MID-19th CENTURY SCIENTIFIC AMERICAN ILLUSTRATIONS

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In Cooperation With

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Abstract

This project, sponsored by the American Antiquarian Society, improved an existing index for early scientific illustrations. The project created a webpage to access the existing database which contains information on illustrations from the early volumes of *Scientific American*. The project also updated the database to include new features, corrected issues with the previous data, added Volume 1 to the database and explored how useful the database might be for researchers studying periodicals, inventions and technology from the mid 1800's.

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Executive Summary

This project, conducted in 2010 and 2011, created a website to access a database created by two earlier project teams. During our analysis of the database we discovered some areas for improvement of the quality of the data and fixed some of the inconsistencies in the data left by the earlier teams. The website field was set with a space filler, the 'Title' field was generally filled in to the point of being the 'article summary' and the 'image description' and 'article summary' were mostly left blank. Furthering the work of the earlier teams we added entries for the first volume of *Scientific American*¸ which were not yet in the database. The website was another major room for improvement; the previous version was hard to use and aesthetically blank. We updated it to be more usable and user friendly.

In an effort to better understand the possible uses and functionality of the database we evaluated what role *Scientific American* played at the time of publication and in what contexts it can be a useful research source. The quantity of data in the magazine and in later historical evaluations regarding sewing machines makes it the most representative category of inventions we found. It shows that *Scientific American* served as a strong hub for advice and a hotbed for innovation.

1. Introduction

This project (completed during the 2010-2011 academic year) continued the work of two earlier projects, completed in 2008 and 2009, which had worked under the goal of creating a database of the images from early American periodicals. The project was originally proposed by the American Antiquarian Society (AAS) with the goal of creating an index of illustrations in magazines from the nineteenth century. This would make these images much easier for researchers to locate, reducing the time spent gathering and locating materials thus allowing more time for analysis. The database has the potential to be quite useful for researchers with the recent development of optical character recognition (OCR) software that can convert pictures of text into digital text files that can then be searched. Similar software for computer recognition of mechanical drawings does not yet exist. Because of this, it is not yet possible to search for images and depictions unless they have been cataloged by hand. Newer publications have begun to be stored and cataloged electronically but those printed before the digital age are typically only available online as images, if at all. Although some older periodicals now have text in OCR format (which allows the user to search or copy the text), the images remain largely un-cataloged. The long term goal of this project is to provide a central index for early American drawings from multiple publications, but has so far focused only on the images from *Scientific American*.

The first project team (in 2008) chose to begin with *Scientific American* because of its historical importance and WPI's interest in technology. The fact that scanned copies of most issues are readily available online through Cornell University's Making of America Project also influenced this decision. The team from 2009 set out to create a basic webpage which would allow users to view the data while simultaneously improving upon and adding to the database. While the second group did overhaul the database and greatly improve the system, their website

was nearly unusable.

As such, the first area we selected for improvement was the website. The previous website consisted of a few unintuitive search fields on a white page that would simply display the data fields contained in the database for a selected illustration on separate lines. Following After an analysis of some online database sites, we replaced the website with one that users could search more intuitively and which allowed for browsing basic categories. Another area we found that needed improvement was the interface for data entry by project members. Previous teams had been logging into MySQL, editing the data directly. This method left the database vulnerable to accidental corruption or deletion. To fix this issue we created a website that would only allow those working on the project to modify the data through use of WPI's authentication system. This now allows safer and easier access for teams adding to or editing the data.

We also uncovered several areas for improving the data. The date field was not in a standardized format; the URL was a placeholder and did not point to anything useful; the subject fields were blank for nearly all entries and the article summary field was usually blank with the article summary in the image description field. We chose to fix some of these problems and simply catalog others with suggested solutions due to time constraints. Most of these issues were not discovered until midway through the project or later, so we decided to finish cataloging the first volume rather than leaving it incomplete and fixing the previously entered data.

To evaluate the database and whether it was a useful resource for researchers, we looked at how accurately *Scientific American* portrayed inventions in their articles. Our premise was that *Scientific American* had monetary interest in some of the inventions (they also ran a patent agency) which were featured in the periodical. We chose to focus specifically on the invention and improvement of sewing machines, as the category seemed to have the most information and would thus be easiest to analyze. We discovered that the periodical managed to stay abreast of the inventions and remain honest in its analysis despite its monetary interest in some inventors

and their creations. Since *Scientific American* did not appear to favor the inventions it stood

behind any more than their relative merit supports, we conclude that the publication is a good

source for understanding the inventions and the entrepreneurial environment of the period.

2. Database

The database was originally created in 2007 at the behest of the American Antiquarian Society. The original conception was of a database containing images in nineteenth-century periodicals. The original group decided that *Scientific American* would be the best place to start given its historical significance and its particular relevance to WPI. The projects have since focused solely on developing and populating this database of images from *Scientific American*. However, all the project teams have been conscious of the larger picture and made sure that it would be relatively simple to add entries from other magazines into the database, or to incorporate separate databases for each periodical into the existing website infrastructure.

2.1 Previous Work

The first group to work on this project created a database using the SPARQL query engine and the Resource Description Framework. To develop the necessary scripts and the website interface they used the Python programming language. While this was certainly functional when they submitted their project, the second group was unable to access either the database or the website due to technical issues and was forced to create a new database (using a text file containing the previous group's data). After investigating and testing different options, the second group decided to use the Python based web framework of Django. However, they encountered significant difficulties, and decided to construct a new database in MySQL, an open source database language. This decision was made due to the practicality of using MySQL on WPI's servers and the ease with which the data could be transferred into the new structure.

The second group split the information contained by each entry into eighteen different categories or "columns" as they are termed within MySQL (Table 1 provides a list of the columns, as of the completion of the 2010-2011 project). These columns contain all the data that

is used to locate the entry when a search is performed, and this is the same information shown when an entry is displayed on the website. The "Title" column uniquely identifies each entry and, as such, no two entries can have the same title. In creating these new columns, the 2008-2009 group removed many of the redundant categories put in place by the first group and added new ones to increase the amount of information provided by the database, as well as the internal organization of the database.

Besides rebuilding the database, the second group added a considerable amount of data to the database, bringing the total number of entries up to 2568 entries, spanning Volumes 2-9 and 11 of *Scientific American.* Unfortunately, this data did not conform to the many additions and improvements to the database made by the same group; much of the data has columns which are empty, incomplete or incorrect. For example, nearly all are limited to a maximum of 100 characters. The only exceptions are those that deal with numbers; volume, issue, page and dateint are all set as 11-digit integers. This limitation, however, was either neglected or forgotten by those who implemented it, resulting in most of their submissions ending mid-sentence or even mid-word. The flexibility in the date column also caused entries to be submitted with differing syntax which inhibited the database's ability to sort the entries by date; some dates were even set to the year 2005. All data also had their url set to www.google.com (this was intentionally used as a placeholder to test the system but it was never corrected or removed). All of these errors severely crippled the usefulness of the database; information was incomplete and though the images were available online, the option to view them through the database was nonexistent.

2.2 Advances

Although the dataset left by previous groups was problematic, the database itself was smartly set up. As the commands for using MySQL (Appendix A) are simple and

straightforward, the 2008-2009 group made an excellent decision. We made some attempts to expand upon the standards created by previous groups (and made sure to implement them in our work) but left the bulk of the homogenization of the current data for future groups, while we focused on minor revisions to the database (to increase its functionality) and the creation of a new website. This decision was made in order to provide a fully functioning, complete and polished structure for future groups to use in assimilating and adding to the data.

The first obstacle we met in attempting to work with the database was similar to the previous group: we could not gain access. After several attempts to contact those who had worked on the earlier version of the project proved unsuccessful, we gained access with help from WPI's Communication and Computing Center's Helpdesk. To prevent this from happening to future groups, we set up a generic log in ID and password which can now be passed down from group to group and ownership of the database will be transferred to Professor Bullock.

Once we had access to the database, and a working knowledge of MySQL, courtesy of http://dev.MySQL.com/doc/refman/5.5/en/index.html (Appendix A contains helpful guidelines and links for new users), we began to evaluate the database and its contents. We chose to keep the columns decided upon by the last group, though we added two more subject categories to allow for more flexibility in labeling and reworked some of the definitions to be less vague. This decision was made because the current configuration documented all the relevant (and potentially available) information for a given image. The columns and an explanation of the data contained within each can be seen below in Table 1.

Table 1: Database Columns and Their Definition

Column Name	Definition
Title	The title of the image as it appears in *Scientific American*. If there is none, then the title of the accompanying article or

	submitter's best educated guess.
Image Description	Description of the viewpoint of the image (e.g. sectional or isometric) and the general shape, orientation or function of the device (i.e. what it actually is).
Artist	The engraver or artist who worked on the image (it is near impossible to differentiate between the two. In the rare instance credit is given it is merely a name somewhere within the illustrated work).
Article Summary	A summary of the article accompanying the image. This is typically a brief description of how the machine or device operates.
Inventor	The individual(s) who invented the object illustrated.
Author	Author of the article. If no one is explicitly credited, no credit is given within the database.
Patented	The date the invention was patented; this is as specific or vague as the information given article itself (e.g. Winter of 1846 or June 15, 1847).
Subject	Selected from the 12 predetermined values given in Table 2.
Subject 2	Same guideline as Subject for 2nd applicable subject, if any.
Subject 3	Same guideline as Subject, for 3rd applicable subject, if any.
Keywords	Any number of relevant words or phrases, determined by the submitter.
Publication	What publication the image is found in. (This is currently set to default to *Scientific American*, but this column allows for other periodicals to be eventually included in the database).
Date	The date on which the issue containing the image was published.
Volume	The volume in which the image was published.
Issue	The issue in which the image was published.
Page	The page on which the image appeared in its respective issue.
Series	Listed as x of y. Shows how many related articles are present in the database.
People Involved	Anyone not included in the artist, inventor or author columns such as manufacturers or merchants selling the invention.

URL	A link to the issue containing the image on Cornell's Making of America website, if available.[1]
Dateint	An 11 digit integer comprised of the numbers in the date (i.e. 1845-08-28 becomes 18450828). This is used within the database for sorting entries by date, whereas the entry in the Date column is displayed when viewing entries on the website.

Each of these columns seems essential to meet the potential needs of the database's users. The necessity of the Title, Image Description, Article Summary, Publication, Date, Volume, Issue and Page should be obvious to the reader. As this is primarily a database of images, providing the artist or engraver's name would assist the researcher in finding images created by the same person, to correlate the work of an individual in *Scientific American* with other sources, or to track down the artist or engraver in a city directory. The inventor and author columns give credit to those responsible for the object in the engraving and the article accompanying it, a potential trove of information for anyone examining the inventions themselves. Similarly, the "patented" heading sheds light on the circumstances surrounding the physical item depicted. The subject, keyword and series columns allow researchers to jump easily between related entries. Whereas the subjects are a defined set of categories, the keywords allow for more freedom and greater differentiation within and across specific subjects.

As the available options for the subject heading are predetermined, they shall be granted a more elaborate description in this paper than the other columns. The subject column was originally created to organize entries by their general topic so that similar inventions could be located easily. The previous group used an article from *Scientific American* outlining patents granted in 1854 to establish the categories; we added three more categories that to better describe common subjects. Our additions were the subject headings of "Aerial Navigation," "Education

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[1] http://dlxs2.library.cornell.edu/s/scia/index.html

and Instructional" and "Electrical Powered Devices." Table 2 provides a complete list of the current subjects.

Table 2: Subject Headings

Aerial Navigation	Agricultural Implements and Operations
Arts—Fine, Polite, and Ornamental	Calorifics, Lamps, Stoves, etc.
Chemical Process, Manufacture and Composition	Civil Engineering and Architecture
Education and Instructional	Electrical Powered Devices
Fire Arms and Implements of War	Grinding Mills and Mill Gearing
Household Furniture	Hydraulics and Pneumatics
Land Conveyance	Leather—Tanning, Dressing and Manufacturing
Lever, Screw and Other Mechanical Power	Lumber, Machines for Manufacturing
Manufacture of Fibrous and Textile Substances	Mathematical, Philosophical, and Optical Instruments
Metallurgy and Manufacture of Metals	Miscellaneous
Navigation and Maritime Implements	Steam and Gas Engines
Surgical and Medical Instruments	Wearing Apparel and Implements for Manufacturing

In addition to making these structural improvements, we also added all of Volume 1 into the database. In doing this, we made certain that all available data was put into the correct column and that no information was lost due to the 100 character cut-offs. This has brought the total number of entries in the database up to 2781; it now includes all images from Volumes 1.1-46, 1.48-52, 2, 3.1-19, 4, 5.1, 5.2, 7-9, 11.1 and 11.2. Issue 47 of Volume 1 could not be found at the AAS, online or elsewhere.

Along with filling a large gap in the database content, we were also able to make

improvements on the data input by previous groups. We focused on making it searchable within the database and providing links so that the images can be found on the Making of America site, even if the database did not fully describe the images themselves. Specifically, we corrected the urls to their proper address on the Making of America website and changed all dates to the proper format (YYYY-MM-DD). Believing these were the most critical problems, we left the incomplete entries for future groups to fix. This decision was made because we felt that this would make the database more usable and that adding new, complete entries to the database would be a better use of the remainder of our time than trying to correct earlier mistakes. A future team could fully devote itself to correcting and systemizing the submissions so that all the entries (ours included) were uniform. The dates were corrected manually; each entry had to be updated so that all dates were of the form YYYY -MM-DD allowing the order by date function to operate correctly. The url correction was easier to implement; a few lines of code were developed to automatically identify the correct portion of the Cornell site by using the volume and issue data for each entry of the database and then insert this link in the "url" column. These changes will allow for researchers to locate the images more easily and to sort all entries by their proper date within the database.

2.3 Conclusions and Recommendations

The changes made to the database were done in order to make all information more useful to researchers. As the majority of problems involved data contained in earlier entries were not found until half way through the second term or later, this left an inadequate amount of time to make corrections. Because of this time constraint most of our improvements to the contents of the database were half-steps to a final solution. As such the main thrust of improvement was originally the addition of new data and the necessary structural improvements to the database to

make its contents more user-friendly, but became the correction of existing data such that it could be used by researchers.

The correction of all the dates within the database allows the information to be properly organized by publication date, and the inclusion of the proper links will allow the relevant images to be accessed. The latter will be especially helpful when the database contains incomplete information on the image, but enough to display it as a result of a given search. With the additional entries added over the course of this project the database can now be used to locate most images between Vol.1-10 of *Scientific American.* When an image is available online, a link is provided. All entries display the Volume, Issue and Page number, keywords and some level of description. This information is complete and detailed for entries from Vol. 1. However the amount and quality of information (beyond the aforementioned minimum) contained by later entries varies greatly. Some entries may have all columns filled, some may have only a title, volume issue and page number, and others include a description which may or may not be cut short by the 100 character cutoff.

We suggest that the next group focus on remedying these problems. The information contained by all entries after Volume 1 needs to be verified and modified to fit within the size limitations. Only twelve of these entries have subjects. Although a good starting point, the current set of subjects should be expanded or edited to be more applicable to these unlabeled entries rather than the improved, but highly arbitrary set currently in use. Similarly, some standardization of the keywords should also be implemented. While the lack of predetermined values in the keyword column allows for far greater flexibility, it also makes it potentially difficult for a researcher to determine just what keyword may be applied to a certain image or group of images. By establishing a list of keywords (or at least attempting to condense and

assimilate the keywords currently in use) a future group would greatly improve the functionality

of the database and the ability of a researcher to find similar terms.

3. Website

While functional, the website created by the 2009 group was hard to use and even more difficult to find. To make the database more accessible to users, we created a new website. For future project teams we also created a webpage for internal use that allows safer and easier access for data entry and editing. These two websites will make the database more accessible to the public as well as make it easier to update and improve.

3.1 Internal Website

The creation of a graphical backend for data entry resulted from a desire to have an easier method for data entry into the database. The main considerations taken into account while creating the new interface were security and ease of use. The new interface needed to be secure so that only authorized entries could be made and the integrity of the data could be assured. In order to be a useful tool, the new interface also needed to be easy to use and helpful, otherwise it would only hinder data entry and become more often avoided than used.

Security of the interface was accomplished by use of the WPI-provided authentication system. Only individuals with a valid WPI login, listed in the security access file, would be able to log into the system and enter data. This also solves an issue with database access, as authorized users can now log into the webpage to enter data without having access to the MySQL database. Before this new interface, users were given a username and password into the MySQL system and entered data using the command line MySQL interface.[2] Giving all users access to the command line interface inherently left open the opportunity for them to mistakenly destroy the entire database, or corrupt the data within the database. By limiting the MySQL access to a few administrative accounts, used by individuals with sufficient knowledge of the

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[2] MySQL Administration: http://www.wpi.edu/academics/CCC/Services/Databases/MySQL.html

system, the threat of accidental loss of information is greatly reduced. Additionally, users without any programming or MySQL background can now enter data into the system without special training on the esoteric details.[3]

The ease of use is harder to quantify, but has nevertheless been greatly improved. First-time users can immediately start entering data, review the data before final submission to avoid errors, remove erroneous entries, and edit existing entries to change minor mistakes. Entries can now be made from anywhere in the world via a basic web-browser window, eliminating compatibility issues found in the earlier system which required use of the VPN and other access software. For assistance in avoiding errors that occurred in earlier data entry, character length limits of data fields are enforced upon entry of text, rather than via automatic truncation after submission of the text field. This allows smarter truncation or rephrasing on the human end, rather than automatically cutting entries, which results in fragmentation and inscrutable entries.

3.2 External Website

Work performed on the public interface focused on two basic goals: the desired characteristics and the desired functionality. Building from the creation of the input system, the main goal of the search interface modification was ease of use. Through a simple aesthetic and basic, easy to use functions we hope to make the site much more accessible than the old one.[4]

After reading the reports from earlier teams working on this project, reviewing their website and code and meeting with our project sponsors at the AAS, we decided on some basic site characteristics we wanted.[5] The site should be easy to navigate, self explanatory, user friendly, organized, and have an improved aesthetic feel compared to the old sites. We looked at

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[3] More '.htaccess' Info: http://www.wpi.edu/academics/CCC/Help/Unix/Webdev/htaccess.html
[4] See Appendix D: Website Diagrams
[5] Fuller, Stephanie, et. al. "Images in Mid-Nineteenth Century American Scientific Periodicals." Worcester Polytechnic Institute. 2008.

a few existing databases similar to our goal and were inspired by the design of SCIPER[6] and JSTOR[7], two websites for searching and browsing articles from scholarly and historical publications. We also decided on some site functionality and content that was important to include. The site should have an explanatory splash/home page, 'about', 'history' and 'help' pages, some basic browsing capability, basic searching from all fields and more advanced search options like those available on JSTOR.[8] In both advanced and basic search modes the output page should be a list of items that can be sorted by the applicable parameters, and have selectable length for those who want to see more (or all) of the results on one page.

3.3 Code Details

Many important upgrades were made to the website code for the external website so that it matched basic web standards and the creation of the internal website followed these standards from the beginning. CSS was used to make the page scale well to differently sized screens. Based on the CCC-supported systems, a Python CGI script was the only choice for the backbone of the website that would support execution of MySQL commands and generate html content to form the visible website.

Important features within the code include robustness, design for later modification, and resistance to attack. In order for the website to retain its integrity it must either manage erroneous inputs (and create a suitable error page instead of crashing) or it must simply reject erroneous inputs. Both methods of dealing with errors were implemented with the hope that if one method did not catch a problem, the other would be able to handle the issue. The code was logically formatted and thoroughly commented to make later modification easier for those unfamiliar with

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[6] http://www.sciper.org/
[7] http://www.jstor.org/
[8] http://www.jstor.org/action/showAdvancedSearch

the code. This formatting includes logical variable naming as well as sectional layout of functions within the code based on their functionality for easier understanding of how the code works. To make the database and CGI code more resilient to malicious use the MySQL queries from the public website run from a limited access user and the queries are sterilized in the CGI code before they are sent to the server.

3.4 Development of the Website Text

To accompany the new website, two main pages of text were developed: the "about" page and a brief essay on the history of *Scientific American* (included as Appendix B to familiarize readers of this report with the periodical). The "about" page is a necessity for every website, as it explains the purpose of the site. The piece on *Scientific American* is meant to inform readers of the magazine's legacy and explain why the database would be of use to their research, as well as to further justify the importance of preserving and organizing the content of the database.

While the previous group had created an about page, it was in actuality a simple set of directions on how to use the database. The new about page explains the purpose of the database and the project system under which it was created (while the new help page provides the instructions). Credit is given to those responsible for its construction: students who have contributed, the advising professors and the sponsor of the project, the American Antiquarian Society. Links are also provided to the WPI, AAS and Cornell University's Making of America websites, along with contact information for both advising professors, in case more information is desired.

The document on the history of *Scientific American* primarily drew upon Frank Luther Mott's *A History of American Magazines Volume II:1850-1865*, as well as further information

from sources on Rufus Porter, the history of the patent office and *Scientific American* itself. The piece describes the circumstances under which the magazine was created and published and outlines the content of the magazine during the time period from which the images in the database were taken. This information highlights the importance of *Scientific American* in its own time and its significance to people researching images or inventions in the mid-to-late nineteenth century.

4. Scientific American and the Success of an Invention

During the latter half of the nineteenth century, *Scientific American* served as a central hub for experienced inventors, curious youth, and the mechanically inclined. Under the direction of Munn & Co., each issue of the periodical contained at least eight pages worth of descriptions and news on the latest inventions along with educational pieces on topics such as physics and galvanism. These readers in turn submitted their work to the paper, filling it with inventions small and large, practical and impractical. Not only did the readers submit their work to the periodical (and the Scientific American Patent Agency that was operated in conjunction with it), they sent letters seeking the opinions of the editors. These letters asked for advice not only on the pursuit of patents, but on engineering tasks and product recommendations. The questions asked ranged anywhere from subscription issues to critiques on submitted inventions (which were also sent to the office on occasion), help with mathematical calculations, and as this section notes, the best household sewing machine.

These questions directed to *Scientific American* recognized the editors' knowledge of all sorts of mechanical, electrical and other scientific topics. This expertise was necessary in order to not only run the magazine, but to provide advice to clients of their patent agency. The presence (and popularity) of both the magazine and the patent agency brought increasing knowledge to those working at *Scientific American*. Potential customers would either come into the office with their invention or mail in a description, daguerreotype or even model of the device. The editors of *Scientific American* would then evaluate it and offer advice as to whether or not it was practicable or patentable. Though they rarely attempted to predict the success or failure of a device in one of their articles, the praise or criticism of *Scientific American* usually correlates well with the eventual fate of the invention in question.

Honest opinions and reviews of new technology were not easy to come by in the nineteenth century. That readers not only subscribed to *Scientific American* in this search for information, but actively sought out the judgment of the staff in regards to all manners of technological concerns shows the faith they had in the knowledge and integrity of the magazine.

A major development in this time period was the mechanization of domestic chores. In particular, *Scientific American* printed and reviewed numerous inventions relating to the production of clothing, claiming to have "illustrated and described more sewing machines that any other periodical."[9] This expertise is displayed and applied in the multiple articles and replies to readers' questions on the subject. Other sources from the mid to late 1800s and modern histories of the sewing machine agree tend to concur with *Scientific American*'s conclusions and recommendations.

Scientific American was originally published in Boston, beginning in 1845. The headquarters moved to New York City the next year after the magazine was sold to the law offices of Munn & Co. The buyers expanded upon Porter's magazine by doubling its size and focusing on new American inventions. This was during a time when many advancements in technology were beginning to be developed, refined and mass produced, making it difficult for the uninitiated outside to keep up. *Scientific American* sought to fill (and profit from) this knowledge gap by providing information on and critiques of new devices, alongside educational pieces meant to instruct readers on basic mechanical and scientific principles. This information would allow readers to understand the advancements occurring all around them and better prepare them for creating their own contributions.

The first commercial sewing machine appeared fifteen years before *Scientific American*

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[9] "Wilson's Sewing Machine." *Scientific American* 6 no. 16 (1851): 124.

in 1830, when it was patented by the French tailor, Barthelemy Thimonnier.[10] The first patent for

a sewing machine was actually awarded to a British Cabinet maker, Thomas Saint, in 1790, and

while a myriad of other devices, both documented and alleged, claiming similar functions filled

the 40 year gap between the two. Thimonnier's machine was the first to be put into practical and

profitable use.[11] After Thimonnier's (brief) success, many others followed in his footsteps, often

helping to solve the problems plaguing the budding industry only to end up, like Thimonnier

himself, penniless and nearly forgotten to history; this would, in fact, become a trend for the

industry. Inventors and manufacturers who were not skilled at marketing their product (or

finding trustworthy partners to do so) would end up losing out on potential profit and fame.

Elias Howe, Jr., the man credited by most historians as inventing the sewing machine,

patented his device in September 1846.[12] Despite the fact that many of the inventors who

followed him based their machines on Howe's design, he originally followed Thimonnier's

precedent of destitution and obscurity, and left for London in search of better fortune. Upon

returning to America several years later, he found other inventors, such as Issac Singer, had

infringed upon his work and he started legal proceedings against them.[13] This too would become

a pattern for the industry; law suits and accusations of patent infringements regarding sewing

machines were common until 1856 when Howe pooled his patent with those of the three largest

corporations of the time, Grover and Baker Company, I. M. Singer and Company, and Wheeler,

Wilson and Company. This allowed each to manufacture their machines without fear of a

lawsuit, while all sharing the profit (Howe also received an additional royalty of $5 on each

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[10] Cooper, Grace. *The Sewing Machine: Its Invention and Development*. Washington D.C.: Smithsonian Institution Press, 1976. 11

[11] Cooper, Grace. *The Sewing Machine: Its Invention and Development*. Washington D.C.: Smithsonian Institution Press, 1976. 4-11

[12] Cooper, Grace. *The Sewing Machine: Its Invention and Development*. Washington D.C.: Smithsonian Institution Press, 1976. 19

[13] Museum of American Heritage. "History of the Sewing Machine."Museum of American Heritage. Available from http://www.moah.org/exhibits/virtual/sewing.html. Internet; accessed 10 February 2011.

machine sold in America).[14]

The emergence of the commercial sewing machine into the popular consciousness (and the turmoil surrounding it) occurred not long after Rufus Porter started publishing *Scientific American*. Howe's design was the first of its type to appear in the journal and did so on September 26th, 1846.[15] That many of the inventions originated from the same locations where *Scientific American* was published, Massachusetts (which had a history of textile production innovation) and New York, may be no more than geographic happenstance, but this made it easier for the editors of the magazine to find information on these devices. The term "sewing machine" appeared in the magazine in approximately 582 separate articles or advertisements between the years of 1846-1869 (the range over which the Making of America project has collected data).[16] This averages out to a sewing machine appearing in about every other issue for a quarter century, lending credence to the magazine's claim as the superior source of information on the device.

That Allen Wilson was aware of this reputation when he approached the Scientific American Patent Agency in 1849, looking for advice as to whether to proceed with his design for a sewing machine or a steam engine, is unlikely. However, his decision to follow their advice and proceed with the sewing machine had a considerable impact on the industry and his personal life. *Scientific American* described Wilson's reversal of fortune in 1858, by informing its readers that "the occupant of one of [Watertown, Connecticut's] most beautiful mansions is no less a personage than our once poor client with his cotton handkerchief full of inventions," Allen

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[14] Cooper, Grace. *The Sewing Machine: Its Invention and Development*. Washington D.C.: Smithsonian Institution Press, 1976. 41
[15] "Howe's Sewing Machine." *Scientific American* 2 no. 1 (1846): 4.
[16] Cornell University. "Making of America." Search: Journals: Scientific American. Available from http://dlxs2.library.cornell.edu/cgi/t/text/text-idx?ALLSELECTED=1&xc=1&g=moagrp&type=simple&rgn=full+text&q1=sewing+machine&cite1=&cite1restrict=author&cite2=&cite2restrict=author&Submit=Search&c=scia. Internet; accessed 10 February 2011.

Wilson.[17] Despite this illustrious property (and the millions of dollars his patents should have

granted him), Wilson did not go on to be as financially successful as some of his counterparts

due to his poor negotiation skills and an early retirement due to poor health; his machine was a

different story.

Wilson's sewing machine (and its later iterations) introduced several mechanisms that are

used in nearly every sewing machine today, and making him one of the major contributors to the

development of the modern sewing machine. *Scientific American* described the device as "an

almost perfect sewing machine" in the same article that gave the sketch of Wilson's life. The

periodical had previously stated that "none can equal this one in simplicity and compactness…it

is one of the most important inventions of the age. We will yet live to see it forming part of every

household furniture."[18] This was a very strong statement (and unpaid promotion) by such a

popular magazine. The belief in Wilson's machine is backed up in the fact that it was

prominently featured, recommended and advertised in the magazine. It appears approximately

103 separate times between 1846 and 1869, accounting for almost 20% of all sewing machines

mentioned in *Scientific American* throughout this period (Howe and his machine, by comparison,

appear 30 times and Singer only 4).[19] While the majority of these appearances seem to be

advertisements, articles referencing Wilson's sewing machine appear throughout the entire set of

issues currently preserved online; the last issue prints a letter from a reader in St. Paul,

Minnesota stating, "I have had a Wheeler & Wilson Sewing machine in my family for fifteen

years, and have paid not a cent for repairs."[20]

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[17] "Reminiscences of Sewing Machine Inventors." *Scientific American* 14 no. 8 (1858): 61.
[18] "Wilson's Sewing Machine." *Scientific American* 6 no. 16 (1851): 124.
[19] Cornell University. "Making of America." Search: Journals: Scientific American. Available from http://dlxs2.library.cornell.edu/cgi/t/text/text-idx?ALLSELECTED=1&xc=1&g=moagrp&type=simple&rgn=full+text&q1=sewing+machine&cite1=&cite1restrict=author&cite2=&cite2restrict=author&Submit=Search&c=scia. Internet; accessed 10 February 2011.
[20] "Facts for the Ladies." *Scientific American* 1021 no. 25 (1869): 395.

Due to the general lack of indexing of periodicals and similar documents from the nineteenth century, it is difficult to track down contemporary views on the sewing machine, making it problematic to identify opinions from other sources which may not have had as much of an investment in Wilson's machine. Sales records, however, show how comparatively popular the Wheeler & Wilson sewing machine was with consumers. As shown by the records from Elias Howe's patent combination, the Wheeler & Wilson machine sold far more machines than any other company between 1857 and 1866 – almost twice as many as his next competitor. In 1867 the Howe patent expired, and the Singer machine began to sell more quickly. The patent expiration seems to have led to a slow reversal of the margin, as Singer gradually began to outsell Wheeler & Wilson by larger margins until 1876 when Singer had two and a half times the market share of Wheeler & Wilson. [21] Until the Howe patent ran out and the Singer product line grew to have over 40 distinct classes of machine, Wheeler & Wilson's machine was the most popular by far.[22]

If Wilson & Wheeler's sales record were not enough to show the merits of the machine, Frederick G. Bourne, in his 1895 article "American Sewing Machines" has nothing but good things to say about Wilson's inventions. "To Allen B. Wilson must be awarded the highest meed of praise as an inventor, and for the ingenuity displayed in constructing and improving the sewing machine."[23] Regretfully, Wilson did not receive much reward for his great inventions; his petition for a second extension of his patents in 1874 was denied by Congress and his patents expired. Upon the formation of their stock company Wilson retired from the day-to-day business

[21] Bourne, Frederick G. "American Sewing Machines" in *One Hundred Years of American Commerce*, vol. 2, ed. Chauncey Mitchel Depew. New York: D.O. Haines, 1895. 530.

[22] Bourne, Frederick G. "American Sewing Machines" in *One Hundred Years of American Commerce*, vol. 2, ed. Chauncey Mitchel Depew. New York: D.O. Haines, 1895. 528.

[23] Bourne, Frederick G. "American Sewing Machines" in *One Hundred Years of American Commerce*, vol. 2, ed. Chauncey Mitchel Depew. New York: D.O. Haines, 1895. 527.

and focused on improving his machines. With the Wilson & Wheeler inventions and patents

leading the development of the sewing machine, Wilson's work kept them on top until the Singer

Company overtook them and then later bought out the company in the early twentieth century.

Wilson's inventions made groundbreaking improvements to sewing machine technology

and his influence on the development of the device can be seen in modern machines. Perhaps the

most indicative of the merits of the machine is Wilson's fourth important patent for a cloth feed

mechanism still used, with minor modifications, in almost every sewing machine today.[24] The

resulting machine was fundamentally different from all other machines in that period in its

methods of both fabric advancement and forming the lock stitch with a rotating hook and

stationary disk bobbin.[25] Wilson & Wheeler's other great breakthrough was their attitude

towards the machine. While other manufacturers were producing machines focused on the

manufacturing market, Wilson & Wheeler saw the demand for small and light machines that

could be used at home. Their inventions contributed greatly to the suitability of their machine for

such a purpose, as it could be made smaller and lighter from their improvements to both the

advancement and stitching methods. Other manufacturers quickly took note of the emerging

market and began to follow suit.[26]

Scientific American also published drawings and articles about the sewing machines

produced by Morey & Johnson, Jean Marie Magnin and Lerow & Blodgett, among others. Like

their assessment of Wilson & Wheeler, *Scientific American* viewed the utility and success of the

other inventors' devices in about the same way as later historians.

Charles Morey and Joseph B. Johnson patented a machine for chain-stitching. As

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[24] US Patent #12,116
[25] Cooper, Grace. *The Sewing Machine: Its Invention and Development*. Washington D.C.: Smithsonian Institution Press, 1976. 29
[26] Cooper, Grace. *The Sewing Machine: Its Invention and Development*. Washington D.C.: Smithsonian Institution Press, 1976. 29

Scientific American points out, the Morey & Johnson machine is only useful if it is finely tuned, but it must have been possible to do so, as it was noted to have been used in flour mills, print works and bleach works. *Scientific American* also noted that in their opinion it was better than the "London Sewing Machine," as the Morey & Johnson machine was simpler.[27] This machine referred to as the London Sewing Machine was the British patent of the Thimonnier machine applied for by Jean Marie Magnin.[28] Although other inventors patented improvements to the machine, none of the improvements were ever reported to have been successfully used.

Jean Marie Magnin's machine was not as simple as Morey & Johnson's, although, according to *Scientific American* it still "performs well and does good work." It is also noted that the machine's method for sewing is exactly like embroidering by machine. "It can embroider in a very beautiful manner, but for seam sewing [*Scientific American* would] not prefer it."[29] His machine did not have any important valuable features compared to other machines of its period.[30] Again, *Scientific American* has interest in the Morey & Johnson machine but provides reasoning behind the support and is not overly biased by their potential conflict of interest.

Sherburne C. Blodgett, a tailor supported financially by John A. Lerow, made some important inventions in the development of the sewing machine. As *Scientific American* notes that the Blodgett & Lerow machine is "the most perfect of [the machines we've published yet] – one which has unquestionable merit." *Scientific American* was most impressed by the self-binding seams the machine produced, as it avoided the "greatest evil" of the loop stitching machines; the seam would unravel if one stitch was missed or broken.[31] *Scientific American* was

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[27] "The American Sewing Machine." *Scientific American* 4 no. 19 (1849): 145.
[28] Cooper, Grace. *The Sewing Machine: Its Invention and Development*. Washington D.C.: Smithsonian Institution Press, 1976. 22
[29] "The French Sewing Machine." *Scientific American* 4 no. 20 (1849): 153.
[30] Bourne, Frederick G. "American Sewing Machines" in *One Hundred Years of American Commerce*, vol. 2, ed. Chauncey Mitchel Depew. New York: D.O. Haines, 1895. 525.
[31] "Lerow & Blodgett's Rotary Sewing Machine." *Scientific American* 5 no. 1 (1849): 1.

right to commend Blodgett's inventions although there were some flaws to the machine – it twisted the thread one turn per stitch such that it would eventually break – it did make some important breakthroughs in sewing machine technology and operation.

In publishing their articles about patents and inventions, *Scientific American* provided a broad and unbiased record of progress despite potential conflicts of interest. While *Scientific American* helped inventors secure patents, and published articles about these patents, the editors also made significant efforts to cover the patents and inventions of those that did not use their patent agency. If this case study of *Scientific American's* coverage of sewing machines is indicative of their general reporting and documentation of patents the publication did a remarkable job of staying abreast of general trends and advancements, whether or not the patents were obtained through their patent agency. These efforts by the editors to remain unbiased by the patent agency make the publication significantly more valuable as reference material.

Our research indicates that *Scientific American*, and particularly an index of the images they published, is quite valuable as a research asset. During this period images in publications were not a simple matter, making only a few engravings for each weekly publication meant prioritizing and only illustrating those articles that were most important. As such, a database of images from the publication is inherently an index of the flagship articles. Between the evidence of efforts to remain unbiased and the benefits of indexing the images within the publication this project and the resulting index has a propensity to be a useful resource for researchers.

5. Conclusions

The goals of this project were to expand and improve upon the previous work of the 2007-2008 and 2008-2009 groups. We began with the idea of creating a new database and increasing the amount of content within the database. This would make the database easier to use and bring it closer to the American Antiquarian Society's goal of making summaries of the images cataloged and available online, thus making the images themselves easier to locate.

While we initially met with obstacles in trying to access the database, causing us to be unable to start work on the database for several weeks, we have taken steps to ensure future groups do not encounter similar problems. There is now a generic username, controlled by Professor Bullock, which will allow for access to the MySQL database by any future students. This is mostly a redundant measure; a section of the new website has been designed specifically to serve as the interface for uploading, editing and deleting entries, all of which is controlled by WPI's authentication system (those working on the project will be given access to this portion by the advisors). In the event that the database itself needs to be modified, then the generic login can be used to make the necessary changes. The reason for this was to protect the database from an unsure user accidentally deleting or corrupting portions of the data while interacting with it.

The website itself is the major accomplishment of this project, providing a much more aesthetically and functionally pleasing design than the previous one. Searching capabilities have been greatly expanded upon; entries can now be sorted by subject, date, volume and the remaining columns allowing researchers to organize the data in any way they choose. There is now greater clarity between which links provide the image and which the information. Links are also provided to the WPI and AAS websites, as well as a section discussing the history of *Scientific American* and one explaining the purpose of the website and those who have

contributed.

In conjunction with the development of the database, research was also conducted on a topic relevant to the project: continuing to decipher what role *Scientific American* played in the technological advancements of the mid to late nineteenth century. Specifically we chose to look at the editors' perception of a specific invention, the sewing machine. This device went through numerous iterations and was coming into vogue during the time period for which we have cataloged images. This was accomplished by using the database in conjunction with the Cornell Making of America website, and various other sources. In conducting this research, we were able to ensure the functionality of the database and continue to investigate the importance that *Scientific American* held within this era.

Our improvements and additions to the database and website have helped increase its usability and the benefits it can bring to those researching the history of technology, engravings, periodicals and similar subjects. The new website allows for far greater flexibility in searching for and organizing the data, while database and entry revisions have increased content and made the previous entries more accessible. The benefits of these changes are exemplified by the assistance it provided to our own research. While there is still room left for advancements (and always the addition of data) our additions have made the database more accessible and informative, bringing it closer in line with the original goal of *Scientific American* itself: efficiently providing useful, technical information to the public.

Appendices:

Appendix A: Relevant MySQL Commands

This section is meant to be a brief overview of MySQL in regards to what was used in working with the Database of *Scientific American* Images; a complete overview of the language can be found in the MySQL reference manual.[32] All editing to the database was done with MySQL workbench, which provides a much more user friendly interface.[33] It is highly recommended that new users do the same.

A database in MySQL is split up into tables; each of these tables contains the individual data entries. Each data entry is described by information contained in columns and is uniquely identified by the information contained by a user-determined "key column." Both the number and title of the tables and columns can be set by the user. The type and quantity of data contained in the columns (integers or characters) are also defined by the user. To summarize and provide an example in our database, the table "images" contains all our entries which consist of the columns found in Table 1 with "title" being the key column that identifies a unique entry.

The commands most likely to be used in working with the sciamimg database (the database containing the data for the images from this project) are select, from, update, where, order by, limit. The following examples of code in MySQL will be shown with MySQL commands capitalized and user entered fields in single quotes. All MySQL command lines end of a semi-colon and all strings, i.e. information contained within a given column, must be entered between single quotes. The select command allows the user to pull up an entry from the database, along with whatever columns are chosen for viewing and would be entered like this:

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[32] http://dev.MySQL.com/doc/refman/5.5/en/index.html
[33] http://dev.MySQL.com/downloads/workbench/5.2.html

SELECT 'columns' FROM 'table' WHERE 'argument' ORDER BY 'second argument'

LIMIT 'x','y';

Here, columns is the 'columns' to be displayed, separated by commas. To select all columns use the * symbol. 'Table' specifies which table to pull the selections from. 'Argument' allows for the specification of different conditions for selecting entries, such as matching information contained in columns (e.g. volume='1' or title='Mechanical Movements') as with select, multiple conditions can be entered, provided they are separated by commas. ORDER BY is an optional command which allows the user to decide how results are displayed. It can be followed by any number of arguments, separated by commas and will follow the order of the arguments (e.g. the command ORDER BY volume, issue would display the entries by volume and sort by issue within the volume (1.1, 1.2, 1.3…) whereas ORDER BY issue, volume would display entries as 1.1, 2.1, 3.1 ,1.2…). If no order is specified, MySQL will automatically sort and display entries by. LIMIT is a second discretionary command which allows designates the range of entries to be displayed; it is followed by two numbers separated by a comma. These two numbers specify the range of entries (e.g. 0, 2000 or 100, 250); this is particularly useful when attempting to see all the entries in the database, as MySQL has a default display limit of 1000. The following example would display the title, inventor and url of the first three entries for Volume 4, Issue 3:

SELECT title, inventor, url FROM images WHERE Volume='4', Issue='3' LIMIT 0,3;

Update allows the user to modify existing entries within the database and is written as

UPDATE 'table' SET 'first argument' WHERE 'second argument';

As before, 'table' specifies which table is being worked with. The 'first argument' is what is being changed (if the url of an entry was to be changed to google.com, then the input

would be SET url='google.com'). The 'second argument' specifies under which conditions the change will occur. Be careful as if there is no where clause (WHERE followed by some criterion). This command will modify the entire database (i.e. in the example above it would set the url of EVERY entry to google.com). However, the MySQL workbench automatically runs in safe mode so that this cannot happen. In order to make update an entry in safe mode use the where clause to specify the key column. This will force the database to modify only that one unique column. To edit multiple entries at the same time, either explicitly specify each entry by its title, or exit safe mode. If safe mode is exited, be careful, as any changes in this mode will be permanent; it is best to type the code first, review it and then add the command to exit safe mode before the update line. The command to exit safe mode is SET sql_safe_updates=0;. To return to safe mode (and it is highly recommended to do so) simply type SET sql_safe_updates=1;. An example of the UPDATE command, which was used in correcting the dates, is:

SET sql_safe_updates=0;

UPDATE images SET date='1852-12-04' WHERE date='1852-12-4';

SET sql_safe_updates=1;

Again, it cannot be stressed enough how important it is to be cautious and to double-check the code/script when using the UPDATE command. Always use a WHERE clause while using the update command and be sure to restore safe updates immediately after (within the same script, if using MySQL workbench) the change. This will prevent unnecessary mistakes and the potential loss of data.

Appendix B: History of *Scientific American*

First printed on August 28, 1845, *Scientific American* was published with the goal of making information on technological advance readily available to the public. As Frank Luther Mott phrased it in his *History of American Magazines*, "*Scientific American* had a significance--at least for its first sixty or seventy years–unapproached in kind and effect by any other periodical."[34]

Scientific American, the oldest continuously published magazine in the United States, was begun by Rufus Porter with the subtitle "The Advocate of Industry and Enterprise, and Journal of Mechanical and Other Improvements." Porter was an American inventor and painter, succinctly characterized by Mott as "one of those inventive Yankees whose versatility, 'handiness,' and restless 'projecting' life have made his type a legend."[35] He began the magazine as a continuance of his previous publishing efforts, all of which were an attempt to popularize his hobbies and introduce his inventions and arts to the world.[36] This can be seen in the early issues dedication to subjects related to painting and aerial transportation, a major life interest of Porter (between 1852 and 1853 he began the Aerial Navigation Company and attempted to build an airport, but numerous setbacks forced him to abandon this venture).[37] Like his earlier magazines, the *New York Mechanic* and its successor the *American Mechanic,* (the two together lasted approximately two years) Porter's involvement with publishing *Scientific American* was short-lived. Only ten months after starting the periodical, Porter sold it to Alfred

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[34] Mott, Frank Luther. *A History of American Magazines Volume II:1850-1865*. 2. Cambridge, MA: Harvard University Press, 1938. 324. Print.

[35] Mott, Frank Luther. *A History of American Magazines Volume II:1850-1865*. 2. Cambridge, MA: Harvard University Press, 1938. 316. Print.

[36] "Rufus Porter Biography." *Rufus Porter Museum*. Rufus Porter Museum, 2010. Web. 5 Dec 2010. <http://www.rufusportermuseum.org/biography/rufus-porter-biography.php>

[37] "Rufus Porter Biography." *Rufus Porter Museum*. Rufus Porter Museum, 2010. Web. 5 Dec 2010. <http://www.rufusportermuseum.org/biography/rufus-porter-biography.php>

Beach and Orson Munn, who then established the law firm Munn & Co. to practice patent law in conjunction with publishing the magazine.[38]

Beach and Munn removed the magazine's subtitle, doubled its size--from four to eight pages--and focused more tightly on new American inventions and patents. To make more room in each issue, they removed the anecdotal content previously published by Porter; largely made up of what Mott called the "fragmentary essays on moral subjects 'selected' from other periodicals, as well as some poetical 'pieces,' the choice of which reflect no credit on the editor's literary judgment," but also included jokes and local stories or curiosities.[39] Munn & Co. also limited each advertisement to sixteen lines and no illustration, as opposed to the full page of ads in each issue while the magazine was under Porter's direction. These changes were highly successful. Subscriptions to the publication jumped from under 300 to over 10,000 during Beach and Munn's first two years.[40]

Along with this increase in readers came an increase in questions: questions about patents. To assist the readers who approached them with concerns over obtaining patents for their inventions and innovations, Munn & Co. started the Scientific American Patent Agency. Frank Mott states that what separated the Scientific American Patent Agency from its competitors was that it "was conducted on high principles and gave honest advice," which caused it to become "a very prosperous concern and the largest agency of the kind in the world" in under two decades.[41] After being cheated out of his previous work by another patent lawyer, inventor Allen Wilson came to the Scientific American Patent Agency with his model for a new

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[38] "Scientific American Company History." *Scientific American*. N.p., 2010. Web. 5 Dec 2010. <http://www.scientificamerican.com/pressroom/aboutus.cfm?tab=company-history>.

[39] Mott, Frank Luther. *A History of American Magazines Volume II:1850-1865*. 2. Cambridge, MA: Harvard University Press, 1938. 317. Print.

[40] Dobyns, Kenneth. *The Patent Office pony: a History of the Early Patent Office Kenneth W. Dobyns*. Sergeant Kirklands Museum, 1994. 130. Print

[41] Mott, Frank Luther. *A History of American Magazines Volume II:1850-1865*. 2. Cambridge, MA: Harvard University Press, 1938. 318. Print.

sewing machine. The New York office would eventually become the first branch of the US

Patent Agency and would spawn other offices in D.C. and beyond. The Patent Agency helped

Scientific American just as much as it was helped by it. According to Mott, the editors ensured

"every patron of Munn & Company got at least a few lines in the paper," no matter how trivial

the invention might seem.[42] Under the ownership of Munn & Co., the Agency secured numerous

patents; in 1865 they filed approximately 3,500 applications, nearly 500 more than the combined

total of those filed in the United Kingdom.[43]

Scientific American differed from contemporary scientific publications because it was

published for inventors and the general populace. Most scientific papers were produced quarterly

or annually in large, expensive bound volumes. This restricted readers to the learned and

wealthy, those who had the money and time. *Scientific American*, however, was published as a

weekly broadsheet allowing for inexpensive and efficient mass production and distribution. This

allowed subscription prices to be equally inexpensive; subscription was originally two dollars per

year and did not change until the price increased by a dollar in 1863.[44]

Along with the articles on inventions, every issue included several pieces on general

sciences, typically the subjects of applied physics or agriculture. Medicine and astronomy were

occasionally discussed in these sections, but topics like geology and biology received little to no

attention.[45] The scientific content served mainly to educate the reader in fields relevant to the

mechanisms described in *Scientific American*. To help the inventors, the magazine also offered

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[42] Mott, Frank Luther. *A History of American Magazines Volume II:1850-1865*. 2. Cambridge, MA: Harvard University Press, 1938. 318. Print.

[43] Dobyns, Kenneth. *The Patent Office pony: a History of the Early Patent Office Kenneth W. Dobyns*. Sergeant Kirklands Museum, 1994. 129. Print.

[44] Mott, Frank Luther. *A History of American Magazines Volume II:1850-1865*. 2. Cambridge, MA: Harvard University Press, 1938. 319. Print.

[45] Mott, Frank Luther. *A History of American Magazines Volume II:1850-1865*. 2. Cambridge, MA: Harvard University Press, 1938. 319. Print.

commentary on patent law and a list of patent claims filed within the past month or two of publication which did not receive more elaborate descriptions in the paper. This allowed readers to keep track of what areas were gaining popularity and which claims had been awarded by the patent office.

The magazine also included 4-10 large illustrations in each issue. Printed from woodcuts, these images displayed the inventions spotlighted in the accompanying articles. The illustrations ranged in size from simple column headings to the half-page sketches of each issue's main invention. The larger images were of a highly technical nature and typically labeled at points which were then referenced within the article, explaining how the depicted device operated. While some of the smaller images served no purpose greater than decoration, these larger images were critical to the explanation of the inventions and some articles depended solely on what was referenced in the drawing to illustrate the machine's operation; making the images an integral portion of *Scientific American* and therefore its success story.

Appendix C: Informal Notes on CGI and Software Work

The CGI scripts used for the websites are written in Python and require the support of a few key modules that can be difficult to set up. To assist later groups this section is mostly a list of tips for how to get set up with the necessary software and support modules to continue work on the project. A Mac was used for most of the code work, and Linux for some of it, so these tips will not be as useful for those using Windows, but much of the work was made easier by the command line functionality of Unix (the underpinnings of Mac OS) and Linux, so it is easier to use one of these rather than Windows.

For the Python CGI code employed for the website, a python interpreter is needed as well as a debugger or GUI tool, all of which can easily be found on the internet.

Mac OS has a built in web server which you can use to test CGI website code once you have installed CGI support modules and set it up correctly. The mod_python module is required for CGI use under the Apache webserver built into the Mac OS.[46] Google and other search engines are incredibly valuable here and there are many sets of directions available on the web. Past that, you'll need to enable web sharing in system preferences and put code in the correct directory for the webserver to find it.

The modules to use MySQL from Python are the hardest part to get working.[47] When you install them you'll likely get any number of errors, and unfortunately the easiest way to diagnose and repair them is to search for them on Google and try the various solutions you find there. This process is much easier under Linux as you can simply run the command "sudo apt-get install python-mysqldb" and generally completes without errors. Your mileage may vary, but the Linux method is much easier if you are comfortable using Linux.

The final difficulty is in writing the actual CGI code. You are writing a Python program whose text output must follow all the HTML requirements no matter what happens within the program. Because of this you must make sure that it always outputs the correct header, and additionally that it continues supplying valid HTML output when skipping between functions within the Python script as you generate different pages based on the input information and data from the database.

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[46] http://www.modpython.org/
[47] http://mysql-python.sourceforge.net/MySQLdb.html

Appendix D: Website Diagrams

Figure 1: Old Website

Figure 2: New Website

Figure 3: New Input Page