

RESEARCH ARTICLE

The First Patents and the Rise of Glass Technology

Marcio Luis Ferreira Nascimento^{1,2,*}

¹*Vitreous Materials Lab, Institute of Humanities, Arts and Sciences, Federal University of Bahia, Rua Barão de Jeremoabo s/n, Idioms Center Pavilion (PAF IV), Ondina University Campus, 40170-115 Salvador, Bahia, Brazil;* ²*PROTEC / PEI — Graduate Program in Industrial Engineering, Department of Chemical Engineering, Polytechnic School, Federal University of Bahia, Rua Aristides Novis 2, Federação, 40210-630 Salvador, Bahia, Brazil*

Abstract: Background: According to the *Guinness Book of Records*, the earliest of all known English patents for an invention was granted by King Henry VI in 1449 to Flemish-born John Utynam for making stained glass. The second patent was approved by King Edward VI and granted to Henry Smyth in 1552 for making Normandy glass.

Objective: To show that most of the first published patents were related to the manufacture of glass or to instruments that used such knowledge.

Method: We analyzed some historical documents and applied a brief statistical analysis on the number of glass patents publications.

Results: In Italy, patent laws started as early as 1474 to protect incipient glass manufactures. The first French patent was granted in 1561 for a special lens dispositive (*l'holmetre*). The first American patent was issued in 1790 for an improvement "in the making of Potash and Pearl ash" - both are basically potassium carbonate, essential for the making glass and soap. The first German trademark registration, PERKEO, was granted in 1894 to a Berlin lamp producer. Approximately 827,643 patents with the term "glass" in the title or abstract have been filed worldwide, according to the European Patent Office (starting in 1859 and up to 2015). This number continues to grow as do total glass sales worldwide. Looking for the word "glass" in the title only, we found 250,589 patents filed in this period.

Conclusion: We conclude that the spirit of innovation has in its origins a strong connection with the rise of glass technology.



ARTICLE HISTORY

Received: March 18, 2015
Revised: August 05, 2016
Accepted: August 10, 2016

DOI:
10.2174/240552040866616081112
4832

Keywords: Glass, history, patent, technology.

1. INTRODUCTION

In 1449 King Henry VI of England (1421 - 1471, Fig. 1a) authorized the Flemish glassmaker John

Utynam to produce stained glass windows for Eton and King's Colleges in exchange for teaching his craft / technique to apprentices at these two institutions. Glass window technology was developed around the birth of Christ, and it was developed to new heights of artistry using different colors by the Christian Church in medieval times. In return for his work the glassmaker requested the exclusive rights to prepare, produce and manufacture stained glass using a process which he claimed to have invented. The King signed a royal order on April 3, 1449, and Utynam was granted a monopoly of the process, which had been hitherto un-

*Address correspondence to this author at the Vitreous Materials Lab, Institute of Humanities, Arts and Sciences, Federal University of Bahia, Rua Barão de Jeremoabo s/n, Idioms Center Pavilion (PAF IV), Ondina University Campus, 40170-115 Salvador, Bahia, Brazil, and PROTEC / PEI — Graduate Program in Industrial Engineering, Department of Chemical Engineering, Polytechnic School, Federal University of Bahia, Rua Aristides Novis 2, Federação, 40210-630 Salvador, Bahia, Brazil; Tel: +7132839803; Fax: +557132829801; E-mail: mlfn@ufba.br



a)



b)

Fig. (1). *a*: King Henry VI (1421 - 1471), oil on panel, *circa* 1540. Purchased in 1930, author unknown (NPG 2457). *b*: King Edward VI (1537 - 1553), oil on panel, *circa* 1542. Purchased in 1898, unknown artist, after Hans Holbein the Younger (NPG 1132). Both at the National Portrait Gallery: www.npg.org.uk (and in public domain).

known in England, for twenty years. In exchange for this monopoly, John Utynam was required to instruct Englishmen in the craft. Today this function of passing on *know-how* is rewarded by patent specification publications. This was perhaps one of the first officially recorded patents in the world, or at least in English, as pointed out by Arthur Allan Gomme (1882 - 1955), librarian at the British Patent Office, researcher and historian of technology [1].

Thus, Utynam became the world's first renowned inventor of a recorded patent, related to glassmaking process. He probably received patent letters not only from King Henry VI of England but also from France (but there are only indirect records on this subject), and certainly for a technology developed at that period, more precisely the northern Italian city of Venice and its province, Murano, that has a long history of approximately since 500 BC in glassmaking [2].

This particular case exemplifies how the ideas about globalization, or more precisely the internationalization of intellectual property are clearly nothing recent. Historians confirm that the ancient Republic of Venice had started publishing patents by indirect references to glassworkers in the 1420s [3] (but until now there are no documents to prove

this). However, it was only from the 1450s onwards that awarded patents became regular [4].

Frumkin [4] claims that the first royal patents were developed in Italy. Filippo Brunelleschi (1377 - 1446), the celebrated Italian architect who began to build the magnificent octagonal cupola of the Florentine Cathedral known as the "*Opera del Duomo*" in 1419 was awarded the earliest patent on record according to some historians. The Italian State of Florence granted him a special right [5] in 1421, valid for three years, to build and use a device of his invention to transport heavy loads of marble in a type of barge with special hoisting gear. It was even stipulated that anybody imitating his invention should be burned. But it was only from 1474 that patent laws were proposed as an explicit economic policy, as established by the Venetian Statute (see Fig. 2). This statute has frequently been claimed to be the first extensive patent law which presented the key rules of intellectual property [5]. This was a declaratory document in Venice codifying existing common basis and customs of awarding patent rights for inventions. The statute stated that patents could be filled for "any new and ingenious device, not previously made", *i.e.*, everything original and useful.

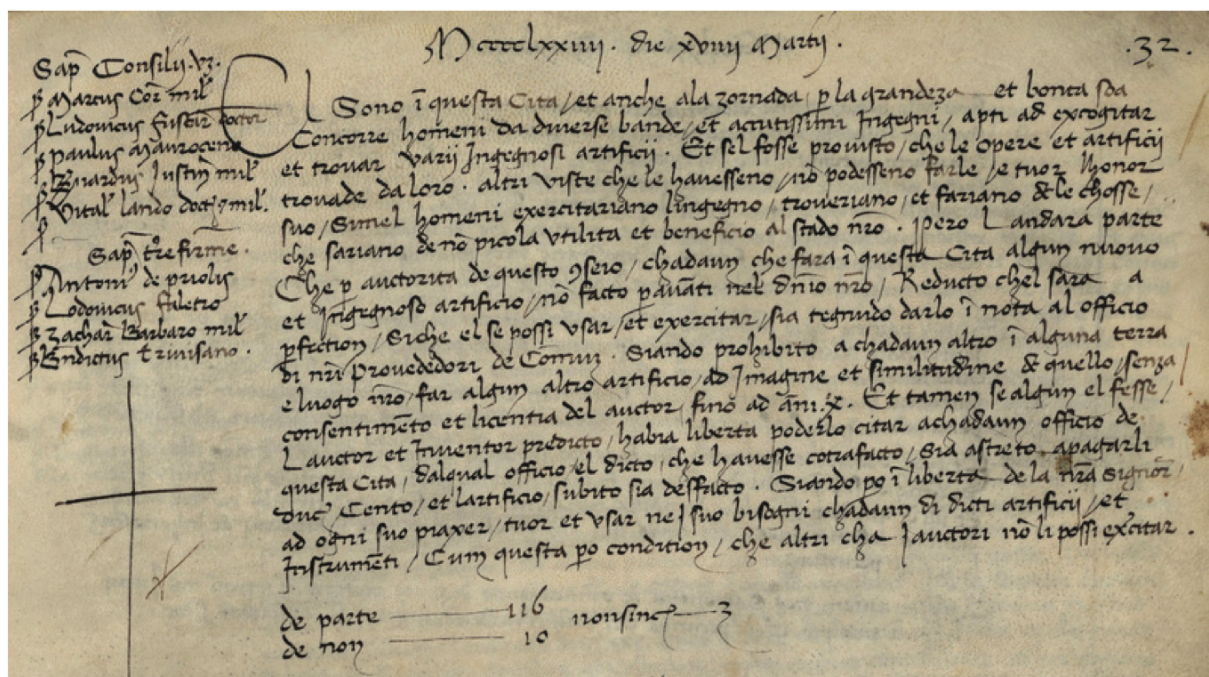


Fig. (2). The first modern patent statute written in old Venetian dialect, issued by the Senate of Venice in March 19, 1474 and held in the *Archivio di Stato di Venezia*, page 32r. According to Kostylo [5], in the preamble, the fruits of “very sharp minds” (“*acutissimi ingenii*”), notably of those who were suitable to “excogitate (*i.e.* to develop in thought) and invent various ingenious artifices” (“*apti ad excogitar et trovar varij ingegniosi artificij*”) were worthy of safeguard in their own right. This document is in public domain: www.archiviodistatovenezia.it (more precisely at: https://commons.wikimedia.org/wiki/File:Venetian_Patent_Statute_1474.png).

According to Frumkim [4], the main craft in Venice, in particular the town of Murano, was glassmaking where the secrets and mysteries of the fine art of glass production were cautiously guarded in the XV century. As patents started to be systematically granted from this period, there was a decree which Venice issued according to which new and inventive devices had to be communicated to the Republic in order to obtain legal protection against potential infringers and to foment and develop the glass trade. The safeguard period was ten years [4]. These patents were mostly for glassmaking processes.

At that time glass started to become valuable in commercial trade due to its particular properties of transparency, chemical resistance, luster, hygiene, easy cutting and polishing, insulation and storage properties (*e.g.*, vessels of many types). As Venetian glassblowers who attempted to practice their craft elsewhere there was a death penalty. Many Venetian craftsmen were tempted to foreign parts, emigrating, and aware of the Venetian patenting system, they obtained a monopoly of their knowledge of new processes and methods they brought from overseas. This automatically led to the diffu-

sion of patent systems to other countries, as it probably occurred with John Utynam from a historical perspective.

King Henry II of France (1519 - 1559) introduced the idea of publishing the description of an invention in form of a patent in 1555 which was awarded to the French engineer, mathematician, poet and inventor Abel Foullon (1513 - *c.* 1563) for “*Usaige & Description de l’Holmetre*”. This equipment was an optical dispositive similar to a modern rangefinder, see Fig. (3). Publication was delayed until after the patent expired in 1561.

The first patent in the USA was issued to the American inventor Samuel Hopkins (1743 - 1818) for an improvement “in the making of Potash and Pearl ash by a new Apparatus and Process” [6], Fig. (4). *Potash* is potassium carbonate (K_2CO_3) in an impure form mixed with other potassium salts; and *pearl ash* is more refined. This was backed by the President George Washington (1732 - 1799) and by Thomas Jefferson (1743 - 1826), at that time the Secretary of State. Potash and Pearl Ash were crucial for the making of glass and soap as well as saltpeter for gunpowder, baking and dye-

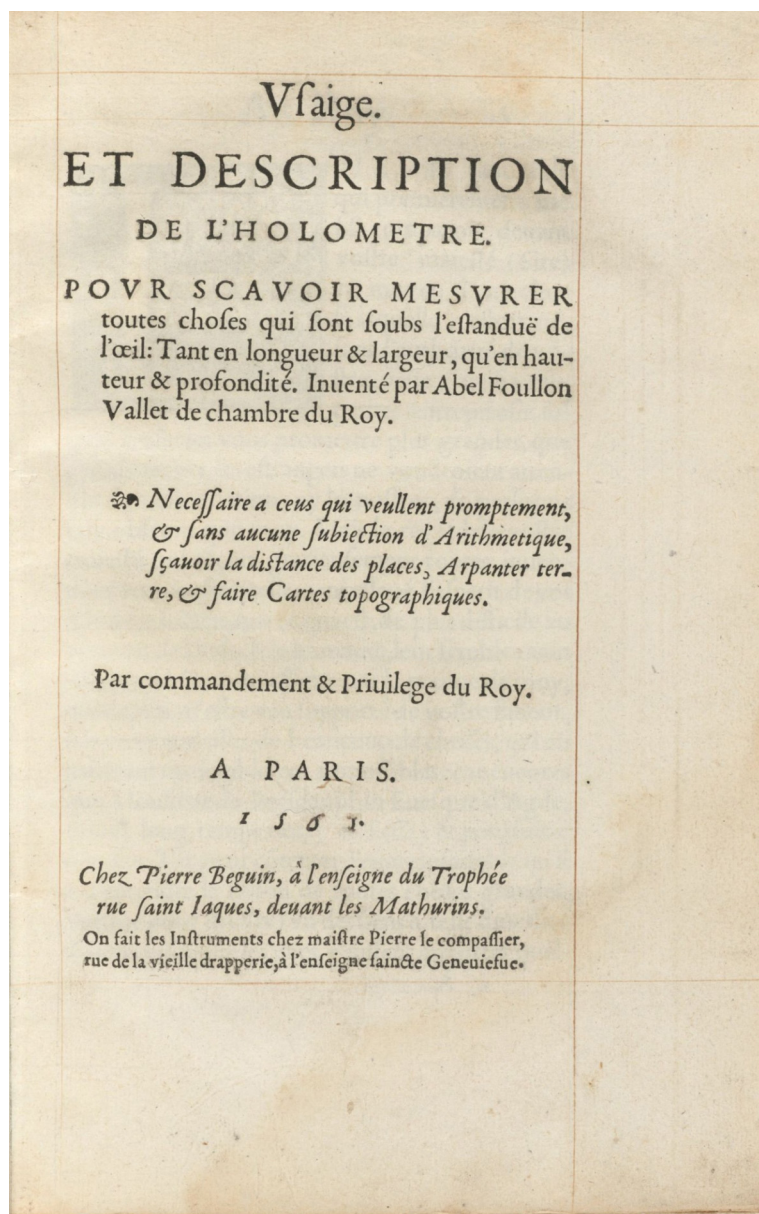


Fig. (3). The first French patent, established in 1561: “Vsaige et description de l’holometre: povr scavoir mesvrer tovttes choses qui sont sous l’estandue de l’oeil, tant en longueur & largeur, qu’en hauteur & profondeur / inuenté par Abel Foullon”. Courtesy: Houghton Library, Harvard University - Typ 515.61.404 (document in public domain: <http://hcl.harvard.edu/libraries/houghton>, more precisely at: https://commons.wikimedia.org/wiki/File:Houghton_Typ_515.61.404_-_Vsaige_et_description_de_l'holometr.jpg).

ing fabrics [7]. This patent is linked to one of the first chemical industries in America. The first evidence of a glassmaking in USA was in an English settlement on Jamestown Island, Virginia, in around 1608 [8]. The location came to be called *Glass House Point*, but production discontinued. Just a century later, another glasshouse was founded in North America by the German glassmaker Caspar Wistar (1696 - 1752) who moved in 1717 to Pennsylvania, starting with soap making and brass button productions. Ten years later he

set up what is considered the first successful American glass factory, the *Wistarburgh Glass Works*, also known as the *United Glass Company* [9].

In 1809, one year after the Portuguese royal family transferred the Court to South America, Brazil became the fourth country in the world to enact a patent law, after United Kingdom, Italy and France. King D. João VI (1767 - 1826) set up the license for inventions of new machines to start

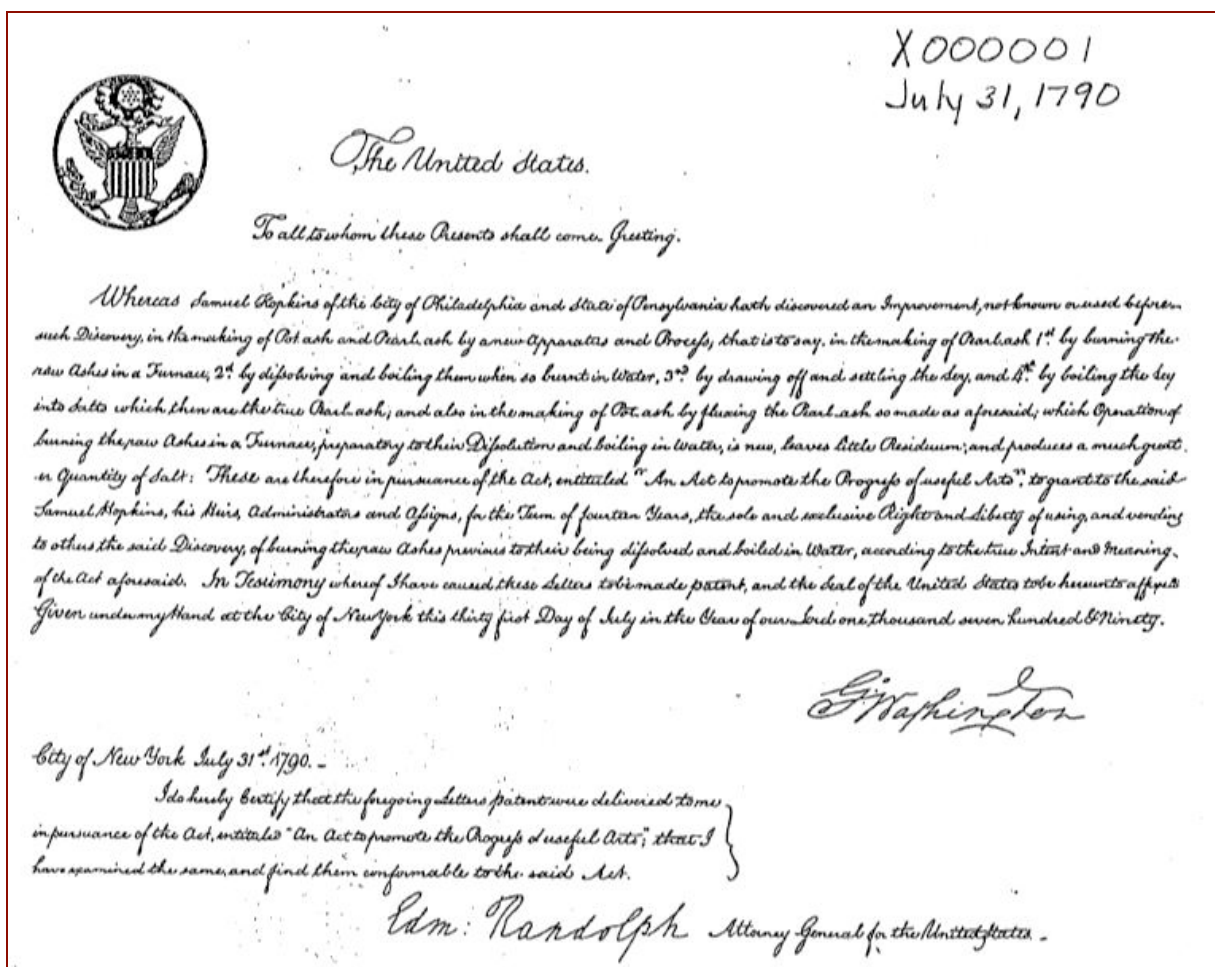


Fig. (4). The first US patent, issued to the American inventor Samuel Hopkins (1743 - 1818), in Pittsford, Vermont, on July 31, 1790, for an innovative way of making "pot ash and pearl ash". Courtesy: The United States Patent and Trademark Office (document in public domain: www.uspto.gov, more precisely at: <https://commons.wikimedia.org/wiki/File:FirstUSpatent.jpg>).

up the incipient Brazilian economy. One of the first patents granted in 1814 was for mining service machines. The raw materials extracted from mines were used in civil engineering applications as well as in the incipient glass industry which started in 1822 [10]. At that time, several small companies started production in places such as Rio de Janeiro, São Paulo and Bahia, making lead "crystal glass" small and large flasks and bottles "at the same prices as those practiced by the Court of London" [10].

The first German patent was granted on July 2, 1877 for a "method for producing a red ultramarine color", invented by the German entrepreneur and inventor Johannes Zeltner (1805 - 1882) [11]. Ultramarine is a special pigment with a deep blue color that was originally made by grinding *lapis lazuli* into a powder - useful for many applications

such as painting, clothing, and a special glass based pigment. However, the first trademark registration: *PERKEO* (Fig. 5), was published by the *Deutsches Patent- und Markenamt* (or the "German Patent and Trade Mark Office": www.dpma.de) under number DE1 on October 16, 1894 filled by the Baumgarten Kom.-Ges, a Berlin lamp producer (mainly oil lamps at that time). The registration is still in force today, and it is automatically renewed by the *German Patent and Trade Mark Office* for historical reasons. This brand name, *PERKEO*, was in honor of Perkeo of Heidelberg (born Clemens Pankert, 1702 - 1735) who was a notable jester and great wine consumer. He usually replied "*perché no?*" ("why not?" in Italian) to every invitation to drink. Other stories about his tiny figure (he was apparently affected by dwarfism) include one of his legendary duties as the guardian of the giant wine barrel of the Hei-

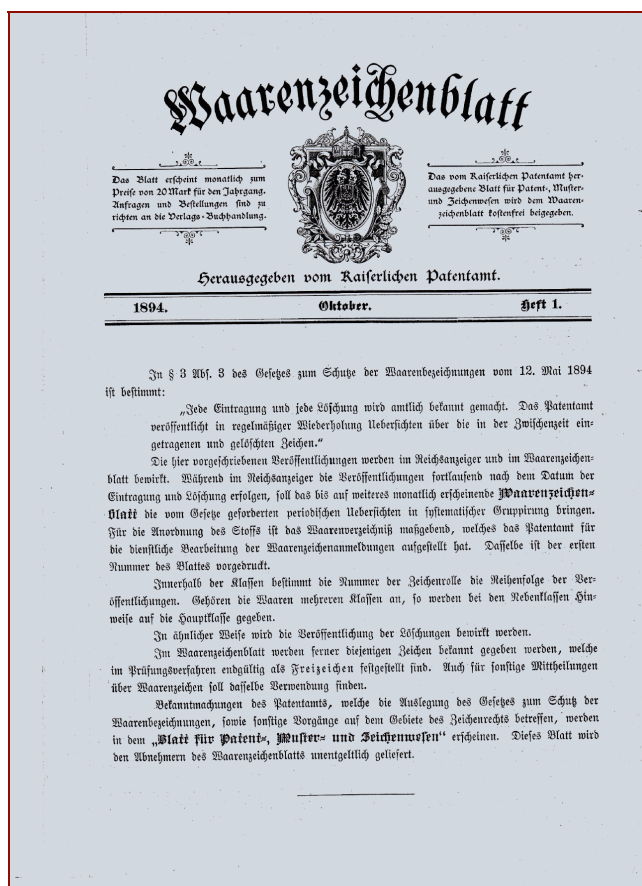


Fig. (5). The first German trademark publication (“Warenzeichenblatt”, left) from 1894 with the first trademark PERKEO (right). Courtesy: Deutsches Patent- und Markenamt (document in public domain: www.dpma.de).

delberg Castle - the largest in the world at that period - most of the time carrying lamps and obviously drinking.

From a historical perspective, the origins of innovative patents remain mysterious; however, according to the *Intellectual Patent Office* (www.ipo.gov.uk), Britain does have one of the longest continuous patent traditions in the world. Its origins date from the 15th century, when the Crown started making specific privilege grants to innovators, manufacturers and traders. Basically, since that time, patents were considered a model of intellectual property.

Up to a hundred years after Utynam’s first letter in 1449, no more patents were approved in England. According to Spear [12] the second one, also for glass making, occurred in the regular series of English patents as a twenty-year monopoly granted to Henry Smyth on April 26, 1552 by King Edward VI (1537 - 1553, Fig. 1b), who desired to introduce other foreign glassmaking techniques into England [13].

Granting patents was a royal privilege in England. Unfortunately, little is known about Utynam and Smyth or their works, except that they were master glassmakers. For example, on Utynam’s patent, King Henry VI noted that he came from Flanders, the northern part of Belgium.

2. A CONCISE HISTORY OF GLASS TECHNOLOGY

Among structurally disordered materials in nature, glass can be considered the most fascinating. Glazed stone beads dates back to 12,000 B.C. [14], and its application was preceded by the use of enamels on pottery. Natural glass such as volcanic obsidian have been used to create arrow tips, knives and other things needed for the daily survival, as well as jewels for the tombs of the pharaohs [2].

The first objects made of glass produced by man date back to about 7,000 B.C. and much glassware has been found in Egypt and Mesopotamia, and later Greece. According to Zarzycki

[2], *glass* (from the Latin term *glaesum*) was almost certainly discovered by accident — the Roman historian Pliny (23 - 79 A.D.) noted the possibility — by Phoenician merchants, who apparently noticed an accidental sand vitrification which formed a clear liquid produced by a reaction with blocks of natron. Such blocks were basically a mixture of Na_2CO_3 and NaHCO_3 which were placed together for cooking pots in a primitive fireplace. In particular, natron was used as a cleaning product for both the body and homecare. When blended with oil, it was an early form of soap. It is also possible that the first glass was simply slags from copper metallurgy [2]. Egyptian craftsmen developed a method for producing glass vessels around 1,500 B.C.

New glass centers appeared in Rhodes, Cyprus, Greece and later in the Italian peninsula around 900 B.C. The great craftsmen of glass vessels, containers, vases and tableware were the Italians, first the Romans and later the Venetians (around 500 B.C. [2]). Glass manufacturing emerged due to the development of glass technology which came with the invention of glass blowing by Syrian artisans in the first century before Christ, and was first distributed by Phoenician traders [2]. This particular method, invented around 50 B.C.) modified and enhanced the glass production as well as its uses, applications and costs, making *vitrium* a very popular material.

Vessels and later windows were produced using the process of glass blowing, which was brought near to perfection by Rome and its colonies [3]. In particular, the use of silvered glass mirrors spread throughout Europe, but not the Middle East nor Asia. Two methods of producing a sheet of glass, the *cylinder* and the *crown* methods, were then developed. After the fall of the Roman Empire, glass manufacturing hardly changed up to the eleventh century and was dispersed to isolated sites in the West. From about 14th century on, Venice became a leading glass manufacturing centre of resurgent Europe, producing the first rate glasses needed for lenses and prisms, other technological advances. Kostylo [5] affirmed that glassmakers who abandoned Venice to work overseas might be banished, forbidden to work in the city again. These new innovations led to the manufacture of spectacles or eyeglasses to improve human vision in Europe during the 13th and 14th centuries [15].

The book by the Italian priest Antonio Neri (1576 - 1614): '*L'Arte Vetraria*', the first manual ever, published in Pisa in 1612, gives an overview of the glassmaking know-how available at the time. Some glassworkers established themselves first in Lorraine and later Normandy, and then moved to England where coal furnaces were introduced in the 18th century [2]. Glassmakers enjoyed an unusually high reputation however, to protect the monopoly, they were strictly forbidden by governments from leaving the country. One example occurred in France, around 1665, where the French politician and architect Jean-Baptiste Colbert (1619 - 1683) decided to fight the Venetian monopoly and created a glass industry to produce the Hall of the Mirrors for the Palace of Versailles: the '*Manufacture Royale des Glaces de France*' which later became the Saint-Gobain company (www.saint-gobain.com). Many glass craftsmen were assassinated by hired killers, two in particular for making the famous Mirrors in Versailles.

Glassmakers spread all over Europe in eighteen century due to the industrial revolution and as a result of new discoveries in chemistry such as the replacement of natural alkali for sodium from sea salts or adding limestone to improve chemical durability [2]. Lighting technology also has strong connections with glass manufacturing. It was the Swiss physicist and chemist François Pierre Ami Argand (1750 - 1803) who improved the traditional oil lamp around 1780. The US 223,898 patent of the American inventor and businessman Thomas Alva Edison (1847 - 1931) was one of the first to develop a practical incandescent bulb in 1880 [16]. Another important technological advance was made by the German chemist Justus Liebig (1803 - 1873) [17] for a new process for silvering glass sheets which eventually became the basis of modern mirror-making. The following century, mechanized processes were introduced, such as the automatic glass blowing machine built in 1903, created by the American inventor Michael Joseph Owens (1859 - 1923), mainly for glass bottle production (US 534,840 [18]). Iconic bottle designs by famous companies such as H. J. Heinz Co. and Coca-Cola were manufactured at the Owens Bottle Company. In 1918, the inventors Emile Fourcault (1862-1919) [19, 20] in Belgium and, independently, Irving Colburn (1861-1917) [21] in the USA patented the technique of producing sheet glass, which involved the glass being

drawn through cooled rollers to produce a ‘fire-polished’ product. One of the single most important innovations made in Great Britain since World War II was the continuous production of float glass on the surface of a bath of molten tin with introduction of the industrial process done by Pilkington and Bickerstaff [22] (GB 769,692, US 2,911,759 patents).

3. THE PAST: LITTERAE PATENTES

According to Dobyns [23], the derivation of specific letters called patents in England was a concession of the monarch. The English King issued patent letters initially as merely public royal proclamations to anyone who might read them. Thus, the monarch or his staff had been convinced that it would be interesting to protect some invention by means of such special documents.

The word *patent* comes from the Latin verb *pateo*, i.e., to lie open, accessible, exposed. Thus, “*litterae patentes*” means an open letter. Klitzike [24] pointed out that this name was addressed not to particular individuals, but “to all to whom these presents shall come.” The documents were usually sealed by the Monarch so that they could not be read without breaking the seals. In fact, such letters were used by medieval royals to award exclusive rights and privileges to some people. With a royal seal, the letters served as proof of those rights, for all to see. A grant of Patent Letters was thus a personal and direct award of some monopoly, dignity, franchise, office, or other benefit by the King through the exercise of the royal sanction and was registered on the English Patent Rolls in the Records Office. Nowadays, according to the *Intellectual Property Office* of UK, the term patent usually refers to the right granted to anyone who invents any original, functional, and innovative process, machine, article of manufacture, or composition of matter.

A letter from King Henry VI is shown below, as presented in the “Calendar of the Patent Rolls preserved in the Public Record Office [25]:

April 3. Westminster

“Licence for life for John Utynam, born in Flanders, who has returned, of late to England at the king’s command, to stay in the realm with his wife and children, sons and daughters, and servants, as

any liege of the king, and protection for the same; grant also to him for life that he may engage in all acts, works and sciences lawful and liberal without impediment, and since he has come to make glass of all colours for the windows of Eton college and the college of St. Mary and St. Nicholas, Cambridge, appointment of him to take artificers, workmen and labourers and to set them to work at the king’s wages, and wood, clay (lutum), stones, ashes, metals and carriage therefor, and to commit to prison all rebellious herein to stay until they find security to serve faithfully; and grant that all glass made at his own costs and not for the use of the colleges may be exposed by him for sale without payment of customs or subsidies thereon; and because the said art has never been used in England and John intends to instruct divers lieges of the king in many other arts never used in the realm beside the said art of making glass, the king retains him therefor for life at his wages and fees and grants that no liege of the king learned in such arts shall use them for a term of twenty years against the will and assent of John, under a penalty of 200l., whereof two parts shall be rendered to the king and one part to John, any liege who cannot levy that sum to suffer imprisonment without delivery save by the king’s special command”. By K. etc.

It is important to note that the declaration above is related to a distinct and comprehensive policy in favor of the glass industry. According to historians of Eton (www.etoncollege.com), the College was established in 1440 by King Henry VI as “The King’s College of Our Lady of Eton besides WyndSOR” to provide free education to seventy poor youths who would then go on to King’s College, Cambridge. At that time, King’s College was formally named “The King’s College of Our Lady and Saint Nicholas in Cambridge” (www.kings.cam.ac.uk). King’s was founded also by Henry VI in 1441. However, the monarch plans for the King’s College were interrupted by the *Wars of the Roses* (1455 - 1487), resulting in insufficiency of funds. Little progress was made on the project until 1508.

According to Klitzike [24], the English Crown was not the first to grant patents to inventors but they were the first to develop a lasting patent law. Only in 1552 did Edward VI grant a patent of in-

vention to Henry Smyth. He was a London merchant there is little information about - only that presented in the Calendar of the Patent Rolls preserved in the Public Records Office [26]:

26 April. Westminster

“Whereas Henry Smyth of London, merchant, intends to bring certain strangers into the realm expert in making “brode glasse” such as is commonly called “Normandy glasse”, whereby divers of the king’s subjects “may be sett to worke and gett their lyyng and in tyme learne and be hable to make the said glasse them selves” and instruct others:

Licence to the said Henry Smyth to bring from beyond seas such persons as are expedient for making the said “grasse” (sic); and for twenty years to make the said “Normandy glasse” anywhere within the realm; and no person without his authority “shall attempte or presume to make any kynde of the said brode glasse commonly wount to be caUed Normandy glasse or any other fytt for wyndowes”, on pain of forfeiture of all glass so made.”

By p.s.

The patentee planned to introduce foreign workmen “mete and experte” in glassmaking. Davies wrote about this letter as follows [27]: *“...brode glasse of like fasshion and goodes to that which is commonly called Normandy glasse which shall not only be a great commoditie to our said realme and dominions but also bothe in the price of the glasse aforesaid and otherwise a benefite to our subjectes and besydes that dyvers of them may be sett to worke and get their lyyng and in tyme learne and be liable, to make the said glasse them selfe and so from tyme to tyme instructe the others in that science and feate.”*

Smyth also received a monopoly privilege for twenty years, under which, according to Davies [27], “no manner of person or persons not licensed, or auctorised by the said Henry Smyth as is afore mencioned shall attempte or presume to make any kynde of the said brode glasse commonly wount to be called Normandy glasse or any other fytt for wyndowes upon peyne or forfayture of all the same glasse by any of them so to be made and as they and eny of them regarde our

expresse comaundment and entende too avoyde that trouble and perell which shall earnestly and in-delayedly insue in this behalfe.”

These were the first and second of the relatively numerous patent grants of the latter half of the sixteenth century in English. As described his patent, Smyth promised to instruct, train and educated persons in his know-how so that the manufacture could be widely available when the award finished. Note that both first and second patents gave both inventors monopoly privileges for 20 years.

Other patent privileges to individuals did not grant monopolies but only privileges to practice innovations in England. Before this time the organizations had been the exclusive recipients of monopolies but nowadays inventors and people who brought new industries from abroad were to receive monopoly privileges similar to those the guilds had received.

Although John Utynam’s patent antecedes Smyth’s by a hundred years, there were no known intervening grants. John’s patent remained the only one in the 15th century and it was not until Henry Smyth that the English system of monopoly patents to inventors for innovations started to be a regular practice. Thus, the English patent system evolved from its early medieval origins into the first modern patent system that recognized intellectual property in order to motivate innovation and invention; this was the key legal foundation upon which the Industrial Revolution (1760 - 1850) could emerge and flourish centuries later, starting as heirs of Utynam’s and Smyth’s.

4. PRESENT AND NEAR FUTURE

A patent continues in almost the same form today. It is a techno-legal document in which the science of the invention is established, the way to manufacture it is described and the legal boundaries of the innovation for which protection is claimed is specified. Great Britain was the first pioneer in the Industrial Revolution and therefore it was the first place where innovative patents evolved from an occasional curiosity to a monopoly and later a dominant commercial tool. Since the first English patent, awarded in 1449, more than 2.5 million patents have been filed at the UK *Intellectual Property Office*

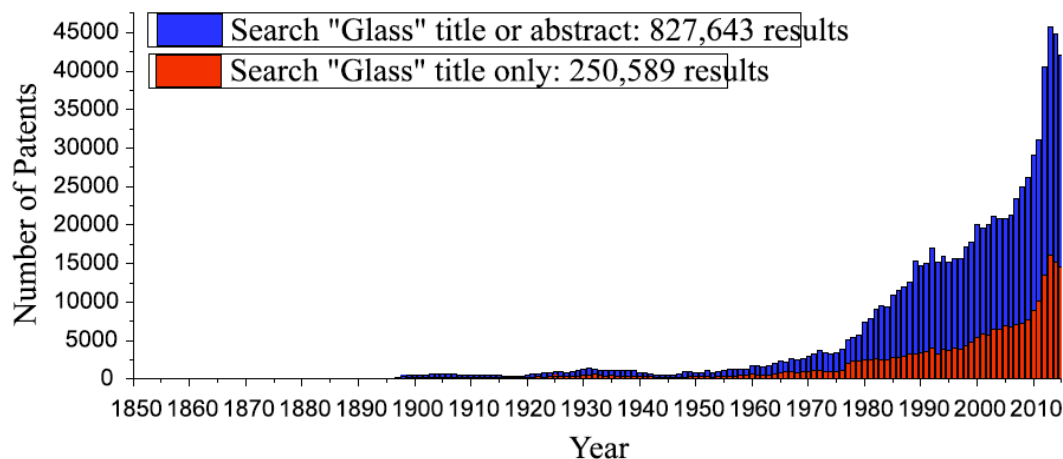


Fig. (6). Frequency distribution results for patent search using “glass” in the *title* only and *title or abstract*; or search using “Float glass” in the *title* only and *title or abstract*, from 1859 to 2015. Data from www.epo.org.

The USA has issued more than 9 million patents since 1790 and celebrated the 225th Anniversary of the Patent Act Celebration in 2015. Currently more than 80 million filed patents have been filed at the European Patent Office: Espacenet (www.epo.org) to 2015. A specific search with the key word “glass” yielded the following results per year considering a *worldwide* base (Fig. 6). From this figure it is clear that there has been an exponential growth in the number of patents. Searching for titles using the term *glass*, 250,589 patents have been filed since 1859. If one considers the same keywords in the *title or abstract*, the number reached 827,643 patents up to 2015 and this number is increasing. Gone are the days when the King simply awarded monopoly rights to an invention by using his seal. Today all patent processes are regulated worldwide.

CONCLUSION

Gomme wrote that the first English monopoly patent for invention was granted on April 3, 1449, to John Utynam, who had come to England from Flanders at the call of the King. It was probably because John’s art and technology of producing colored / stained glass had never been used in England and since John intended to instruct persons and stay in England, no one other than John was permitted to practice these arts for twenty years. Thus, the crown issued him a Patent Letter, with the King’s Great Seal, to guarantee John’s privileges. But John Utynam’s triumphant mission to protect his technological innovations originated a system that gave people official sanction to enjoy the economic benefits of their own knowledge.

In this work we have presented the great evolution of the patent system in glass industry considering data from 1850s. More than 827,643 patents have been filed around the world in these half hundred years using the term “glass” at the title or abstract prior to 2015. These numbers just continue to grow as do total sales worldwide. Looking for titles using “glass” only, we found 250,589 patents filed in the same period. But in fact we can consider the beginning of this intellectual production officially as early as 1449.

Neither John or Smyth may have been the actual inventors of the innovative glassmaking process; however, to obtain patents, this was not necessary. Like later patentees, both John Utynam as Henry Smyth promised to instruct others in their arts and knowledge so that it could be developed in England when the grants expired. Unlike the others, however, John as well as Smyth were the first to have granted monopoly licenses under which they could exclude others from practicing their arts for twenty years. These are probably the first and second English patents for invention as it is known in England today. It is no coincidence that the first patents in Italy, France, United States, Brazil and Germany were also related to glass technology. The patent language represents a fascinating interface between innovation and science and technology. We briefly showed how patent laws around the world reveal the influence of the practical uses of glass in their history. Thus, we may conclude that all inventors are indebted to Utynam and Smyth and the rise of glass technology.

CONFLICT OF INTEREST

The author confirms that this article content has no conflict of interest.

ACKNOWLEDGEMENTS

The author thanks the Brazilian agency CNPq for their financial support, in special grant numbers 305373/2009-9, 479799/2010-5, 300938/2012-8 and 471546/2012-7. And for the *Deutsche Patent- und Markenamt* (German Patent and Trade Mark Office: www.dpma.de), in particular to Brigitte Feierabend for sending a copy of the first German trademark.

REFERENCES

- [1] A. A. Gomme. Early British Patent Grants. *Nature* **119** (1927) 494-494.
- [2] J. Zarzycki. Glasses and the Vitreous State. Cambridge Solid State Science Series. Cambridge Univ. Press (1991) 505 pages.
- [3] A. Macfarlane and G. Martin, *Glass: A World History*, Chicago Univ. Press, Chicago, (2002) 288 pages.
- [4] M. Frumkin. The Origin of Patents. *J. Patent Office Soc.* **27**, (1945) 143-149.
- [5] J. Kostylo. Commentary on the Venetian Statute on Industrial Brevets (1474), in *Primary Sources on Copyright (1450 - 1900)*. Eds. L. Bently & M. Kretschmer (2008).
- [6] S. Hopkins. Making Pot ash and Pearl ash by a new Apparatus and Process. *US X,000,001* (1790).
- [7] H. M. Paynter. The First U.S. Patent. *Invention & Tech.* Fall (1990) 18-22.
- [8] W. M. Kelso. *Jamestown, the Buried Truth*. Charlottesville: University of Virginia Press (2008) 256 pages.
- [9] R. J. Beiler. *Immigrant and Entrepreneur: The Atlantic World of Caspar Wistar, 1650-1750*. Penn State Press (2008) 224 pages.
- [10] A. C. M. Rodrigues, E. D. Zanutto. Glass Industry and Research in Brazil. *Glass Intern.* **22** (2002) 24-27.
- [11] J. Zeltner. "Verfahren zur Herstellung einer rothen Ultramarinfarbe". *DE patent 1* (1877).
- [12] B. Spear. James Watt: The Steam Engine and the Commercialization of Patents. *World Patent Info.* **30** (2008) 53-58.
- [13] A. A. Gomme. *Patents of Invention: Origin and Growth of the Patent System in Britain*. British Council (1946).
- [14] A. K. Varshneya. *Fundamentals of Inorganic Glasses*. Society of Glass Technology, Second edition (2006) 682 pages.
- [15] A. Macfarlane and G. Martin. A World of Glass. *Science* **305** (2004) 1407-1408.
- [16] T. A. Edison. "Electric lamp". *US 223,898* (1880).
- [17] J. Liebig. Ueber Versilberung und Vergoldung von Glas. *Annalen der Chemie* **98** (1856) 132-139.
- [18] M. J. Owens. "Apparatus for blowing glass". *US 534,840* (1895).
- [19] E. Fourcault. "Apparatus for the manufacture of plate-glass by stretching" *US 717,378* (1902).
- [20] E. Fourcault. "Method of and apparatus for drawing continuous sheets of glass". *US 941,866* (1909).
- [21] I. W. Colburn. "Process and apparatus for drawing sheet-glass". *US 1,394,809* (1921).
- [22] M. L. F. Nascimento. Brief History of the Flat Glass Patent - Sixty Years of the Float Process. *World Pat. Info.* **38** (2014) 56-60.
- [23] K. W. Dobyns. *The Patent Office Pony: A History of the Early Patent Office*. Sergeant Kirkland's Press (1997).
- [24] R. A. Klitzike. Historical Background of the English Patent Law. *J. Patent Office* **41** (1959) 615-650.
- [25] Calendar of the Patent Rolls preserved in the Public Record Office - Henry VI, covering the years 1446-1452, Volume **5** (1909) 255-255. <http://sdrc.lib.uiowa.edu/patentrolls> - Web access on June 23, 2016.
- [26] Calendar of the Patent Rolls preserved in the Public Record Office - Edward VI, covering the years 1550-1553, Volume **4**, Part V (1926) 323-323. <http://www.medievalgenealogy.org.uk/sources/rolls.shtml> - Web access on June 23, 2016.
- [27] D. S. Davies. Further Light on the Case of Monopolies. *Law Quarterly Rev.* **48** (1932) 394-414.