

The Scientific Use of Archives: Case Studies from London Metropolitan Archives Highlighting the Importance of STEM

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ABSTRACT

This paper illustrates the scientific uses for which archives can be a major contributing factor in the fields of education and research. For too long archives have only been the preserve of the historian but there are many more uses and factors of relevance to today's modern world. This paper reveals some of the ways that archives have been unlocked and used more widely by different groups of researchers. Whilst historians and genealogists have concentrated their studies on names and places, there are many more uses for archives to explain some of the complexities and specialisms of human activity. London Metropolitan Archives (LMA) has sought to extend the use of its City archive collections in new ways which could be made relevant to broad subject areas known as STEM (Science, Technology, Engineering and Mathematics). The archives believed that historical sources could add depth to the teaching of subjects like science.

Key words: science, technology, engineering, mathematics, London Metropolitan Archives

L'utilizzo scientifico dell'archivio: l'esempio dell'Archivio metropolitano londinese sottolinea l'importanza dello STEM

SINTESI

L'articolo illustra l'utilizzo scientifico per il quale gli archivi possono essere un importante contributo nei settori dell'educazione e della ricerca. Per troppo tempo gli archivi sono stati solo predominio degli storici, ma ci sono oggi più utilizzi e fattori di rilievo. Questo articolo mostra alcuni dei modi in cui gli archivi sono stati aperti e più diffusamente usati da differenti gruppi di ricercatori. Mentre storici e genealogisti hanno concentrato i loro studi su nomi e luoghi, ci sono molti più utilizzi per gli archivi per spiegare alcune delle complessità e delle specializzazioni dell'attività umana. L'Archivio metropolitano londinese (LMA) ha cercato di estendere l'utilizzo delle proprie collezioni a nuove modalità che possono diventare rilevanti per le più ampie aree di soggetti, note come STEM (Science, Technology, Engineering and Mathematics - Scienza, Tecnologia, Ingegneria e Matematica). Gli archivi hanno creduto che queste fonti storiche possano aggiungere spessore all'insegnamento scientifico.

Parole chiave: scienza, tecnologia, ingegneria, matematica, Archivio metropolitano londinese

Uporaba arhivskega gradiva v znanstvene namene: primeri dobre prakse iz Londonskega Metropolitanskega arhiva, ki poudarjajo pomen STEM

IZVLEČEK

Članek predstavlja znanstveno uporabo arhivskega gradiva, pri čemer so lahko arhivi pomemben dejavnik na področju izobraževanja in raziskovanja. Predolgo so bili arhivi le domena zgodovinarjev, vendar obstaja veliko več načinov uporabe, saj predstavljajo arhivi pomemben dejavnike sodobnega sveta. Prispevek predstavlja nekaj načinov širše uporabe za različne skupine raziskovalcev. Medtem ko so zgodovinarji in rodoslovci svoje raziskave koncentrirali na imena in kraje, pa obstaja veliko več načinov uporabe arhivskega gradiva, s katerim lahko pojasnimo nekatere kompleksnosti in posebnosti človekovega delovanja. Londonski Metropolitanski arhiv

(LMA) je želel razširiti uporabo svojih arhivskih zbirk na nove načine, ki bi lahko bili pomembni za širša predmetna področja, znana kot STEM (znanost/Science, tehnologija/Technology, gradbeništvo/Engineering in matematika). V arhivu so verjeli, da bi zgodovinski viri lahko podali dodatno globino poučevanju naravoslovnih predmetov.

Ključne besede: znanost, tehnologija, gradbeništvo, matematika, Londonski Metropolitanski arhiv

This paper proposes to illustrate the scientific uses for which archives can be a major contributing factor in the fields of education and research. For too long archives have only been the preserve of the historian but there are many more uses and factors of relevance to today's modern world. This paper will reveal some of the ways that archives have been unlocked to make them more accessible and used more widely by different groups of researchers.

By their very nature archives cover a universal field of knowledge about the activities of humankind as recorded through the centuries. Wherever there was activity in the field of human endeavour, a record would be created at some stage in its development. Whilst historians and genealogists have concentrated their studies on names and places, there are many more uses for archives to explain some of the complexities and specialisms of human activity.

We often see the results of human endeavour in our everyday life: buildings, transport infrastructure, power stations, means of communication. We take all these things for granted, but what do we know about how they were invented, or how schemes were put in place to transfer theoretical knowledge into practical application. Sometimes that back story, that essential information giving context to an invention or construction is sitting in our archives not being recognised and perhaps being unavailable for future application of technology - without making the mistakes of the past.

London Metropolitan Archives (LMA) is the largest local authority managed archive in the United Kingdom with over 100 km of contents on shelving in Central London. The archives consist of the magnificent City of London Corporation archive dating from 1067 - date; the manuscripts of the Guildhall Library; and the Metropolitan collections of the counties of London, Middlesex and the former Greater London Council. It has a habit of reinventing itself as local government structures change but is now mostly centred on one set of premises in Clerkenwell, just outside the ancient city walls. In each year it receives 30,000 onsite visitors, 25,000 distance enquiries and 30 million web page hits.

One of the reasons why important records were kept by the City government was in the administration of early technological improvements. The provision of efficient land drainage and the prevention of flooding were the two main technical reasons behind the establishment of the Commissioners of Sewers in the Sixteenth and Seventeenth Centuries (only in later centuries were the issues of dirty water and provision of clean water addressed). In 1530 disastrous floods occurred and this led to legislation in 1531 which enabled the construction of waterways and ditches to avoid flooding. These Commissions are seen as the predecessors of modern London Government and in 1855, these various technical functions were brought under the Metropolitan Board of Works an immediate predecessor of the London County Council and then the Greater London Council. Many of the sewers and waterways built in the mid-nineteenth century are still in working order today and many researchers come to the archives to see plans of subterranean London.

London Metropolitan Archives (LMA) has always sought to extend the use of its City archive collections in new ways. A major UK Government initiative in education led LMA to scope out which of its collections could be made relevant to educational activity in broad subject areas known as STEM (Science, Technology, Engineering and Mathematics). Whilst the broad thrust might have been to move educational concentration from the arts to the sciences, the archives believed that historical sources could add depth to the teaching of subjects like science.

The Development Team at LMA, consisting of 3 teacher trained staff, looked beyond the obvious historical sources to find other ways of exploring science through the archives. Children from London's schools can visit the archives from Age 8 onwards to find out about history in their local com-

munities or to follow particular subject areas as prescribed by the national curriculum. These subject areas have now been developed so in this year's schools programme there were 6 relating to science and technology.

Document Doctors

Perhaps this is an obvious starting point for archives to discuss technology but it will be a new subject area for many students. After being instructed in the importance of conservation in the archive, for example the impact of environmental conditions on archive preservation, the students are then set to gather temperature, humidity and light level data to find out how documents should ideally be stored. They also learn about how documents are protected from decay and how they are repaired after damage by various agents, for example mould or insect infestation. The programme is interactive so students have the opportunity to make decisions about conservation and get a chance to run their own 'Document Hospital' using the scientific knowledge they have of physical materials such as paper, ink and leather.

Bridges and Towers

Amongst the official records of the City of London are many obvious treasures but also many hidden delights. The City ran an architectural competition to provide a new bridge in the 1890s and many of the designs entered for the competition survive in the archives. Unusually they feature a vast range of scientific and engineering solutions to the age old problem of balancing the needs of trade (height of ships) with the need for efficient crossing of public transport, traffic, goods and pedestrians in a city centre context. These designs are investigated by the students and they challenge their ideas about building structures, why some materials are better than others, and how do you cope with multifaceted uses of bridges. In London this is complicated by the fact that the River Thames is a tidal river which can fluctuate in levels by 7 metres twice per day. Making those calculations, using tide tables and scientific knowledge gained from the archives the designs are recreated with modern Twenty First century twists and groups are challenged into deciding what makes a strong tower or bridge. In London's example of Tower Bridge 1894 (now actually run by colleagues in the Culture department) many of these historical and scientific themes are merged.

Disease

Many of our archives include reference to disease. From medieval references, to the plague and Black Death, to more modern epidemics such as cholera or smallpox. Apart from statistics kept on a weekly basis by City parishes, plague books, mortality bills were an indicator of the rise and fall of diseases. With the advance of science it became possible to understand and monitor the spread of diseases if not necessarily the scientific cause of the disease. An underused set of records which were recently conserved at LMA were a set of smallpox maps which recorded the location of smallpox incidents on sheets 5 metres by 5 metres. These have now been scanned and the digital copy is available for use by researchers. The original intention was for health managers in late nineteenth century London from the Metropolitan Asylums Board to plot incidence and rate of spread of disease. Now they provide a useful resource for medical historians linking up pieces of information about population, hospital treatments, and communications. As an aside the groups of students play an interactive game demonstrating the spread of disease through everyday contact and examine first-hand accounts of disease through the eyes of patients and health managers. Hospital records have never been so interesting. Or indeed so nauseating when archival stereoscopic images of smallpox, produced for medical consultants, are shown in all their gruesome detail.

Optics

Perhaps a less obvious area but one where archives from different formats and collection have some evidence to bear on scientific understanding. Town planning in cities often refers to the right to light for dwellings, especially in the days of small local industry in the pre-industrial age, where natural daylight was all important. A contemporary of Newton and Wren, Robert Hooke was City Surveyor for London and undertook experiments on light, some of which are included in his diary which is one

of LMA's iconic archives, which has been used in a number of important scientific history exhibitions. More modern use of optics is illustrated to students through accounts of the history of photography and the various early methods and materials used to provide images of the contemporary world from the 1850 onwards. Some early daguerrotypes by Delamotte from the 1851 Great Exhibition are some of LMA's earliest photographic images. Continuing the theme, modern microscopes from conservation are used by students to see the type of detail required for understanding the cause of conservation problems and those insects which might be responsible for them.

Have your Cake and Sweet London

These two sessions are both centred on the Lyons business archive which is an amazing account of the growth and industrialisation of food production in the UK. Lyons was firstly famous for tea and coffee through its corner shops but later expanded into seafood, cakes, was an early pioneer of frozen food (FROOD) and made ice creams through the brand Lyon's Maid. The archive illustrates the range of food items on menus and through packaging but also quite a lot of detail around the manufacturing process through photographs of equipment and factories. Following in the footsteps of Margaret Thatcher who worked as a chemist at Lyons in her early career, students learn to make ice cream as an example of how raw materials such as sugar and cream change state and undergo crystallisation and transformation. This is one the many ways in which our development team turn a possibly dull visit to the archives into a memorable one with an educational scientific purpose. These sessions have proved very popular and demonstrated to politicians that archives have many different and varied uses but always have the ability to inspire.

Science in the archives

Once the focus was put on these subject areas it soon became apparent that there were many references, illustrations, debates and treatises on scientific subjects in the archives. Anything from design and construction of bridges, the architecture of cathedrals, the methodology behind sewer networks, transport planning for future expansion of cities and use of new building technologies through to the manufacture of frozen food or making equipment for use in everyday business and domestic life. These studies could be extended to include the science behind modern medicine, photography, the conservation of paper and the importance of statistics.

The history of medicine is a popular and growing field of research, In the UK this has been massively helped by the Wellcome Trust's Research Resources in Medical History funding stream. Not only are these great opportunities for archivists to receive funding to list and conserve their medical collections they are also essential in bringing together academic historians and scientific practitioners with archive institutions. Funding is not given unless the project is sponsored by an academic researcher and unless the findings of the research are distributed more widely by publication or seminar or exhibition. This results in collaborative working which in turn assists the researcher and the archive institution.

LMA has used this model for a number of projects including the records of the Royal National Homeopathic Hospital (whose records were badly damaged during World War Two but whose case books provided a unique insight into pioneering treatments using homeopathic methods). They were also used for cataloguing the papers of the Normansfield Hospital which included detailed scientific correspondence by the pioneering physician John Langdon Down who identified what is now known as Down Syndrome. Similarly the funding was used for the preservation of records of the Royal Free Hospital the first hospital to employ women doctors in the UK including the internationally renowned physician and politician Elizabeth Garrett Anderson. A lot of the records are not the dull administrative archives that we know so well but are detailed scientific case books with calculations and theories using language and notations unfamiliar to the standard archivist.

Besides history of medicine there are extensive archives of engineering and design projects which have shaped the City of London, especially since after 1666 - this year marks the 350th Anniversary of the Great Fire of London - when there was a massive opportunity for the City to rebuild which it did using stone rather than wood but using the old street pattern which means a lot of medieval streets are still in existence today, but they are lined with large modern buildings instead. Apart from investiga-

tions of how the fire started, how it spread there were also calculations of the size of landed plots left after the fire, the dimensions of new buildings and plans for new buildings such as Christopher Wren's designs for St Paul's Cathedral which had to demonstrate how the huge dome (the second largest in the world) would be supported.

Over the centuries London has grown in size and expanded into the countryside with some areas remodelled during Victorian times to allow improvements to take place: removing slum dwellings and constructing new highways with better drainage underneath, and the world's first underground railway. All of these are illustrated by engineers drawings and architects' plans preserved in the archives. Many of these are scale drawings and are still used by modern day engineers when it comes to repairing or replacing infrastructure.

With the growth of population and industry came the need for better sources of power and heating. The City of London introduced some of the first street lighting in the world and the records of the City's Nineteenth Century Gas Light and Coke company, and later the London Electricity Board in LMA make for interesting reading about how energy was manufactured and stored for the benefits of Londoners, how power was distributed to the population. The New River Company worked out how to channel fresh water from springs in the hills 30 miles North of London to the City in the early Seventeenth Century using a series of canals and wooden conduits. These are all technological advances which we take for granted today - water, electricity, gas - and all are documented in the archives for scientific historians and engineers to study.

Photography is perhaps more of a science than an art although many people have discussed definitions and the jury is still out. Every archive collection these days has photographs but even at the start of my working life in the 1980s they were counted as not quite being archival as they were not seen as primary documents, weren't on paper and had different conservation requirements beyond the traditional knowledge of the paper conservator. They were often referred to as modern media and too often were left neglected in archive stores, partly because there was a lack of skill and technical knowledge in how to preserve them.

Conservation and now digitisation of photographs allows the archive institution the opportunity to develop expertise and demonstrate a willingness to interact with the scientific community over how best to preserve and present photograph images. However it is important in order to preserve photographs to be able to understand the science behind photography in all its varying use of chemicals, materials and processes. This is also true of moving film, cine film and video. Expertise in these areas is highly sought after and equipment to run and demonstrate vintage technologies are even rarer. It is important for the archivist not to shy away from the challenge but to look at how best collections of film can be used as true documentary material for historians. Neither should the archivist be discouraged by the stringent standards. It is difficult to achieve perfect conditions according to set international standards such as PD5454 and sometimes innovative solutions need to be employed.

At LMA we have often taken the view that we test engineering assumptions about environmental conditions as too often we are presented with highly complex over engineered solutions which are unsustainable in the current economic climate and the move towards more energy efficient buildings. As an example we were offered some funding by Film London to provide film storage for a number of London archives, including 17 London Borough archives. The funding was never going to be enough to build a full-scale film store as we had observed at the Imperial War museum or the British Film Institute. Instead we examined tolerances of temperature and humidity for film collections so that conditions could be made better than existing strongrooms and approaching the high quality threshold of fully conditioned systems.

Using basic but effective technology used in beer cellars (for cooling beer) LMA created a film store where films are kept at appropriate temperature and humidity without recourse to major expenditure. It started as a trial but has now been working effectively after a few minor tweaks to moderate humidity levels.

It is difficult to select the best example to illustrate the connections between science and the archives as there are so many to choose from in our extensive official and business archives. The one I have chosen is the Great Parchment Book Project which brought together conservation techniques, palaeography, digital scanning, photography and mathematics applied to engineering.

Great Parchment Book

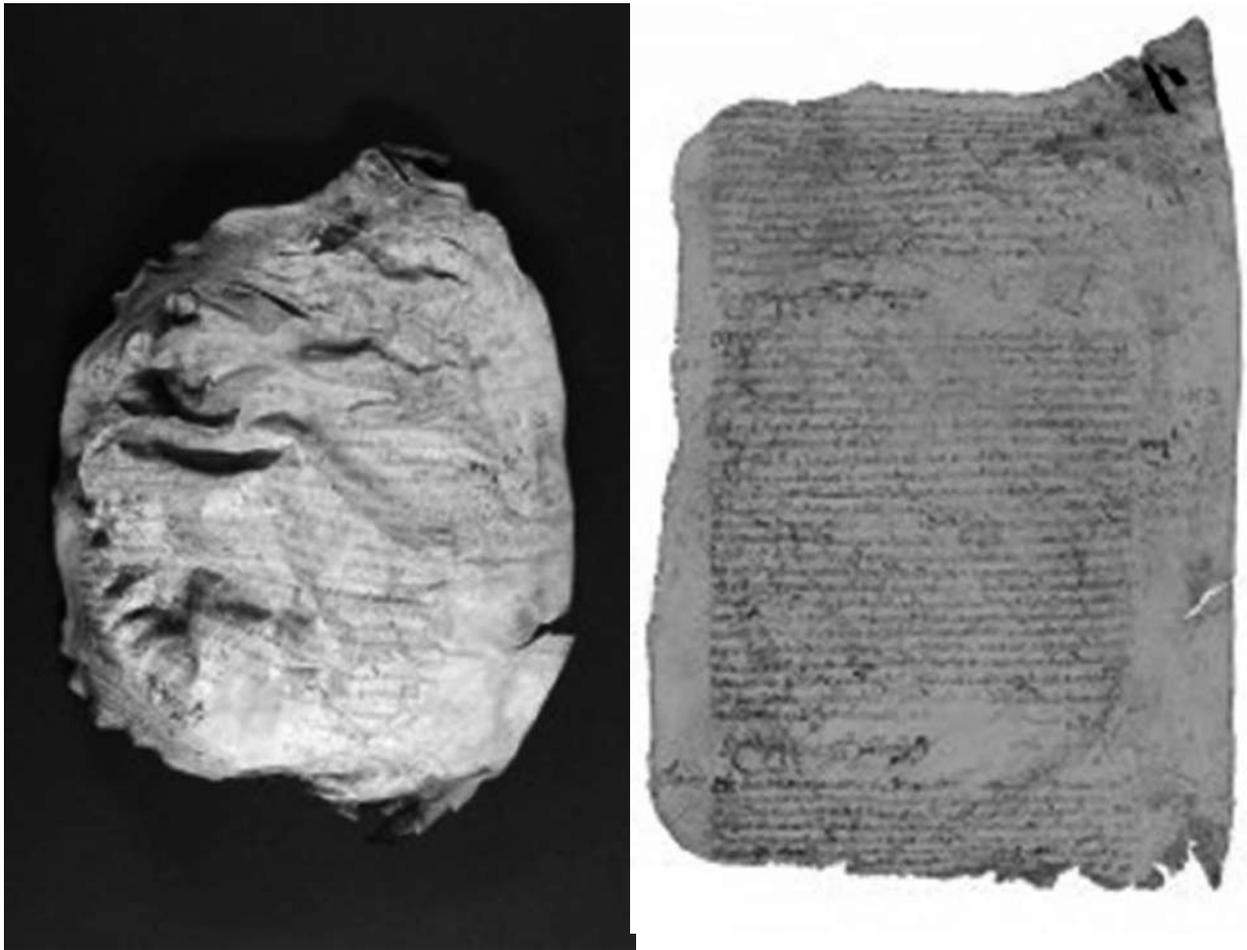


Image 1: Great Parchment Book 1639 before and after treatment

This Seventeenth Century parchment volume is an iconic document in Irish history and London history as it is a survey of all lands colonised for political and religious reasons in Ulster in the 1630s. The Right Honourable The Irish Society developed industry with the assistance of the City livery companies. The volume was damaged during a fire in London in the Eighteenth Century. The fire and smoke damage was made worse by water used to put out the fire. This left 250 leaves of parchment in a very crinkled state but most of the text was just about legible. However the texture and format had changed so that the script was either very small or contorted so the full content could not be extracted or understood. This was a seemingly intractable problem that had been around for 200 years.

Conservation staff made some progress in relaxing and stretching back the parchment gradually to increase the legibility of the script. This in itself was quite ground-breaking treatment. But it didn't go far enough. An application to the Engineering and Science Research Council resulted in a 2 year post-doctoral research grant to apply a combination digital photographic technology together with algorithms to establish a 3D matrix through which a final text could be produced.

The results are astonishing as now every word on every sheet of parchment can be read. The results make information available that had been lost and there has been an international conference on the book together with an award winning blog. The application of the technology is now available under licence from UCL, the host institution and partner of LMA and the results for the future of parchment repair are exciting in providing hope for the repair of lost information in archives.

Conclusion

Apart from teaching and events, LMA has been able to host exhibitions reflecting on scientific discoveries. The famous scientist Robert Hooke left a wonderful seventeenth century diary recording his experiments and this has been displayed at the City of London Heritage Gallery in 2016, the 350th Anniversary of the Great Fire of London alongside Sir Christopher Wren's drawing for the rebuilding of St Paul's Cathedral. This unlocks these scientific papers for wider use and draws new users in.

Through our experiences and experiments with extending the use of archives into disciplines beyond the traditional historian's horizon, the LMA has benefited richly through new partnerships with external organisations and new insights into its own collections resulting in a wider and deeper use of the archives.

SUMMARY

This paper proposes to illustrate the scientific uses for which archives can be a major contributing factor in the fields of education and research. For too long archives have only been the preserve of the historian but there are many more uses and factors of relevance to today's modern world. This paper will reveal some of the ways that archives have been unlocked to make them more accessible and used more widely by different groups of researchers. London Metropolitan Archives (LMA) has always sought to extend the use of its City archive collections in new ways. A major UK Government initiative in education lead LMA to scope out which of its collections could be made relevant to educational activity in broad subject areas known as STEM (Science, Technology, Engineering and Mathematics). Whilst the broad thrust might have been to move educational concentration from the arts to the sciences, the archives believed that historical sources could add depth to the teaching of subjects like science. Once the focus was put on these subject areas it soon became apparent that there were many references, illustrations, debates and treatises on scientific subjects in the archives. Anything from design and construction of bridges, the architecture of cathedrals, the methodology behind sewer networks, transport planning for future expansion of cities and use of new building technologies through to the manufacture of frozen food or making equipment for use in everyday business and domestic life. These studies could be extended to include the science behind modern medicine, photography, the conservation of paper and the importance of statistics. Apart from teaching and events, LMA has been able to host exhibitions reflecting on scientific discoveries. The famous scientist Robert Hooke left a wonderful seventeenth century diary recording his experiments and this will be displayed at the City of London Heritage Gallery in 2016, the 350th Anniversary of the Great Fire of London alongside Sir Christopher Wren's drawing for the rebuilding of St Paul's Cathedral. This unlocks these scientific papers for wider use and draws new users in. Through our experiences and experiments with extending the use of archives into disciplines beyond the traditional historian's horizon, the LMA has benefited richly through new partnerships with external organisations and new insights into its own collections resulting in a wider and deeper use of the archives.

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