

Phylantrisk An ideal of the patrrix.

Quasiquad No definition yet.

Quasi-transfinite homology torus No definition yet.

Semi-regular tangential periodicity The ability of a machine to generally produce results that usually go in the same direction as the answer.

Transfinite functonian definition No definition yet.

Triangulogovector No definition yet.

GS 1 Party Game

This section contains the handouts for the party game that serves as the liminal experience at Babbage's party during the GS 1. The first handout is for Babbage, who serves as the presiding officer for GS 1, and the master of the revels for the game. The second handout is for everyone else attending the party. The game, "I Love my Love with an A," is adapted from the 1825 book, *Winter Evening Passtimes; or, The Merry-Maker's Companion* [Rev25].

I Love my Love with an A

For Charles Babbage, master of the revels

Your party during takes place during GS 1, and the party starts off with a rousing game of “I Love my Love with an A,” described below. The game, circa 1825, is similar to modern *Mad Libs* books, where players have to recite an ode with their own adjectives, food items, etc. added in. A wrinkle to the game, compared to *Mad Libs*, is that all of the items chosen for the ode must begin with the same letter. Additionally, the specified letter is different for each player in turn.

As the master of the revels, you choose the player to begin with the letter ‘A.’ For example, you might say, “Mr. Hershel, recite the ode with the letter ‘A’.”

Herschel might then say, “I love my love with an A, because she is ardent; I hate her, because she is ambitious; I took her to Andover, to the sign of the Angel; I treated her with artichokes; and her name is Anne Adair.” After repeating the ode, Herschel then chooses who goes next, as in: “Mrs. Somerville, recite the ode with the letter ‘B’.” Somerville recites the ode with ‘B’ words, and chooses who will recite with ‘C.’ This process continues for each letter, with the exceptions of ‘Q,’ ‘X,’ ‘Y,’ and ‘Z.’ If there are enough players in the game, the cycle begins again at ‘A’ after someone completes ‘W.’

As master of the revels, you are also responsible for assigning forfeits. The gamemaster will help keep track of the forfeits as the game proceeds. Forfeits are assigned if:

- If a player cannot complete the ode using their assigned letter, they receive a forfeit
- If a player prompts another player aloud with suggestions for their ode, the suggesting player receives a forfeit
- If a player includes a grossly anachronistic word in their ode, they receive a forfeit; for example, “pizza,” “French fries,” or “hot dogs” are food items that should generate a forfeit
- If a player, when choosing who to recite the ode next, chooses a player that has already recited, they receive a forfeit
- If a player addresses another player with their real name (instead of their character’s name), they receive a forfeit
- If a player addresses another player with the incorrect title, they receive a forfeit; for example, if they say “Mr. Russell, recite the ode with the letter ‘K,’” instead of “Lord Russell, recite the ode with the letter ‘K,’” they receive a forfeit
- If there are enough players to reuse letters, repeating a word from the first time around merits a forfeit

When you detect a forfeit, briefly interrupt the proceedings and say something like, “a forfeit on Mr. Faraday for re-using the word ‘apple!’”

The instructions for the game that the other characters receive are printed on the reverse of this sheet.

I Love my Love with an A

This game is too well known to require much description. The difficulty may be increased, where the players are expert, by adding some article of dress, some bird or animal, to be presented, or the composition of some author. Every person must take a letter in rotation; and if the alphabet goes around more than once, it becomes a forfeit to mention any name employed before. Any person not being able to find a suitable word, pays a forfeit; likewise, any one prompting another.

The master of the revels shall choose the person that starts; this lady or gentleman must begin with the letter 'A.' Having thus completed the ode, he then chooses the next person, who must recite the ode using the letter 'B,' and so forth through the alphabet. The letters 'Q,' 'X,' 'Y,' and 'Z' may be passed over. Any person choosing another who has already recited the ode to be next, pays a forfeit.

The ode:

I love my love with a(n) (letter) , because she is (adjective) : I hate her, because she is (adjective) : I took her to (location) , to the sign of the (noun) : I treated her with (food) ; and her name is (first name) (last name) .

I Love my Love with an A

This game is too well known to require much description. The difficulty may be increased, where the players are expert, by adding some article of dress, some bird or animal, to be presented, or the composition of some author. Every person must take a letter in rotation; and if the alphabet goes around more than once, it becomes a forfeit to mention any name employed before. Any person not being able to find a suitable word, pays a forfeit; likewise, any one prompting another.

The master of the revels shall choose the person that starts; this lady or gentleman must begin with the letter 'A.' Having thus completed the ode, he then chooses the next person, who must recite the ode using the letter 'B,' and so forth through the alphabet. The letters 'Q,' 'X,' 'Y,' and 'Z' may be passed over. Any person choosing another who has already recited the ode to be next, pays a forfeit.

The ode:

*I love my love with a(n) (letter) , because she is
(adjective) : I hate her, because she is (adjective) :
 I took her to (location) , to the sign of the (noun) :
 I treated her with (food) ; and her name is
(first name) (last name) .*

Lab 1: Finite Differences

Babbage's Difference Engine was meant to automatically calculate and typeset numerical tables of the kind used by navigators, astronomers, and other men of science. Such tables were contained in large volumes, such as *Numerical Tables and Constants in Elementary Science*, [Lup84] or Babbage's own *Table of Logarithms of the Natural Numbers from 1 to 108,000* [Bab15]. (Such books persisted well into the computer age. Consider, for instance, *Statistical Tables* [RS69], published in 1969.) The Difference Engine was to use the method of finite differences to perform the calculations. This lab will introduce you to the method of finite differences, as it would have been used to calculate numerical tables.

Where's the beef?

Let us begin with an example similar to one used by Babbage himself in his autobiography, *Passages from the Life of a Philosopher* [Bab64]. Let us suppose the owner of a butcher shop wishes to post a sign with the prices of various quantities of ground beef. Assuming the price of ground beef is \$3.19 per pound, we might envision a table like the one shown below in Table 1.

Table 1: Prices for various quantities of ground beef

Pounds	Price
1	\$3.19
2	\$6.38
3	\$9.57
4	\$12.76
5	\$15.95
6	\$19.14
7	\$22.33
8	\$25.52
9	\$28.71
10	\$31.90

Such a table is easy enough to produce, is it not? A butcher with moderate mathematical skills, even without a modern calculator, could simply do ten separate multiplications to make the table. Suppose the butcher uses paper and pencil to do the calculations, with multiplications like this:

$$\begin{array}{r} 2 \\ 3.19 \\ \times 3 \\ \hline 9.57 \end{array}$$

Another row in the table could be computed like this:

$$\begin{array}{r} 18 \\ 3.19 \\ \times 9 \\ \hline 28.71 \end{array}$$

The butcher repeats this pencil-and-paper multiplication a total of nine times and produces the prices shown in Table 2:

Table 2: Prices computed by the butcher

Pounds	Price
1	\$3.19
2	\$6.38
3	\$9.57
4	\$12.67
5	\$15.95
6	\$19.14
7	\$22.33
8	\$25.42
9	\$28.71
10	\$31.90

How did our butcher do? Since the tables are small, it is not too difficult to see that there are two errors in the table computed by the butcher, specifically, the lines for four and eight pounds of beef. The error in the four pound line is a simple transposition (the 7 and 6 have been switched in \$12.76). The error in the eight pound line was caused by making a carry mistake during the actual calculation. These errors, if left uncorrected, would cost our butcher money! The prices for four pounds and eight pounds of ground beef are each a dime too low.

What if the table was much larger, however? How easy would it be to detect errors in a table of, say, the logarithms of the natural numbers from 1 to 108,000? Certainly detecting errors would be much harder in this case. For example, a printed multiplication table of the period was found to have no less than 40 errors on one page alone [Smi64]! Also, suppose we do detect an error somewhere in a large table. Does this help us to find any other errors that might exist? No, it does not.

Now, let us consider a second method to produce the price table. Instead of multiplying the number of pounds by \$3.19 for each row, we will start with \$3.19 for the one-pound line, and then *add \$3.19 to each successive line*. Using this method, we perform nine additions instead of nine multiplications. The first addition would be:

$$\begin{array}{r} 1 \\ 3.19 \\ + 3.19 \\ \hline 6.38 \end{array}$$

The next would be:

$$\begin{array}{r} 1 \\ 6.38 \\ + 3.19 \\ \hline 9.57 \end{array}$$

And so on. Using our second method to produce the table, if we make an error during a calculation, what are the implications? It is obvious that one error would cause all of the rest of the calculations to be off as well. But, that is actually a good thing. After we have completed all the additions to produce the table, we can check the last line of the table using multiplication. If our multiplication produces the same answer as the last line of the table, we can assume (with high confidence) that all of the lines are correct. If our multiplication does not agree with the last line, then we know that an error is present somewhere in the table, and we can go about searching for it. So, our second method introduces a self-checking feature to the table that was not present if the table was computed with a multiplication for each line.

There is another important benefit of the second method for producing the numbers for our price table, a special case of the method of finite differences. Babbage could conceive of a way to add numbers together by some sort of machine. So, important mathematical tables might be produced *automatically*, and with a guarantee that the tables themselves were *without error*.

Finite differences and polynomials

Of course, Babbage was not interested in producing pricing charts for butchers. He wanted to mechanize the production of mathematical tables which could then be used by navigators, astronomers, and other men of science. So, let us turn our attention to calculating a table of numbers for a mathematical function. We will create a table that could be used to compute successive values of the function via simple addition and subtraction, like the second meat price table we created above. We will focus on a function that Babbage used himself when talking about the Difference Engine: $f(x) = x^2 + x + 41$.

Our table will have four columns. The first column will be the value of x , which in this case we will constrain to be from the non-negative integers, $\{0, 1, 2, 3, \dots\}$. Next, we will have the value of our function, $f(x)$. The last two columns will be for the first and second differences, defined respectively as $d_1(x) = f(x + 1) - f(x)$ and $d_2(x) = d_1(x + 1) - d_1(x)$.

To begin our table, we must compute the first three values of our function, $f(0)$, $f(1)$, and $f(2)$, so that we have enough data to compute the first row's first and second differences, $d_1(0)$ and $d_2(0)$. Here is our start:

x	$f(x)$	$d_1(x)$	$d_2(x)$
0	41		
1	43		
2	47		

Now we can compute some of the differences:

$$d_1(0) = f(1) - f(0) = 43 - 41 = 2,$$

$$d_1(1) = f(2) - f(1) = 47 - 43 = 4,$$

and

$$d_2(0) = d_1(1) - d_1(0) = 4 - 2 = 2.$$

Filling those values into our table, we have:

x	$f(x)$	$d_1(x)$	$d_2(x)$
0	41	2	2
1	43	4	
2	47		

Your turn

1. We have computed a few more values of the function $f(x) = x^2 + x + 41$ for you and inserted them as new rows in the table. Fill in as many of the differences ($d_1(x)$ and $d_2(x)$) as you can.

x	$f(x)$	$d_1(x)$	$d_2(x)$
0	41	2	2
1	43	4	
2	47		
3	53		
4	61		
5	71		

2. Do you notice anything special about the fourth column of the table, $d_2(x)$? Explain your findings.
3. Now, compare the fourth-column header to the degree of our polynomial function $f(x) = x^2 + x + 41$. (The degree is the largest power of x in the function). What do you see?

4. Here is the start of another table, for a different function: $f(x) = 3x^3 - 14x^2 + 12x + 13$. The new column, for the third difference, is $d_3(x) = d_2(x + 1) - d_2(x)$. Fill in as much of the table as you can.

x	$f(x)$	$d_1(x)$	$d_2(x)$	$d_3(x)$
0	13			
1	14			
2	5			
3	4			
4	29			
5	98			

5. Now, what do you think about the relationship between the third difference column and the degree of the polynomial $f(x) = 3x^3 - 14x^2 + 12x + 13$? Based on your findings with these two tables, what can you generalize about the degree of the polynomial, k , and the k^{th} difference $d_k(x)$?

Working backwards

For any polynomial function of degree k , $f(x) = c_k x^k + c_{k-1} x^{k-1} + c_{k-2} x^{k-2} + \dots + c_1 x^1 + c_0$, the k^{th} difference is always a constant. If that is the generalization you came to after your work on the previous two tables, congratulations!

Now, let us employ finite differences in the way Babbage intended the Difference Engine to work. In our butcher example, the second method of producing the price table generated each successive row of the chart via repeated additions. Once we have completed the first row and have found the k^{th} constant difference, we can use a similar procedure to determine the successive values of a polynomial function of degree k , using *only addition*.

We will work with a quadratic for the following example – a polynomial with degree two. As we saw for the previous quadratic example, our formula for computing the second difference is:

$$d_2(x) = d_1(x + 1) - d_1(x).$$

If we do some algebraic manipulation, we can find the next value of the first difference like this:

$$d_1(x + 1) = d_2(x) + d_1(x).$$

Similar algebra gives us a way to find the next value of $f(x)$ as well:

$$f(x + 1) = d_1(x) + f(x).$$

Now, consider the following table, with only the first row completed, for the function $f(x) = 19x^2 - 5x + 17$. Using the new formulae we just developed, we can now fill in as many lines as we choose.

x	$f(x)$	$d_1(x)$	$d_2(x)$
0	17	14	38
1			
2			
3			
4			
5			

For example, to produce the next for $x = 1$,

$$d_2(1) = 38,$$

since the 2nd difference will always be constant for a polynomial of degree two. Now we can calculate the entries for the row from right to left:

$$d_1(1) = d_2(0) + d_1(0) = 38 + 14 = 52,$$

and

$$f(1) = d_1(0) + f(0) = 14 + 17 = 31.$$

Your turn

6. Complete the table for $f(x) = 19x^2 - 5x + 17$, up through $x = 5$, using the method of finite differences elucidated above:

x	$f(x)$	$d_1(x)$	$d_2(x)$
0	17	14	38
1	31	52	38
2			
3			
4			
5			

7. Check your table by computing $f(5)$ directly. Did your finite differences method produce the correct value? If so, what conclusions can you draw about the other numbers in the table? If your finite differences method *did not* produce the same answer as the direct calculation, what conclusions could you draw?

Estimating other functions

The method of finite differences can be used to calculate many other sorts of functions in addition to the polynomials we have examined so far – as long as we are willing to settle for very accurate approximations instead of the “real” values. We can do this via Taylor Series approximations.

For our purposes, a Taylor Series expansion is a way to determine the value of a function, by computing the value of an abbreviated form of an infinitely long polynomial. For example, if we wish to find the cosine of an angle θ ,

$$\cos(\theta) = 1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} - \frac{\theta^6}{6!} + \frac{\theta^8}{8!} - \dots$$

Of course as it stands the Taylor Series expansion of $\cos(\theta)$ is not very useful, since it takes a really long time to compute the value of an infinitely long polynomial. However, if we are willing to settle for values of $\cos(\theta)$ that are “good enough,” i.e., approximations of $\cos(\theta)$, we can use an abbreviated version of the Taylor Series expansion, along with the method of finite differences, to compute our values.

In order to do finite differences calculations, let us suppose we end our approximating Taylor Series expansion at the $\theta^6/6!$ term. Then the degree of our polynomial is six, and therefore our table would have eight columns if we use the same format as our previous examples. To use finite differences, we must have a complete first row, and to do that, we must compute the Taylor Series expansion values directly for the first seven rows, so we have enough data to compute the differences $d_1(x)$ through $d_6(x)$.

Here is this process would work. Our function in this case is our truncated Taylor Series approximation,

$$f(x) = 1 - \frac{\theta^2}{2!} + \frac{\theta^4}{4!} - \frac{\theta^6}{6!}$$

Our values for x will be angles, in radians: $\{0, \pi/32, \pi/16, 3\pi/32, \pi/8, \dots\}$. Here is the table, with enough values for $f(x)$ to be able to calculate the values in the first row. All the computed values are shown in scientific notation.

x	$f(x)$	$d_1(x)$	$d_2(x)$	$d_3(x)$	$d_4(x)$	$d_5(x)$	$d_6(x)$
0	1.0000E+00	-4.8153E-03	-9.5842E-03	1.3867E-04	9.0957E-05	-2.2384E-06	-8.9536E-07
$\frac{\pi}{32}$	9.9518E-01	-1.4399E-02	-9.4455E-03	2.2963E-04	8.8718E-05	-3.1338E-06	
$\frac{\pi}{16}$	9.8079E-01	-2.3845E-02	-9.2159E-03	3.1835E-04	8.5584E-05		
$\frac{3\pi}{32}$	9.5694E-01	-3.3061E-02	-8.8975E-03	4.0393E-04			
$\frac{\pi}{8}$	9.2388E-01	-4.1958E-02	-8.4936E-03				
$\frac{5\pi}{32}$	8.8192E-01	-5.0452E-02					
$\frac{3\pi}{16}$	8.3147E-01						

Once we have that start, we could produce as many entries in the table as we wish, using the addition procedure outlined above.

There are Taylor Series expansions for many other functions that men of science might be interested in. For example, another trigonometric function, $\sin(\theta)$, can be expanded as:

$$\sin(\theta) = \theta - \frac{\theta^3}{3!} + \frac{\theta^5}{5!} - \frac{\theta^7}{7!} + \dots$$

Another example is the natural logarithm. For values of $x < 1$, the natural logarithm $\ln(x)$ can be expanded thus:

$$\ln(x + 1) = x - \frac{x^2}{2} + \frac{x^3}{3} - \frac{x^4}{4} + \dots$$

Summing up (sorry about that)

We have seen two separate, but complimentary, mathematical concepts in this lab. First, the method of *finite differences* allows us to compute successive values of polynomial functions through the repeated application of addition. A bonus of the finite differences method for computing functions is that it provides a self-checking mechanism so that we can be confident that our calculations are correct.

Secondly, we have seen that *Taylor Series approximations* can give us approximate values for other functions, such as $\cos(\theta)$, $\sin(\theta)$, and $\ln(x)$. We can make our approximations as accurate as we want by including more of the terms in the expansion.

Charles Babbage envisioned combining these two techniques in his Difference Engine to automatically produce error-free mathematical tables.

Programming labs (optional)

Lab A: Computing $\cos(\theta)$ with Taylor Series approximations

(This programming lab is appropriate for students who have been introduced to the basics of programming, up through the concept of iteration.)

Write a program to produce approximations for $\cos(\theta)$, for values of

$$\theta = \{0, \pi/32, \pi/16, 3\pi/32, \pi/8, \dots, \pi\},$$

using a Taylor Series approximation. Output three columns of numbers: θ , the value of $\cos(\theta)$ as computed by your programming language's built-in cosine function, and the approximation of $\cos(\theta)$ you compute via the Taylor Series approximation. Use enough terms in your Taylor Series approximation function so that the two values of $\cos(\theta)$ agree to four decimal places.

Lab B: Computing $\cos(\theta)$ with finite differences

(This programming lab is appropriate for students who have been introduced to two-dimensional arrays.)

Write a program to produce approximations for $\cos(\theta)$, for values of

$$\theta = \{0, \pi/32, \pi/16, 3\pi/32, \pi/8, \dots, \pi\},$$

using a finite differences approximation. Output three columns of numbers: θ , the value of $\cos(\theta)$ as computed by your programming language's built-in cosine function, and the approximation of $\cos(\theta)$ you compute via the finite differences approximation. Use enough terms in your finite differences approximation table so that the two values of $\cos(\theta)$ agree to four decimal places.

References

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[RS69] F. James Rohlf and Robert R. Sokal. *Statistical Tables*. W. H. Freeman and Company, San Francisco, CA, 1969.

[Smi64] Samuel Smiles. *Industrial Biography: Iron-Workers and Tool-Makers*. Ticknor and Fields, Boston, MA, 1864. Available via Google Books.

Lab 2: The Difference Engine

Lab 3: The Analytical Engine

Influence point (IP) slips

<p>Influence Point</p> <p>Pre-game IP awarded to:</p> <p>Davies Gilbert</p>	<p>Influence Point</p> <p>Pre-game IP awarded to:</p> <p>Prince Augustus Frederick, Duke of Sussex</p>	<p>Influence Point</p> <p>Pre-game IP awarded to:</p> <p>Lord Charles Grey</p>
<p>Influence Point</p> <p>Pre-game IP awarded to:</p> <p>Sir Robert Peel</p>	<p>Influence Point</p> <p>Pre-game IP awarded to:</p> <p>Lord Frederick John Robinson</p>	<p>Influence Point</p> <p>Pre-game IP awarded to:</p> <p>Lord John Russell</p>
<p>Influence Point</p> <p>Pre-game IP awarded to:</p> <p>Field Marshal Arthur Wellesley</p>	<p>Influence Point</p> <p>IP awarded for winning GS 1 party game:</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 1 presentation (GM):</p> <hr/>
<p>Influence Point</p> <p>IP awarded for best GS 1 presentation (persuasiveness metric):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 2 presentation (GM):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 2 presentation (persuasiveness metric):</p> <hr/>

<p>Influence Point</p> <p>IP awarded for best GS 3 presentation (GM):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 3 presentation (persuasiveness metric):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 4 presentation (GM):</p> <hr/>
<p>Influence Point</p> <p>IP awarded for best GS 4 presentation (persuasiveness metric):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 5 presentation (GM):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 5 presentation (persuasiveness metric):</p> <hr/>
<p>Influence Point</p> <p>IP awarded for best GS 6 presentation (GM):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 6 presentation (persuasiveness metric):</p> <hr/>	<p>Influence Point</p> <p>IP awarded for best GS 7 presentation (GM):</p> <hr/>
<p>Influence Point</p> <p>IP awarded for best GS 7 presentation (persuasiveness metric):</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>

<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>
<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>
<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>
<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>	<p>Influence Point</p> <p>Awarded to:</p> <hr/> <p>for:</p> <hr/>