

# CATALOGING AND HISTORY OF MID- NINETEENTH CENTURY *SCIENTIFIC AMERICAN* ILLUSTRATIONS

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of the Bachelor of Science degree at  
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Submitted to:

Professor Steven C. Bullock  
Professor M. David Samson

Michelle Guertin

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Andelle Kudzal

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James Martinez

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Advisor Signature

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Co-advisor Signature

## Abstract

This project, sponsored by the American Antiquarian Society, continues the work of creating a database of images from the early years of *Scientific American*. The magazine, founded in the mid-nineteenth century, featured numerous engravings of recent inventions. Building upon the work of three previous projects, our group cataloged the illustrations from four volumes of the magazine (1855-1859) into a database created by a previous group. This project further explored the technical and business history of the engravings featured in the magazine, identifying for the first time some of the artists who created these illustrations.

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## Authorship

Abstract.....	Michelle Guertin & Andelle Kudzal
Authorship .....	Michelle Guertin & Andelle Kudzal
Introduction.....	Michelle Guertin, Andelle Kudzal, & James Martinez
Database.....	James Martinez
Indexing <i>Scientific American</i> Illustrations.....	Michelle Guertin & Andelle Kudzal
Illustrating Inventions at <i>Scientific American</i> .....	Michelle Guertin & Andelle Kudzal
Recommendations for the Next Group .....	Michelle Guertin, Andelle Kudzal, & James Martinez
Conclusions.....	Michelle Guertin & Andelle Kudzal
Appendix A: Notes on Research Process .....	Michelle Guertin & Andelle Kudzal
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Appendix C: Illustrations .....	Andelle Kudzal
Appendix C:IQP Research Bibilography.....	Michelle Guertin & Andelle Kudzal

Editing: Michelle Guertin & Andelle Kudzal

## Introduction

This project represents the most recent step in a continuing effort to create, refine, and populate a database of images from nineteenth century American periodicals. The American Antiquarian Society wanted a way for their researchers to search for images in periodicals as easily and quickly as they search for text. They have sponsored a series of projects to build a database based on metadata/data structures, and a search interface, like a virtual library card catalog. This will allow researchers to find images by searching for criteria such as the illustration's name, the illustrated device's inventor, the patent date, the publication date, and the volume and issue number.

Our group chose to undertake two tasks. The first was adding as many entries as we could to the database. We indexed the illustrations that appeared from 1855 to 1859, so that the database now includes Volume I to Volume XIV of *Scientific American*. We chose to stop at this point because Volume XV starts a new series.

The second task we undertook was to compile a written history of engraving and illustration in the early years of *Scientific American*. As a magazine of science and inventions, illustrations were crucial. The editors sought detailed and accurate illustrations of the machines that the editors featured in their articles, so they hired the best engravers, and embraced the latest printing processes. This project explored the magazine's engraving process, offering a range of new material about the engravers who prepared these illustrations and the methods by which the illustrations were created and used.

Our efforts at making modifications to the database and website were frustrated by various issues. We arranged the files that make up the source code of the website in such a way that future groups will not face the same roadblocks when dealing with access and permissions.

## Database

The database as it exists in its current form was created by the third project group (2010-2011).

### Previous Work: First IQP Group (2007-2008)

The first project group for this IQP project worked from 2007 to 2008. The first database created was completely inaccessible by all subsequent groups because its design was unnecessarily complex. It was created using the SPARQL query engine, the RDF (Resource Description Framework) and used scripts written in the programming language Python for data management and user interface.<sup>1</sup> RDF is a metadata management system that represents information about resources as statements in the form “subject predicate object.” For example, “*illustration1* has-name 'cotton gin',” “*illustration 1* has-inventor 'Eli Whitney' .” These statements are referred to as “tuples.” SPARQL is the query language designed to work with RDF. It searched for database entries by looking for patterns of tuples, and returns entries where these patterns match.<sup>2</sup> While this system is not as automated as other methods of database construction, it has the advantage of being both precise and free-form.

Before information was uploaded to online storage, a considerable amount of thought was put into how to manually record information on illustrations for later uploading. The first method was to enter the information into Excel documents. There would be no syntax errors in uploading data formatted this way, but since Excel spreadsheets are essentially giant tables,

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1 Mehtens and Montague, Mid-19th Century Scientific American Illustrations, 2011, 7.

2 Fuller, Stephanie, Johnathan Gibbons, and Nicole M. Nelson. Images in Mid-Nineteenth Century American Scientific Periodicals, 2008, 12

Excel could not be used to properly represent a “multiple entity relational database.”<sup>3</sup> The alternative would be to use multiple tables, but this was deemed to be too much like manually recreating the whole database.<sup>4</sup> Another option considered was plaintext with a specially formatted template. This method had the advantages of allowing quicker revision and compatibility with general-purpose spell-checking and search programs. This method had the disadvantage of not being protected from syntax errors. Eventually, it was decided to catalogue data for indexing using a system called Notation 3. Notation 3 is a template for manually organizing data that is specifically designed to work with RDF.<sup>5</sup> Using Notation 3 had the advantages of plaintext without the danger of syntax errors.

The first project group indexed volumes II through IX of *Scientific American*, being unable to find a copy of the first volume. In the report it was noted that only the entries of volumes III and V have multiple subjects for each illustration. They recommended that all indexed data use multiple subjects.<sup>6</sup> However this ended up being a moot point, because the second project group was unable to access this database or the website that went along with it. The information was stored on an original group members’ private website with no way to get to it.<sup>7</sup> As such, the second group had to rely on the data that the first group had manually recorded before indexing.

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3 Fuller et al., 2008, 21

4 Fuller et al., 2008, 22

5 Fuller et al., 2008, 23.

6 Fuller et al., 2008, 27

7 Barton, Steven, Candace Chouinard, Forrest Hogeboom, and Sarah Latta, *Cataloging 19th Century Periodical Images*, 2009, 5



## Previous Work: Second IQP Group (2008-2009)

The second group's efforts can be roughly divided into 2 phases: the first attempt to create a database and website using Django XML, and then the successful attempt to create them with Python and MySQL.

The second project group (2008-2009) was unable to access the previous group's database or the website it because the information was stored on an original group member's private website.<sup>7</sup> A new database had to be created from scratch; the focus was on how to best organize the data. Their explicitly stated goal was to “[craft] a new database that could be read, accessed, and edited by all.”<sup>8</sup> The new filing system was based on the “Dublin Core” metadata terms—a list of fifteen types of information (*title, creator, subject, description, date, publisher, etc.*) that could be used to create searchable lists of various items.<sup>9</sup> The variation on Dublin Core that was used had a series of eighteen column headings to organize entries. A subject column was included to provide a predetermined list of categories for all the indexed images to be placed in. The items on the list were chosen based on an 1854 article in *Scientific American* that described the categories of patents that had been filed for in the previous year. MARC (MACHINE-Readable Cataloging), the Library of Congress' filing system, was considered; however it was decided that it would be too complex to implement.<sup>10</sup> After deciding on a structure, the next step was implementing it.

The second project group actually made two attempts to create a new database. The first attempt used the Python-based web framework Django. In the Django database, each piece of information in an entry (image name, patent date, issue number, etc.) would have had its own

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7 Barton, Steven, Candace Chouinard, Forrest Hogeboom, and Sarah Latta, *Cataloging 19th Century Periodical Images*, 2009, 5.

8 *Ibid.*

9 Dublin Core Metadata Initiative, 2010, <http://dublincore.org/documents/dces/>.

10 Barton et al., 2009, 13.

distinct field, rather than being categorized and sub-categorized as had been in the first database. Django XML format allowed document creation by filling the database via the browser and dumping it into a file. Handling the data was to be a two-step process; first, entering data into custom structures and second, printing those structures in the required format.<sup>11</sup> Despite the advantage of relative automation, Django has the major drawback of requiring a constantly running process on the host server. This places a high demand on the server, and limits hosting options. The second project group wanted to be able to host their website and database almost anywhere, so this aspect of Django made the database unusable so it was decided to create a new database using alternate systems.<sup>12</sup> The systems chosen were Python CGI scripts and MYSQL.

The project group resolved to make a database using Python CGI scripts and MYSQL. For the final implementation, the group used Python to manually code several tasks that Django would have done automatically, such as form submission and organizing entries by date.<sup>13</sup> The database was constructed using MySQL and all data was stored in a single table titled “images.” Using MySQL meant that in order to display information, the database had to be queried directly. This meant that the process of indexing involved writing code which required a basic knowledge of MySQL. There is also the risk of a single command being used which could have erased all of the data.

In order to host the website on WPI Webspace, all page transitions had to be handled by a single CGI file, which was written in Python. The CGI script generates the HTML code for the website based on information it retrieves from the URL. If the script is generating search results, it also takes any search parameters the user may have entered, queries the database using a

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11 Barton et al., 2009,19.

12 Barton et al., 2009, 20.

13 *Ibid.*

MySQL command, and displays the results as HTML.<sup>14</sup> This system eliminated redundancies in code: the HTML code for the elements shared by multiple pages only had to be written out once.

With the new database in place, indexing was brought up to a total number of 2568 entries, spanning Volumes 2-9 of *Scientific American* and included re-indexed entries from group one. However, much of this data was improperly formatted. In many of the entries, some columns were blank or filled with incorrect information. Occasionally text entries ended mid-sentence. The dates did not conform to a specific syntax, and the URLs were placeholders.<sup>15</sup> These conditions represented a severe impediment to the practical usefulness of the database.

When considering the future of the project the second group agreed with the first group's (2007-2008) conclusions that a web-based data entry form would be most efficient, but did not implement it. In addition, it was pointed out that many of the early data entries do not have the correct URL. To fix the issue of the placeholder URL a “click bot” was considered, which would browse through the Making of America site via a combination of searching, for volume and issue numbers in the text of links, and repeated clicking, using the page number in the database entry to figure out how many times to click the 'next page' button after the correct issue was found via search.<sup>16</sup> Time restraints forced the group to focus on certain aspects of the project over others. The decision to have a fully functioning database was deemed more important than having complete data.<sup>17</sup> It was suggested that future groups should eventually find independent hosting for the website and database, rather than keeping it on WPI Webspace. The database should also expand beyond *Scientific American* and other periodicals such as *Harper's New Monthly Magazine* and *The North American Review* were recommended.

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14 Barton et al., 2009, 21.

15 Mehrtens and Montague, 2011, 8.

16 Barton et al., 2009, 23.

17 Mehrtens and Montague, 2011, 9.

## Previous Work: Third IQP Group (2010-2011)

The third group decided to make the focus of their project improving the website's ease of use, both when searching for data and when entering data. As part of this effort, they revamped the website's search and browse functions, as well as created a data entry tool that did not require any computer science knowledge on the part of the indexer.

While the website created by second IQP group was functional, the next project team decided it was nearly unusable. When the third project group (2009-2010) encountered the project website, it allowed users to upload and view data, but there were other problems. According to the third project team's report, the search fields were unintuitive, dates were not entered in a standardized format, and the information delivered by searching was displayed as aesthetically unpleasing. It was also pointed out that flawed database entries were missing information in the subject and article summary fields and in almost all of the entries the URL was substituted with a placeholder. Faced with these issues, it was decided that the primary goal would be reworking the website so that it would be easier for future groups to add data. Focusing on ease of use, other websites, such as SCIPER and JSTOR, were used as reference.<sup>18</sup> The browsing functionality was improved by adding the option for users to browse by multiple categories. The issue of controlling access to the database was resolved by setting up WPI Authentication on the website. In the interest of greater accuracy, two new fields were added to each entry in the database: Second Subject and Third Subject. This allowed for illustrations of inventions that fit into more than one of the predetermined categories. For example, an engine

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<sup>18</sup> Mehtens and Montague, 2011, 17.

for a steamship might have “Steam and Gas Engines” for its First Subject, and “Navigation and Maritime Implements” for its second category.<sup>19</sup>

The third group's alterations to the website and database began with a decision to create a “graphical backend for data entry.”<sup>20</sup> The backbone of the website is a Python CGI script. Given the nature of the CCC-supported systems, this was the only choice that would support execution of MySQL commands and generate HTML content.<sup>21</sup> In the previous incarnations of the database, data entries had to be manually typed out with SQL commands. A browser-based data entry system was added in order to make indexing more efficient. All the user would have to do was fill in a form with the necessary information and then the CGI script would generate a SQL command based on that information. The form script has the ability to detect improperly entered information and has the ability to reject bad input, further protecting the database from user error. If the information is properly written, the SQL command is sent to the server, and the information that the user typed into the form is entered into the database. A similar system is used for deleting entries. With this system more people can contribute information without the risk of a bad SQL command damaging preexisting data. Direct MySQL access is still limited to very few.<sup>22</sup> The new database made updating more available by making the website accessible from any network—it does not require a VPN connection or any other access software although it did require proper permissions.<sup>23</sup> As a finishing touch, the project group also added CSS to the website, which makes the page scale to various screen sizes.<sup>24</sup> These changes provide a greater degree of usability.

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19 Mehtens and Montague, 2011, 9.

20 Mehtens and Montague, 2011, 16.

21 Mehtens and Montague, 2011, 18.

22 Mehtens and Montague, 2011, 16.

23 Mehtens and Montague, 2011, 17.

24 Mehtens and Montague, 2011, 18.

Due to the work done by this IQP group, creating new entries in the database is very user-friendly. With proper permissions one can navigate to four other pages: *Basic Search*, *Advanced Search*, *About*, and *Data Removal*. *Data Removal* is the only page that is part of the `inputmodule.cgi` script; the other three pages are generated by different scripts. Clicking on the *Basic Search* or *Advanced search* links will take one to a basic search page. The back button will have to be used to get back to the menu because there is no link back on the page. The *About* page is an HTML file that links to the *Cornell Scientific American* website. The URL for the data input form is <https://users.wpi.edu/~sbullock/input/inputmodule.cgi>. To input data, simply type the information into the appropriate fields and click the “compile entry” button. This will check if there are any required fields that have been left blank. If all the data has been checked to be accurate, clicking the “submit” button will enter the information into the database. Incorrect information can be removed by going to the *Data Removal* page and typing the exact title of the entry along with selecting the year. Clicking the “submit” button will display the entry with the option for removal.

The third project group left suggestions for future improvements such as verifying the integrity of the entries after Volume I, modifying certain fields to fit character limitations and standardizing a list of keywords. The fields most likely to be affected by the 100 character limit are *article summary* and *image description*. The character limit is determined at the time that the database table is created, and cannot be changed later. The hundred-character limit could be circumvented by creating a new table within the same database whose character limits are higher and finding a way to automatically transfer all entries to the new table.

Determining a list of keywords would be an intensive process because with multiple indexers it is hard to create homogenous thinking. Unless the keywords were essentially a rehash

of the categories in the *subject* field or some similar set of categories, then there would be too many possibilities for a preset list to be feasible. However, it would be feasible to have a list of words, not coded into a drop-down menu, but simply presented to users who will be doing data entry. Those users would be advised to refer to the list of potential keywords and see if each word was applicable to the invention that was being indexed. If relevant the word would be entered into the Keywords section of the input module, along with any additional words that were decided upon.

## Current IQP Group

The goals set out by the previous IQP group were not met due to the technical aspects of the database being beyond the capacity of the current IQP group (2011-2012). In these early weeks of the project, database could not be accessed due to permissions issues. When prior group members could not be reached an alternate plan was made to create another database from the groups' limited knowledge MySQL and PHP, and the files left over from the earlier group efforts. Professor Bullock sent these files to a pair of Computer Science graduate students and received a set of instructions for using the files to create a new database. There were issues with modules that some Python scripts needed to run in order to work with MySQL and as soon as one issue was resolved, it seemed another issue with another module would appear. The graduate students were helpful when it came to finding and handling these files, but did not have the time to consult about more specific issues.

Due to permissions issues, we started creating a new database to store indexing information. The creation of the database was fairly straightforward: there were instructions on WPI's website for creating a MySQL database on their webspace. The.txt file, from a previous group, contained several hundred entries written out as text, with the information for different

columns separated by line breaks. A program was being written that would parse the .txt file into the individual components of each entry and create MySQL commands based on that information. After the graduate students were contacted, it was realized that *loadData.py*, a previously written file, did just that. After a few weeks, we were able to get in touch with one of the members of the third project group. He gave information that made creating a new database unnecessary. A closer inspection of some of the Python scripts gave us what was needed to view the database via MySQL Workbench. By this time, permission was granted to use the input module on the website and new data was being entered. At that time, we shifted our focus to other aspects of the project because we did not have the technical ability to update the database.

What future groups are left with are two Python CGI scripts that must somehow be combined. One script, *sciam.cgi*, contains the code for the website's home page, as well as the *about*, *history*, and *help* pages. The script begins by looking for certain keywords in the URL and based on what keywords it finds, it determines what to include from a list of blocks of HTML code. The keywords that appear in the URL are determined by which of the links on the page has been clicked. The other script, *cgireal.cgi*, contains the code that sends queries to the database, as well as the code for the *basic search*, *advanced search*, and *browse* pages. A solution for combining two scripts would be to alter *sciam.cgi* to make the *basic search* and *advanced search* links direct the browser to the corresponding pages in *cgireal.cgi*, instead of merely changing what HTML code from *sciam.cgi* is being displayed. A more ideal solution would be to write an entirely new CGI script that combines the functionality of both *sciam.cgi* and *cgireal.cgi*, but such a task is far beyond the ability of this project group. If these two scripts are combined, then the website's search functions will be useable by people outside the group.



## Indexing *Scientific American* Illustrations

The following table was taken from the third project group (2010-2011):

Column	Content
Title	The title of the image as it appears in <i>Scientific American</i> . If there is none, then the title of the accompanying article, or the indexer'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.
Patent Date	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 1	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 <i>Scientific American</i> , 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 of Images	In some entries, Listed as x of y. Shows how many related articles are present in the database. In other entries, shows the name of the set of images, where the Title column designates them "figure 1, figure 2, et

	cetera.”
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.

Indexing of illustrations is completed manually, with indexers following a set of procedures for cataloging engravings. Each section that is manually entered has a 100 character limit. The title is taken from the name of the article that details the engraving. The image description notes what type of view the engraving is—for example whether it is a perspective view or a cross-sectional view and any extra details. The article summary describes the purpose of the invention and how it is an improvement on other inventions of the time period. There is a section for listing an author of the article but so far no authors have been named because *Scientific American* did not give recognition to their writers. If the invention has been patented, the patent date is noted. Choosing the proper subjects is up to the indexer's discretion but due to the wide variety of topics it is a simple process. The indexer must also pick keywords based on the engraving and the invention. The indexer selects the year, month, and day of the issue as well as the volume, issue, and page number of the magazine. If there are others involved with the invention such as companies, it is noted in the people involved section. Lastly, the URL to the image of the page the invention is found on is listed.

Our project group’s main goal was to index up to the start of the new series of *Scientific American*. Further indexing would require adjustment to the database to include a new field to represent the new series. A simple adjustment to the indexing website could fix this issue by adding a new subject box that would specify if the illustration was from the new series.

Illustration data was entered from volume eleven to volume fourteen (1855 to 1859). Our group deviated from the previous group's guidelines. Series of images were entered at one time, in order to decrease confusion for someone searching the database fig x, y, z were described at the same time in the image description box. In the time period indexed by the current group, the illustrators were primarily the draughtsmen group Forbes & Bond and the engraver was Richard Ten Eyck. Subsequent groups are not likely to be viewing work by the same exact people; with the publication of the new series Munn & Co hired new engravers and illustrators.

The following image is from the January 1, 1859 issue of *Scientific American*:

# Scientific American

THE ADVOCATE OF INDUSTRY, AND JOURNAL OF SCIENTIFIC, MECHANICAL AND OTHER IMPROVEMENTS.

VOL. XIV. NEW YORK, JANUARY 1, 1859. NO. 17.

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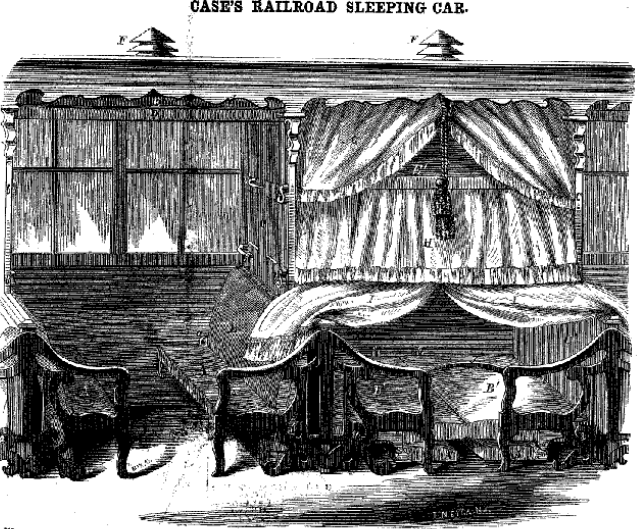
**THE SCIENTIFIC AMERICAN,**  
PUBLISHED WEEKLY  
At No. 129 Fulton street, (near Walling), New York.  
BY FRANK & CO.

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Responsible Agents may also be found in all the principal cities and towns of the United States.  
Single copies of the paper are on sale at the office of publication, and of all the principal stores in this city for the price of five cents.

To appear free, See & Co., the American Bookbinding, of London Hill, London, have, on the 15th inst., received the following subscription for the *Scientific American* for a year, viz:—  
FRANK & CO., Publishers, per annum—One Dollar in advance, and the remainder in six months.  
See the prospectus on last page. No traveling Agents employed.

## CASE'S RAILROAD SLEEPING CAR.



**Hardening Steel.**  
Steel possesses the property of becoming much harder by being highly heated, and then suddenly cooled, which process is called tempering. Different qualities of steel are not affected precisely alike by the same process: one requires a much higher heat than another, and the degree of hardness which is finally obtained depends both upon the temperature to which it is exposed, and the medium of the medium in which it is cooled. It requires considerable experience to become acquainted with the different qualities of steel, and the particular degree of heat to which each should be raised to give it the proper temper. The practical test is to draw a bar of steel belonging to a certain lot, or brand, to a tapered point, such as a chisel, and then temper it. The tapered part will then be variously affected according to its thickness, and by breaking off pieces from the point towards the diameter of the grain will show the effects of the difference of temperature which has been applied, the finest grain being considered the best.

As various cooling mediums produce different qualities of temper, cold water, oil baths, and cold soap suds are employed. Steel which is required to be very hard, such as files, are plunged into a salt brine, which is colder than pure water; most tools, however, are tempered in water. In tempering large masses of steel, such as anvils, rollers, or dies, they should be heated in a low oil or oil, and cold water applied so as to strike their whole surface evenly, and then flow off freely, which prevents them from cracking. Any degree of hardness may be imparted to steel by first tempering, then annealing it. The latter process consists in reheating the steel after it is polished, until it assumes a peculiar color, which is an index of its hardness. The gradations of these colors are light yellow or straw, violet, blue, and finally black, which latter is the softest, and about the same degree as that of the steel before it was hardened. Various tools would be too indelible, and devoid of spring, were they not annealed. Some are annealed by a temperature at which tallow or oil burns, hence their surfaces are rubbed over with oil, and then placed in a fire, when they become elastic.

A number of theories have been advanced respecting the change produced in the character of steel by tempering, but none of them are satisfactory. The metal undergoes no change in its composition by the process; its molecules only assume a different arrangement. In volume XII. of the *Scientific American*, a considerable amount of useful information was presented on the tempering of mill plates, but since that period several inquiries have been made for more general information on the subject.

We were much pleased the other day, while taking a trip by rail, to observe at the roadside stations, that, as an additional attraction to several Western roads, it was announced that "sleeping cars" accompanied each night train. This shows that their value and comfort are appreciated, and that they are gradually coming into general use. We have therefore no hesitation in presenting to our readers all the various inventions which have been produced to supply the railroad companies and the public with a convenient and comfortable sleeping car.

Our present illustration shows the invention of Sidney C. Case, of Detroit, Mich., with one compartment arranged for day, and the other for night use. In both of these compartments, the seats, A, are hinged to the side rails or arms, and stiles of the car, so that they can fold down as seen at A', B'. These folded down form berths for two. The divisions between the compartments, C, are provided with small seats or supports, D, so arranged that the supplemental berths, D, E, in the daytime placed in the top of the car or of the way, can be readily placed in their respective positions by turning them down, and can be supported in the grooves by small pins projecting from the ends of the supplemental berths. Each of these berths, D and E, hold one person, thus making a compartment hold as many persons lying down, as in a sitting position.

Ventilators, F, are placed in each compartment to keep up a proper circulation of air, so necessary when sleeping, throughout the car and berths.

Near the roof of the car the curtains, G, are attached, which completely conceal the occupants of the top berths, and this has certain advantages. If attached, that is, they manage conceal the occupant of the most single berth, while it has curtains, I, that pass over the hand rails or arms, and cover the occupants of the lower berths. To the bottom or underside of the top berth groove, supports are secured, in which the lower single berth can be stored, when they are placed out of the way in the top of the car, in which position the curtains fold in with them and are kept out of the way. There is room between the backs, B, and the division of the compartments, C', for the pillows, the bedding is placed under the seats, and an arm, J, extends across the arms, to afford a support for the curtains, I, when thrown over the occupants. The seats, A, are supported by pieces, K, in the arms and stiles, from which, however, they can be readily detached when a bed is to be formed. The change from a sitting to a sleeping car can be easily and quickly made by the passengers themselves, to accommodate either one, two, three, or four persons.

It was patented June 22, 1858, and any further particulars can be obtained by addressing the inventor of this, a most excellent arrangement, as above.

**Superheated Steam and Cylinder Jacket.**  
In the recent address of J. Macquorn Rankine, C. E., F. R. S., delivered before the Institution of Engineers in Scotland, we find some exceedingly practical and useful information on this subject. He states that in the working of expansive condensing steam engines, in order to obtain the economy properly due to expansion, means should be taken, by the use of steam jackets, or some other mode, to prevent that combination which always takes place in saturated steam, when its pressure work is performed by expansion, and is not supplied by heat from some external source. The water condensed in an expansive working cylinder cools the steam at the beginning of the stroke, lowers the initial pressure, and increases the vacuum so as to reduce the work of the engine below that which is properly due to expansion, and to make it approximately that of a full pressure engine working at some pressure intermediate below that of the exhaust. By the use of a steam jacket the condensation of a certain quantity of steam is not prevented, but instead of this being placed in the cylinder, it is effected in the jacket where the condensed water does no injury. Besides the proper management of the expansive working of steam there is another means of improving the economy of power in the cylinder of the engine, namely, by using steam heated to a temperature above the boiling point at which it was generated ("superheated steam"). The efficiency of any engine is as the difference between the temperatures at which the steam performs its work and that temperature at which the steam is condensed. The use of "superheated steam" enables work to be performed at a high temperature without producing a dangerous pressure.

**Sugar in Louisiana.**

The New Orleans (La.) Daily says—Sugar is twenty thousand bagsheads and molasses nearly thousand barrels ahead of last year. We do not think it extravagant to say that the aggregate value of the receipts of the products of the valley of the Mississippi at this port, up to the present period, is double that for the same period last year.

Figure 1: Front page article from *Scientific American* from the Cornell's Making of America Website

<b>Example of an Indexed Entry</b>	
<b>Column</b>	<b>Content</b>
<b>Title</b>	Case's Railroad Sleeping Car
<b>Image Description</b>	Perspective view of train benches that can be turned into a bed.
<b>Artist</b>	Engraver Richard Ten Eyck, Draughtsman Byron Mix
<b>Article Summary</b>	Improvement to sleeping cars which allow an easy change from day to night.
<b>Inventor</b>	Sidney C. Case
<b>Author</b>	This would be left empty because there is no author listed.
<b>Patent Date</b>	June 22, 1858
<b>Subject 1</b>	Land Conveyance.
<b>Keywords</b>	Train, Car, Sleeper, Case, Railroad, Sleeping car
<b>Date</b>	January 22, 1859
<b>Volume</b>	14
<b>Issue</b>	17
<b>Page</b>	133

## **Illustrating Inventions at *Scientific American***

Little research has been done into the process of the journal's mechanical engravings, from submission of the invention plans to publication in *Scientific American* and republication in other media like catalogs. This paper includes the general history, patent procedure, and engraving process of *Scientific American*. What makes this work different from previous groups is that instead of research into the history of a machine that was commonly featured in the magazine, it uncovers new information about the early illustrators at *Scientific American* and reveals how they were phased out by cheaper and more efficient methods of engraving. The magazine in its earliest years used skilled technical illustrators in order to present the mechanics behind the inventions using traditional wood-engraving methods. Later, the magazine moved to more efficient methods of engraving.

The *Scientific American* was first published in 1845 by Rufus M. Porter and was purchased in 1846 by Munn & Co to represent their patent agency as well as showcase new inventions. *Scientific American* separated itself from the other illustrated magazines of the period by specializing in mechanical engravings. Every inventor who used Munn & Co. as their patent agency had the option to publish their invention in the journal. An editor's response to a letter sent to the *Scientific American*, by an inventor praising the value of having an invention published in the magazine, details the benefits of this opportunity:

We have often mentioned the importance of this mode of introducing inventions and we again repeat it, hoping that many inventors will profit thereby. The large circulation of the *Scientific American* makes it a most valuable medium for giving publicity to

inventions and there is nothing which so quickly calls attention as an engraving. Those who have rights or machines to dispose of should by all means avail themselves of this mode of making it publicly known. The cost of an engraving is trifling.<sup>1</sup>

Publication in the *Scientific American* helped inventors gain investors to start the progression to manufacturing and marketing their invention. Historian Richard M. Candee examined the Aikens family business in his paper “Illustrating invention: Nineteenth-century machine advertising for the Aikens of Franklin, New Hampshire,” which went into depth about the family’s commissions of engravings by the *Scientific American*, from the viewpoint of an inventor. Although he touched on the inner workings of Munn & Co.’s office, stressing its facilitation of mechanical industry, he did not explore *Scientific American* itself.



PATENT DEPARTMENT OF MUNN & COMPANY, 1848.  
From a contemporary print.

Figure 2: Patent Department of Munn & Company from the 50th Anniversary Issue of *Scientific American*.

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<sup>1</sup> “For Inventors to Read,” *Scientific American*, November 4, 1848, accessed on January 4, 2012, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia0004-7>.



**SIXTEENTH YEAR.**

The most Popular Journal in the world—Devoted to SCIENCE, INVENTION, MANUFACTURES, MECHANICS, PATENTS, and to INDUSTRIAL ART generally.  
A New Volume commences July 1st, 1860. The numbers for one year comprise 523 pages of reading matter, and several hundred original engravings.

In announcing the above fact, the publishers embrace the opportunity to thank their old patrons and subscribers for the very liberal support they have hitherto extended to this journal; placing it, as they have, far beyond that of any other publication of the kind in the world, in point of circulation. The average circulation of the *Scientific American* during the past year has been—

**30,000 Copies per Week!**

Some editions have reached as high as 60,000; some less than 25,000. The extent of the circulation evinces the popularity of the paper; and with our readers soon satisfied with the quantity and quality of matter they get in one year's numbers, (comprising 523 pages and costing only \$2.) the publishers are determined to still improve the paper during the coming year.

The *Scientific American* has the reputation, at home and abroad, of being the best weekly publication devoted to mechanical and industrial pursuits now published, and the publishers are determined if labor and enterprise will do it) to keep up the reputation they have earned during the former years they have been concerned with its publication.

**To the Inventor:**

The *Scientific American* is indispensable to every inventor, as it not only contains illustrated descriptions of nearly all the best inventions as they come out, but each number contains an official list of the claims of all the patents issued from the United States Patent Office during the week previous; thus giving a correct history of the progress of inventions in this country. We are also receiving, every week, the best scientific journals of Great Britain, France, and Germany; thus placing in our possession all that is transpiring in mechanical science and art in these old countries. We shall continue to transfer to our columns, copious extracts from these journals, of whatever we may deem of interest to our readers.

**To the Mechanic and Machinist!**

No person engaged in any of the mechanical pursuits should think of "doing without" the *Scientific American*. It costs but five cents per week; every number contains from six to ten engravings of new machines and inventions which cannot be found in any other publication. It is an established rule of the publishers to insert none but original engravings, and those of the first-class in the art, drawn and engraved by experienced persons under their own supervision.

**To the Chemist and Architect!**

Chemists and architects will find the *Scientific American* a useful journal to them. All the new discoveries in the science of chemistry are circulated in its columns, and the interests of the architect and carpenter are not overlooked; but all the new inventions and discoveries appertaining to these pursuits are published from week to week.

**To the Millwright and Mill-Owner!**

Useful and practical information appertaining to the interests of millwrights and mill-owners will be found published in the *Scientific American*, which information they cannot possibly obtain from any other source. To this class the paper is specially recommended.

**To the Planter and Farmer!**

Subjects in which planters and farmers are interested will be found discussed in the *Scientific American*; most of the improvements in agricultural implements being illustrated in its columns.

**To the Man-of-Letsure and the Man-of-Science!**

Individuals of both these classes cannot fail to be interested in the *Scientific American*, which contains the latest intelligence on all subjects appertaining to the arts and sciences, both practical and theoretical; all the latest discoveries and phenomena which come to our knowledge being early recorded therein.

The *Scientific American* is published weekly, and furnished to subscribers at the following rates:

**Terms of Subscription—Two Dollars a year, or One Dollar for Six Months.**

**CLUB RATES:**

Five Copies, for Six Months, ..... \$4.00—Ten Copies, for Six Months, ..... \$8.00—Ten Copies, for Twelve Months, ..... \$15.00  
Fifteen Copies, for Twelve Months, ..... \$22.50—Twenty Copies, for Twelve Months, ..... \$28.00.

Senders, Western, and Canadian Money or Post-Office Receipts taken at par for subscriptions. Circulars sent free of charge to each party subscribed, in proper season.  
For all Clubs of twenty and over, the yearly subscription is only \$1.25. Names can be sent in as different times and from different Post-Offices. Specimen copies will be sent gratis in any part of the country.

ADDRESS,

**MUNN & CO., Publishers and Patent Agents,**

A pamphlet of advice about procuring Patents, sent gratis, on application as above.

**No. 37 PARK ROW, NEW YORK.**

MESSRS. MUNN & CO., 37 Park Row, New York,

For the enclosed dollars please send the *SCIENTIFIC AMERICAN* to \_\_\_\_\_ Name,  
 \_\_\_\_\_ Town,  
 \_\_\_\_\_ County,  
 \_\_\_\_\_ State.

Figure 3: Prospectus for the 1860 Volume of *Scientific American*.



## Short History of *Scientific American* and Munn & Co. Patent Agency

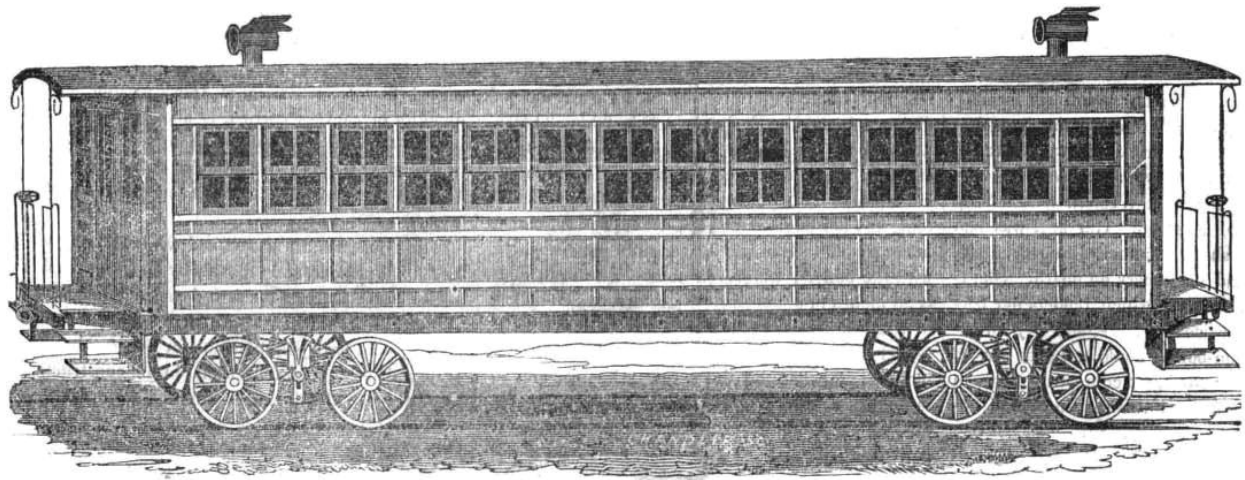


Figure 4: The first engraving in *Scientific American*.

*Scientific American* was the first magazine devoted to “mechanics and manufactures” in the United States.<sup>2</sup> Rufus Porter originally wanted to make a magazine that covered the contemporary scientific world and he expanded the journal by adding in poetry, jokes and editorial essays. Engravings from the first issue were later described in the 50<sup>th</sup> anniversary of *Scientific American* as “crude and simple,” not requiring a skilled engraver, but a good selling point for the magazine.<sup>3</sup> In July 1846, Munn & Company purchased the magazine from Porter for eight hundred dollars and in 1847 Munn & Company purchased the *Mechanics’ Journal* and hired its editor Joel Munsell as editor of *Scientific American*.<sup>4</sup> With each magazine purchase the patent agency retained their subscribers’ list, further enlarging the readership of *Scientific American*. The change in ownership caused *Scientific American* to become more serious; to try and differentiate themselves from what contemporary magazines offered Munn & Co. shifted the focus to scientific discoveries and new inventions rather than light entertainment. This is noted

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<sup>2</sup> Rufus Porter, “*Scientific American*,” *Scientific American*, August 28, 1845, accessed on December 17, 2011, [http://www.history.rochester.edu/scientific\\_american/vol1/vol1n001/n1.htm](http://www.history.rochester.edu/scientific_american/vol1/vol1n001/n1.htm).

<sup>3</sup> “Fifty Years of the *Scientific American*,” *Scientific American*, July, 25, 1896, accessed on January 3, 2012, <http://books.google.com/books?id=XYI9AQAIAAJ&dq=%E2%80%9CFifty%20Years%20%20Scientific%20American%22&pg=PA91#v=onepage&q&f=false>.

<sup>4</sup> “Fifty Years of the *Scientific American*,” 91.

by less irrelevant material appearing in issues published after Munn & Co.'s acquisition of the magazine. The change to more focused content helped cement the journal as an influence for fledgling inventors. In the first year of publication the circulation of *Scientific American* was only three hundred subscribers.<sup>5</sup> By the fourteenth volume (1858-1859), the magazine was sending out an average of thirty thousand copies each week, sometimes as high as 60,000.<sup>6</sup> By 1875 the magazine had more than fifty thousand subscribers.<sup>7</sup> The magazine also helped Munn & Co.'s patent agency; by 1861, Munn & Co. patented over a third of all inventions filed in the United States.<sup>8</sup> The patent agency used *Scientific American's* popularity to advertise them.

The overhaul of the magazine's structure created a business-minded reputation for the magazine and helped connect the readers to the company. The front page of the magazine was used to showcase new inventions; these inventions would get the biggest engravings as well as have the largest articles. The emphasis on inventions required Munn & Company to hire mechanically skilled engravers and draughtsman in order to produce cuts that accurately represented the mechanics behind each invention. To keep readers updated with new technology each issue of *Scientific American* had a new patent section, which included all the patent claims, including a short description and name of the inventor, that were issued from the United States Patent Office for each week regardless of which company they were filed from. The patent claim page was usually followed by the correspondent's page; this section was the most efficient way the editors could interact directly with their subscribers. By using the anonymity of the subscribers initials the editors could respond to questions, patent updates, and how much money

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<sup>5</sup> "The *Scientific American* then and now," *Centennial Newspaper Exhibition 1876*. (New York: Geo. P. Rowell & Co., 1876) 223.

<sup>6</sup> Munn & Co., "Prospectus 25 June 1860," American Antiquarian Society, Worcester, M.A.

<sup>7</sup> "The *Scientific American* then and now," *Centennial Newspaper Exhibition 1876*. (New York: Geo. P. Rowell & Co., 1876) 223.

<sup>8</sup> *Hints to Inventors*. (New York : Munn & Co, 1861) 5.

was received or owed. The correspondent page also included advertisements that were submitted for a set price. Advertisements were aimed at inventors by manufacturers and marketers. The focus on inventions promoted *Scientific American* as a very technically advanced magazine that influenced inventors of the time period.

*Scientific American*, however, was not exclusively a magazine for patented inventions. It dedicated almost equal weight to scientific and engineering advancements. Munn & Co. had to hire scientifically knowledgeable editors. In a typical letter to the editor's column, the answers focused on engineering and scientific or patent-related questions. The easy access subscribers had to the answers for any question was important to the development of new technology and machinery of the time. This helped people who had limited means for education to apply new ideas to inventions. Without that access it would probably have taken longer for an inventor to find information, if at all. The prospectus for the *Scientific American* elaborates on the purpose of the journal further:

It is an illustrated periodical, devoted to the promulgation of information relating to the various mechanical and chemical arts, manufacturers, agriculture, patents, inventions, engineering, mill work, and all interests which the light of practical science is calculated to advance. All the most patented discoveries are delineated and described in its issues, so that, as respects inventions, it may be justly regarded as an *Illustrated repertory*, where the inventor may learn what has been done before him in the same field which he is exploring, and where he may publish to the world a knowledge of his own achievement. . . . Mechanics, inventors, engineers, chemists, manufacturers, agriculturists, and people in every profession of life, will find the *Scientific American* to be of great value in their respective callings. Its counsels and suggestions will save them hundreds of dollars

annually, besides affording them a continual source of knowledge, the value of which is beyond pecuniary estimates.<sup>9</sup>

With information easily accessible *Scientific American* affected readers regardless of their academic background and profession by providing them with practical information.

### How to get an engraving in *Scientific American*

Munn & Co. offered many services to their customers besides patenting inventions. Upon obtaining a patent through Munn & Co. the inventor was given the option of having an engraving produced for a small price which would be published in *Scientific American* with an accompanying article, free of charge, which served as an advertisement for the device. This was considered “the best mode of introducing inventions” because the featured article would be seen by all of the subscribers of the magazine.<sup>10</sup> By being featured in the magazine the inventor was more likely to find an investor to fund his invention than if he tried other means to promote himself.



Figure 5: A model room at Munn & Co.

<sup>9</sup> “Prospectus of the *Scientific American*,” *Scientific American*, March 19, 1859, accessed on December 31, 2011, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia0014-28>.

<sup>10</sup> *Hints to Inventors*, 27.

The first step to acquiring an engraving featured in *Scientific American* was to file a patent with Munn & Co. To obtain a patent the inventor would send in the necessary patent paperwork and fee to Munn & Co.'s New York City office, which would then forward the material to their Washington D. C. office, which dealt with the United State Patent and Trademark Office directly. The applicant was required to send in a model of the invention as well as multiple drawings: "The model must not exceed twelve inches in any of its dimensions; it should be neatly made, of hard wood or metal, or other substantial material."<sup>11</sup> The model was also described to be, "made as small as convenient, representing the construction and operation of the improvement."<sup>12</sup> According to the patent guide book Munn and & Co. published, *Hints to Inventors*, if a person was not able to produce a model on their own they could commission Munn & Co. to create one, "In such cases, we [ Munn & Co.] can have proper models built by experienced and trusty makers, at moderate charges."<sup>13</sup> The agency temporarily stored models for the patenting or publication process and it is unknown if the models were returned to the owner.

*Scientific American* offered inventors the option of having an engraving made of their invention that would be featured in the journal for a price. Editors, in 1861 when Munn & Co. was a well-established patent agency, detailed the benefits of having an engraving published in the journal.

Inventors and constructors of new and useful contrivances or machines, of whatever kind, can have their inventions illustrated and described in the columns of the *Scientific American* on payment of a reasonable charge for the engraving. No charge is made for the publication,

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<sup>11</sup> *Hints to Inventors*, 11.

<sup>12</sup> "Correspondents," *Scientific American*, May 13, 1848, accessed on January 3, 2012, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia0003-28>.

<sup>13</sup> *Hints to Inventors*, 35.

and the cuts are furnished to the party for whom they are executed as soon as they have been used.<sup>14</sup>

An inventor could commission an engraving to be made if they used Munn & Co.'s patent agency. In response to "D.B.T. of O.," an inventor requesting an engraving, the *Scientific American* editorial staff stated, "If you will send us your Letters Patent we will inform you at once the cost of getting an engraving to illustrate your invention. A model we should prefer, however, to make the sketches from, if you have one."<sup>15</sup> The cost for the engraving is based on the model and drawings, not a set price because each invention required different degrees of detail. Munn & Co. preferred that the engraving would be done by the company's in-house engravers as opposed to freelance engravers in order to ensure quality. This was different than Porter's tenure of the magazine where engravings were used more for artistic ability and not functionality of technology. The quality of the engravings increased significantly under Munn & Co.'s ownership because of the emphasis of the visual component of presenting an invention. In *Hints to Inventors*, Munn & Co. stressed that, "We wish it understood, however, that no second-hand or poor engravings, such as patentees often get executed by inexperienced artists for printing circulars and handbills from, can be admitted into these pages."<sup>16</sup> The quality of engraving was important to *Scientific American* because the illustration played a big part in showcasing the invention.

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<sup>14</sup> *Hints to Inventors*, 27.

<sup>15</sup> "The Correspondents Page," *Scientific American*, November 23, 1856, accessed January 4, 2012, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia0012-11>.

<sup>16</sup> *Hints to Inventors*, 27.



Figure 6: Ten Eyck engraving featured in a sewing machine catalog.

Once the inventor's paperwork and money was received, the draughtsman would begin sketching the invention. The inventor would then receive a rough draft drawn by an engraver, drawn directly onto wood, of the potential engraving. This would be done delicately in pencil in order for it to be easily altered to make any changes suggested by the inventor. The customer would then look over the piece and send it back with any corrections, written on a separate sheet of paper to protect the drawing.<sup>17</sup> Once the rough drawing was received and all changes were made, the engraver would then begin cutting the final print. The completed engraving would be

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<sup>17</sup> Richard M. Candee "Illustrating invention: Nineteenth-century machine advertising for the Aikens of Franklin, New Hampshire," *Printing History* 20(1996) 14.

set into an issue of *Scientific American* accompanied by a large article about how the inventions worked an article that also would include the inventors name, contact information, patent date, and cost, if the invention was ready to be manufactured and sold. After the issue was published the inventor would receive the final plate for their own use. If the invention was put into production, the cut was likely to be used again in trade catalogs. The illustration above (figure 6) is a Richard Ten Eyck engraving that was reused as an advertisement for a sewing machine. An example is shown in the book *History of the Sewing Machine*.<sup>18</sup> Inventors would often write back to the *Scientific American* about the benefits they obtained from being featured in the magazine.

### How to make an engraving

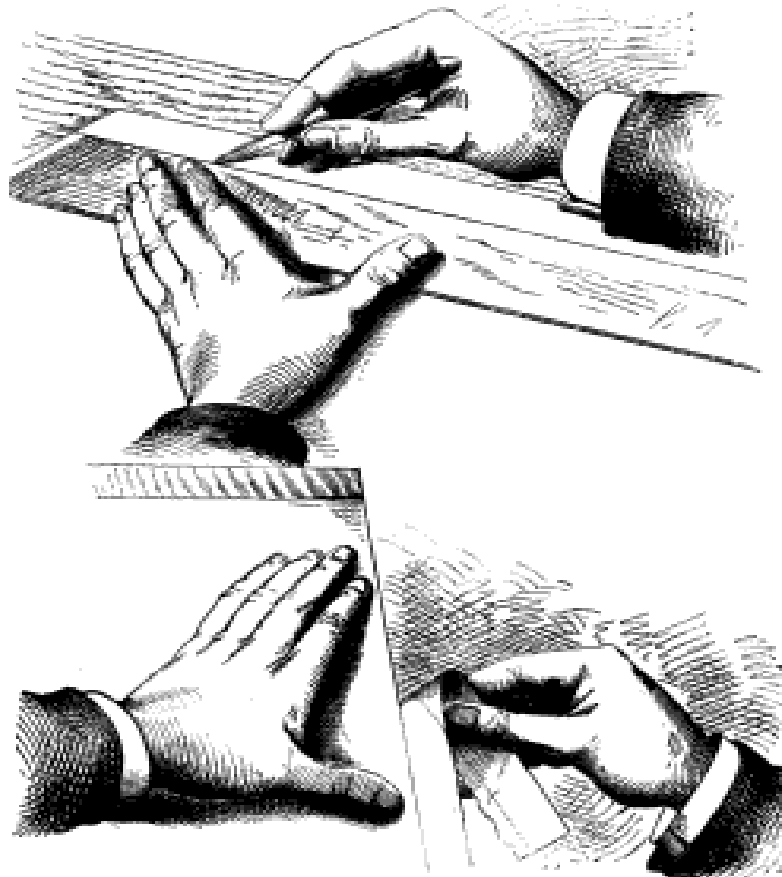


Figure 7: A draughtsman preparing the Drawing Paper.

<sup>18</sup> James Parton, *History of the Sewing Machine*, (Lancaster: House of Bindery, 1868) 2.



The procedure for creating an engraving started with a detailed description and model of the invention. A draughtsman began creating the drawing of the mechanical invention by first preparing his paper for sketching. The sides of the paper were torn so it fit on the drawing board (figure 7).<sup>19</sup> The draughtsman then wetted the paper and stretched it over a wooden board so it would be taut when dried. Some draughtsmen used glue to stick the paper to the board, but they had to be quick or the glue would dry before the paper could adhere to the board.<sup>20</sup> The draughtsman carefully smoothed out any wrinkles in the damp paper and kept the paper and board spotlessly clean. He would have to sketch on the paper as soon as it was dry; if not, the paper would contract causing it to tear or strain the board.<sup>21</sup> The artist used lead pencils for sketching and then completed the outlines with brushes or camel's hair pencil filled with sepia or Indian ink.<sup>22</sup> Sometimes a device with straight-edges would be used, which when placed perpendicular to the board, allowed straight lines to be drawn with ease.<sup>23</sup> They would have to be done very lightly because the block would be sent to the inventor in order for it to be reviewed.<sup>24</sup> Due to the complex nature of many inventions, it was difficult for the average artist to sketch the inventions correctly. Draughtsmen had to be mechanically minded and fully understand how the invention worked to adequately put it on paper.<sup>25</sup> Once a draughtsman's drawing was complete it was up to the engraver to finalize his work.

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<sup>19</sup> "Lessons in Mechanical Drawing," *Scientific American Supplement*, July-December, 1876, accessed January 18, 2012, [http://books.google.com/books?id=bO48AQAIAAJ&pg=PA823&img=1&zoom=3&hl=en&sig=ACfU3U3yP6VpKVttDcT2uc042I\\_tdj-x-A&ci=31%2C55%2C909%2C1400&edge=0](http://books.google.com/books?id=bO48AQAIAAJ&pg=PA823&img=1&zoom=3&hl=en&sig=ACfU3U3yP6VpKVttDcT2uc042I_tdj-x-A&ci=31%2C55%2C909%2C1400&edge=0).

<sup>20</sup> Ibid.

<sup>21</sup> Ibid.

<sup>22</sup> "Wood Engravings—How They are Made," *The Sydney Morning Herald*, May 26, 1868, accessed January 27, 2012, <http://trove.nla.gov.au/ndp/del/article/13166750>.

<sup>23</sup> "Lessons in Mechanical Drawing."

<sup>24</sup> "Illustrating invention: Nineteenth-century machine advertising for the Aikens of Franklin, New Hampshire," *Printing History* 20(1996).

<sup>25</sup> "Lessons in Mechanical Drawing."

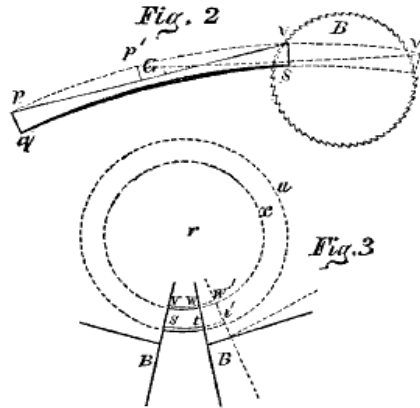


Figure 8: A sectional view of an invention.

Engravers had the arduous task of using their own artistic judgment to bring the draughtsman’s sketch to life in the engraving. Engravers transferred the draughtsman’s sketch to the wood with the use of transparent paper. Most of the engraving was done by hand, but for the less detailed sectional views of inventions, a device called a ruling machine was used for the more geometric shapes (figure 8).<sup>26</sup> The engraver pressed the sketch against the wood by hand and engraved around the stamped outlines. While various types of wood worked well for engraving, boxwood was the best for all types of engravings. *Scientific American* used blocks of boxwood that were twenty-nine thirtieths of an inch thick and typically contained three to eight different engravings, though they could have as many as ten. The width and height of the engraving were important because it had to be the same dimensions as the typeface in order to print properly. The boxwood had to be kept away from moisture and exposure to sunlight, lest the wood soften or crack, which would make it difficult to engrave. Since boxwood is very soft, wood engravings would not last as long as engravings made out of metal. The pressman, the person who pressed the engravings onto the magazine paper, would spend hours adjusting the

<sup>26</sup> “Hutchinson’s Stave Jointer,” *Scientific American*, October 21, 1854, accessed January 1, 2012, <http://ebooks.library.cornell.edu/cache/s/c/i/scia0010-6/00045.tif200.gif>.

printing press to make sure the engravings printed perfectly.<sup>27</sup> Over time wood engravings were replaced by metal lithography in *Scientific American* which gave the engravings a longer life time and decreased labor costs.

### The Illustrators of *Scientific American*

Recognition was not widely given to magazine writers and engravers in the nineteenth century. Not much has been known about the employees and contractors of the *Scientific American*. The *Scientific American* bragged in 1853 about their “five to six hundred original engravings” annually, noting that they had engravers on their staff.<sup>28</sup> Address books from the late 1850s listed over a hundred engravers living in New York City at that time. Most engravers worked within an easy distance of the building, although only two operated at the same address as Munn & Co.



Figure 9: Richard Ten Eyck's business card.

<sup>27</sup> “Wood Engravings—How They are Made.”

<sup>28</sup> “Manufacturers and Inventors,” *Scientific American*, January 1, 1853, accessed on January 2, 2012, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia0008-16>.

The easiest way to identify an engraver was if he or she chose to sign their cut. Until 1859 the only identified engraver hired by the *Scientific American* was Richard Ten Eyck Jr. Ten Eyck started as an engraver at *Scientific American* in 1850.<sup>29</sup> In advertisements he described himself as the “Engraver of the *Scientific American*,” but he was probably contracted in to prepare the more detailed front page illustrations. Not enough information is known to suggest if either *Scientific American* or Ten Eyck hired draughtsmen to design the drawings of the inventions found in the magazine. His business card stated that he was a mechanical engraver who specialized on wood cuts; although he also made engravings of landscapes.<sup>30</sup> According to address books published at the time Ten Eyck listed his work place in the same building as the Munn & Co. publishing and patent company, 128 Fulton St also known as the Sun Building.<sup>31</sup> When these offices became too small and Munn & Co. moved from the Sun building to 37 Park Row in 1859, Ten Eyck remained.<sup>32</sup> This may suggest that Ten Eyck had offices separate from Munn & Co. After the journal was restarted from volume one in 1859, Munn & Co. hired Byron Mix who also worked at the same address as Ten Eyck.<sup>33</sup> Even though they would be featured in the same issue there is not enough information that Ten Eyck and Mix were business partners.

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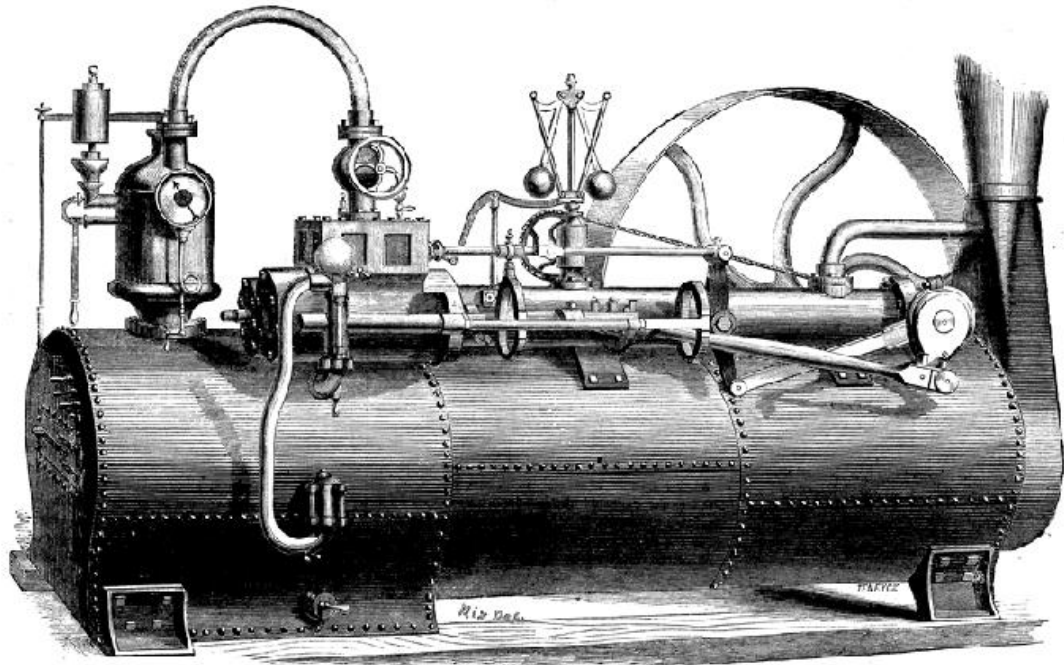
<sup>29</sup> “Wood Engravings,” *Scientific American*, October 21, 1865, accessed January 3, 2012, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia1013-17>.

<sup>30</sup> James McCabe, *Illustrated History of the Centennial Exhibition* (Philadelphia: National Publishing Co, 1876), 174.

<sup>31</sup> H. Wilson, *Trow's New York City Directory 1856-7* (New York: John F. Trow, 1857), 602, 810.

<sup>32</sup> “Fifty Years of the *Scientific American*.”

<sup>33</sup> H. Wilson, *Trow's New York City Directory* (New York: John F. Trow, 1859).



THE BLANDY IMPROVED STATIONARY STEAM ENGINE.

Figure 10: An engraving sketched by Mix and engraved by Ten Eyck in 1860.



A BRIDGE IN THE SCOTTISH HIGHLANDS.

Figure 11: An example of a Richard Ten Eyck landscape engraving.

Ten Eyck has been recognized by contemporary journals for his work at *Scientific American*. In the *Inland Printer*, in 1889, Ten Eyck was recognized for his contribution to wood engraving.

Wood engraving has made rapid strides the last fifteen or twenty years, and the American nation deserves the credit for pushing it forward with its capital and enterprise. The *Scientific American* stimulated wood engravers ( mechanical) to do better work by its illustrations made by Ten Eyck, fifteen years ago; take up a copy of the same paper today, and you will not find any better work in it. <sup>35</sup>

Many people attributed the success of *Scientific American* to Richard Ten Eyck. His engravings were an important selling point for the magazine and his skill in mechanical engraving made him stand apart from other newspaper illustrators at the time. In a review for a trade catalog for *Punching and Shearing Machinery*, the reviewer notes the skill of Richard Ten Eyck; “The engravings in this book are the very best kind of woodcuts most of them made by Ten Eyck of New York who is a veteran and a master in this kind of art.”<sup>36</sup> Ten Eyck was not just an engraver, he was also an inventor; he owned patent No. 28022 *Improved Machine for Enameling Molding* which was listed in the new patents page in *Scientific American* on May 5, 1860. <sup>37</sup> Ten Eyck’s recognition as an expert engraver helped influence inventors to turn towards *Scientific American* as a launch pad for their invention.

Forbes & Bond were a mechanical draughtsman team whose work was often featured with Richard Ten Eyck in the 1850s. Elisha Forbes and Robert Bond were probably contracted for Ten Eyck to draw the inventions for him to cut, because their names were only included on engravings that Ten Eyck had made. They also had different work addresses than Ten Eyck and

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<sup>35</sup> Thomas W. Elliott, “Wood Versus Photo-Engraving,” *The Inland Printer*, July 1889.

<sup>36</sup> “Trade Catalogues,” *The American Engineer and Railroad Journal*, November 14, 1895, 537-538.

<sup>37</sup> Ten Eyck, Richard. *Improved Machine for Enameling Mouldings*. US Patent 28,022, issued April 24, 1860.

Munn & Co.<sup>38</sup> Advertisements found in *Scientific American* specified them as “mechanical & general draughtsmen.”<sup>39</sup> They separated as business partners in the late 1850s and were not found working together in directories after 1857.<sup>40</sup> Articles published in *Scientific American* after 1860 directly stated that Louis Seitz and Henry E. Mead were used as draughtsmen for Ten Eyck in the 1860s.<sup>41</sup> Another article specifically identified F. Louis Seitz as *Scientific American*’s “principal artist” for Richard Ten Eyck.<sup>42</sup> These draughtsmen have an important role in the engraving process, but get less recognition for their efforts.

## The Future of Munn & Co. Engraving

L. SMITH HOBART,  
President.

J. C. MOSS,  
Superintendent.

D. I. CARSON,  
General Agent.

**NEW METHOD OF ENGRAVING**  
Moss Process.

**Photo Engraving Co.**  
62 Courtlandt St. New York.

THE PHOTO-ENGRAVING COMPANY was incorporated May, 1872, and, by a patient and steady persistence in spite of obstacles, has established a business which is permanent and successful.

Our Relief Plates are now used satisfactorily by the principal publishers and manufacturers in every State in the Union over 50,000 of them having been made and distributed in the past three years. They are produced photographically by a secret method invented by our Superintendent, known as the “MOSS PROCESS,” which differs essentially from all other processes for making Relief Plates, has been demonstrated to be vastly superior to them all and is owned and operated solely by the PHOTO-ENGRAVING CO.

Our plates are adapted to all sorts of illustrations for books, newspapers and catalogues, as an excellent substitute for wood cuts, costing much less and being prepared more quickly.

They are in hard type-metal, not “biten” or “etched,” and should not be confounded with etchings in zinc, or other metal. They are mounted on blocks type high, ready for use on any type-printing press, require no more “making ready” than any other “cuts,” and will wear as long as any stereotype plates. Electrotypes or stereotypes may be made from them in the usual way.

THE AMERICAN TRACT SOCIETY, MESSRS. D. Appleton & Co., A. D. F. Randolph & Co., Scribner & Co., and other prominent publishing houses are among our regular customers, and our plates may be found constantly in the ILLUSTRATED CHRISTIAN WEEKLY, *Scientific American*, etc.

Send stamp for our illustrated Circular containing full information. Please say where you saw this.

**PHOTO-ENGRAVING CO., 62 Courtlandt St., New-York**

Figure 12: Advertisement for Moss Photo Engraving Company.

<sup>38</sup> H. Wilson, *Trow’s New York City Directory 1856-7*.

<sup>39</sup> “Advertisement,” *Scientific American*, January 31, 1857, accessed January 21, 2012, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia0012-21>.

<sup>40</sup> H. Wilson, *Trow’s New York City Directory* (New York: John F. Trow, 1859).

<sup>41</sup> “Mechanical Skill Not Always Artistical Taste,” *Scientific American*, September 23, 1868, accessed January 17, 2012, <http://digital.library.cornell.edu/cgi/t/text/text-idx?c=scia;idno=scia1019-13>.

<sup>42</sup> “Wood Engravings-How they are made.”

In the 1870s, *Scientific American* began transitioning from wood to photoengraving on metal using the Moss method. John C. Moss began experimenting with different methods of replicating drawings by the process of photoengraving in 1858, but it was not until ten years later that he was able to market his method.<sup>43</sup> Moss hired his own relatives and appointed them as executives in Moss Engraving Company. His wife was treasurer of the company and she helped develop his photoengraving process.<sup>44</sup> Once the process was completed, Moss hired workmen and skilled artists and bought the machinery required for printing and photoengraving. The flexibility of photoengraving meant more complex images could be printed and fewer artists were needed. Any hand-drawn image or photograph, or steel, wood, or lithographic engraving, could be reproduced on a relief plate.<sup>45</sup> In place of a draughtsman a photograph, taken on arrowroot paper twice the size of a steel plate, was used. An artist outlined the photograph with a pen filled with Indian ink. The photograph was then covered with chemicals that bleached away the photographic color but kept the Indian ink.<sup>46</sup> The outlined paper could then be used as an imprint for creating engravings; from wood by hand or via chemical lithography on metal.

Moss' photo-engraving process was a well-kept secret; although there were many attempts to try and figure it out, none were successful.<sup>47</sup> Moss was probably influenced by previous attempts at photo-engraving. In prior methods, a photograph was taken and either ink

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<sup>43</sup> "Photo-Engraving," *Scientific American*, September 18, 1875, accessed January 10, 2012, <http://books.google.com/books?id=zoY9AQAIAAJ&pg=PA178&img=1&zoom=3&hl=en&sig=ACfU3U3MRNsH0qQIPnrOMPpykot5hEwF1zw&ci=77%2C31%2C858%2C1381&edge=0>.

<sup>44</sup> "The Moss Engraving Company," *The New York Times*, January 1, 1886, accessed January 5, 2012, <http://search.proquest.com/hnpnewyorktimes/docview/94340756/1352732968E10CA7A6E/3?accountid=29120>.

<sup>45</sup> "Photo-Engraving."

<sup>46</sup> Benson John Lossing, *History of New York City* (New York: The Perine Engraving and Publishing Co., 1884), accessed January 18, 2012, [http://books.google.com/books?id=HEFbb8uI\\_cEC&pg=PA845&img=1&zoom=3&hl=en&sig=ACfU3U2hHfLs8LE-Gh009ur7qLuxy65rnA&ci=147%2C99%2C695%2C1185&edge=0](http://books.google.com/books?id=HEFbb8uI_cEC&pg=PA845&img=1&zoom=3&hl=en&sig=ACfU3U2hHfLs8LE-Gh009ur7qLuxy65rnA&ci=147%2C99%2C695%2C1185&edge=0).

<sup>47</sup> *Johnson's Universal Cyclopaedia*, ed. Charles Kendall Adams, LL. D. (New York: A.J. Johnson Company, 1895), s.v. "Photo-Engraving," accessed January 12, 2012, [http://books.google.com/books?id=VsEXAQAIAAJ&pg=PA589&img=1&zoom=3&hl=en&sig=ACfU3U0fP\\_Du3ShNKeSYOV7XVym6SA\\_bww&ci=86%2C96%2C410%2C743&edge=0](http://books.google.com/books?id=VsEXAQAIAAJ&pg=PA589&img=1&zoom=3&hl=en&sig=ACfU3U0fP_Du3ShNKeSYOV7XVym6SA_bww&ci=86%2C96%2C410%2C743&edge=0).



from the photo was pressed against a steel plate or the photograph was taken on a steel plate was coated in special chemicals. An acid was then spread over the plate, which dissolved away the surface except for the lines of the photograph; the result was called a relief plate.<sup>48</sup> This process was much quicker and cheaper than the traditional method of using draughtsmen and engravers. The Moss engraving method produced more than fifty thousand steel relief plates by 1875. In total, the company produced millions of engravings. The lower costs and quicker output were ideal for mass-produced magazines and newspapers. Photoengraving replaced hand-carved engravings in the *Scientific American* sometime in the 1870s since the method was more efficient. The company boasted that, with the Moss engraving, “two hundred photoengravers could do the same work as two thousand wood engravers.”<sup>49</sup> The shift from traditional engraving meant that wood engraving was no longer needed; however, this change exemplified the developing technology that *Scientific American* encouraged.

## Conclusion

The engravings at *Scientific American* started out rough and simple, but during Munn & Co.’s ownership the illustrations became more sophisticated and detailed as well as more aesthetically pleasing. The hiring of specialized engravers and draughtsmen helped market the magazine as the paper to read for new inventions and scientific progress. To keep up with technological advances *Scientific American* eventually turned to new methods for their illustrations. The *Scientific American* distanced itself from outdated technology, wood engraving, that made the magazine distinguished in order to stay true to its objective of providing its subscribers with up-to-date technology.

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<sup>48</sup> “Photo-Engraving,” *Scientific American*.

<sup>49</sup> “The Moss Engraving Company.”

## Recommendations for the Next Group

Many suggestions for further work made by previous groups have never been implemented. Some of these ideas have been rendered moot by changes to the structure of the database and website. We would recommend that future project groups find a way to display the illustrations themselves in the database, rather than merely providing a link to the illustration on Cornell's "Making of America" archive. The first step in doing so would be to determine if Cornell possesses a copyright on their digital copy of those images and if they do, obtain permission from them to display the illustrations. After that, we would suggest finding a way to automate or outsource the process of finding those images. Automation could take the form of the 'click bot' mentioned in the "Previous Work" section.

Another suggestion is that the cataloging website could be adjusted to include the inventors address in a new subject heading. This could be used to make the database multipurpose as well as finding trends in where inventors lived to see if there are any social hubs of inventing. If future groups have the same technology issues this could be a good research option.

There is still a fair amount of improperly formatted data in the entries for the earlier volumes of *Scientific American*. Cleaning all of it up would be an extremely daunting task, and we would suggest that any group that wishes to undertake this should make it the main thrust of their project. In order for further cataloging of *Scientific American* illustrations the website needs to be edited for a distinction between the old and new series, which should be the first step the next group takes.

Munn & Co. was famous for their ability to communicate with their readers and use the magazine as a means to encourage business for their patent agency. To further explore the interaction between the *Scientific American* and its subscribers, research could be done into the inventors who utilized the patent agency Munn & Co. in order to obtain patents for their inventions. Investigation into the subscribers of *Scientific American* could be done to discover what type of people the magazine was advertised for and if any inventions published revolutionized mechanical advancement or scientific technology. Empty subscription forms that would be given to agents that would sell subscriptions to people in cities have been found, giving the possibility of finding completed subscription lists. Inventors name and addresses were listed in each article which if compiled and analyzed can be used to find centers of inventing. Also, the *Scientific American* editors choose inventions to feature each week. We know there was a set policy that they had to feature paying inventors, but it is not clear why specific choices were made.

## Conclusion

The main goals for this project group was to improve the database, index up to the new series of *Scientific American*, and examine the artists behind the illustrations of the magazine. The indexing for this project was completed. Through hours of grueling research we have been able to identify previously unknown engravers and draughtsmen whose work was featured in *Scientific American*. However, technical issues prevented any adjustment to the database or website. The initial expectation of the group's potential progress was high but had to be altered due to complications. We hope that future groups can learn from the missteps detailed in this report and avoid the same mistakes. An important goal in future project groups will be overcoming the permissions issues set in place by the third group. If our group had been able to get over these issues, we would have had a longer opportunity to work on the database. The permission issues were put in place to protect the database, but instead they delayed project progress. Despite the technical problems, the team made good progress both in cataloging four volumes and researching the engraving process of *Scientific American*.

Research became a major component of the project as opposed to previous groups that used the research paper as an application of the website. Research about engraving at *Scientific American* was emphasized when the database permissions issues became a delaying factor on the project. Before the group could use the cataloging website, the only progress in the project was the examination of *Scientific American's* illustration method. After the permissions issues were dealt with, time restraints forced work on the database to diminish so more emphasis was placed on acquiring more information for the research paper. The examination into the roles of

inventors and engravers in the illustrations featured in *Scientific American* provided new insight into how the magazine became an important part of the development of American technology.

## Appendix A: Notes on Research Process

The American Antiquarian Society's library provided a major resource for this project. The library holds almost all of the *Scientific American* issues. Another benefit of using the library was their holdings of back issue of historical journals on a variety of subjects that are not found online. One particular journal, *Printing History*, had an article written by Richard Candee that helped pull the research paper together. He researched the inventor's side of patenting and commissioning an article from Munn & Co. Even though the library has a plethora of material on a variety of topics their selection of mechanical engravings is lacking because trade catalogs from that era were not as likely to be saved. However, they had a few catalogs that reused cuts that were featured in *Scientific American*. The trade catalogs found featured cuts from Richard Ten Eyck for his engravings of sewing machines, one of which is figure 6 in the research paper.

A number of primary sources of the time period for *Scientific American* are easily accessible with Google Books. These works are fully searchable. Old issues of *Scientific American* as well as Munn & Co.'s other published works were easily searched for specific terms. The research paper had several of the same sources as Candee's journal article. The article was published in 1996, before the sources were published online. City directories were cited in both papers, but in the research paper the information was easily searched for. Candee must have sat in front of a microfilm machine for hours just to find the address for a certain person.

Information for the research paper was mostly found in directories and periodicals from the mid-nineteenth-century. These directories listed a person's name, occupation and address. If a person supplied their work address, it could be used to figure out who they worked for.

Luckily, *Scientific American* was very popular for their engravings which other periodicals took notice of. The July 1889 article on “Wood Versus Photo-Engraving” in the *Inland Printer* was the most important article used in the whole research paper. This article was the first found that mentioned Richard Ten Eyck and how his skill as an engraver helped bolster *Scientific American* as a major mechanical magazine. Without that article little other information would have been found on the engraving process of *Scientific American*.

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