MAP LIBRARIANSHIP: Readings

compiled by
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PREFACE

Graphic representation of the earth's surface is not a recent discovery. From the earliest times men prepared maps, although not necessarily in familiar forms, to show and understand space relationships. That simple function has since been multiplied, and now, in modern life, the map is used in many disciplines and has no substitute. To realize the importance of maps today, it would be sufficient to mention only a few vital subjects such as density and distribution of population, geographical location of diseases, land use, geology, distribution of minerals and industries, transportation, planning and many other subjects, which could not be better represented, understood or studied than on a map. According to Professor Salishchev, "maps find their use in all spheres of scientific, economic and cultural activities. They are indispensable for a detailed registration, analysis and objective evaluation of natural conditions and resources, labour resources and productive forces, as well as the multiform service system (education, public health services, trade etc.). ... Many works from cartography are among the outstanding achievements of the world of science; they are cultural values of non-transient significance."*

In this age of intense and sophisticated investigations of the environment, the map as a medium for information storage and as an analytical tool is of a great importance. How to prepare, search, order, catalog, store, preserve and retrieve them is a complicated task. Satisfactory service in these areas can be provided only by properly trained map librarians. It is surprising that, although the value of maps

*"The Present-day Thematic Cartography and the Task of International Collaboration," Institution of Surveyors, (India). New Delhi: 21st International Geographical Congress, New Delhi, Nov.-Dec. 1968; 7-8.

has been long recognized, the fundamentals of map librarianship are only beginning to be considered. There has been very limited professional training in map librarianship. Map curators, or if you prefer, map librarians, have indicated that their collections could be improved in both service and care, if professionally trained personnel were available. Realizing the present needs and future demands in map librarianship, the Columbia University School of Library Service initiated a course in map resources and map librarianship in 1969.

Although numerous articles on the subject of map librarianship have been published--mostly in specialized journals--a systematic and sequential description of map collection operation has heretofore not been available. The present work is intended by presenting a compilation of selected articles on seven specific subjects, to provide at least some guidance for map librarians. At the end of the book will be found a bibliography, arranged by chapter, of further readings related to each area of interest. Taken together, these represent an extensive listing of articles related to the processing and care of maps and the running of map libraries.

This publication was possible only because so many writers have contributed to the knowledge of map librarianship. They made possible the selection of 48 excellent articles herein reprinted; to them I express my thanks and appreciation. Also, I would like to thank the many authors, organizations and editors who granted permission to reprint the selected articles, and the many persons who helped prepare this book. Special thanks I would like to express to Dr. Walter W. Ristow, Chief of the Geography and Map Division, Library of Congress, for very useful suggestions and professional advice.

Roman Drazniowsky
New York City
August 1973

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1. INTRODUCTION TO MAPS

MILESTONES OF MAPPING*

E.D. Baldock

The origin of maps is unknown, but their genesis must have been associated with man's need to record his surroundings in some graphic form. Primitive man drew pictures on the walls of his cave; many of these drawings probably represented a pictorial map of the area where he lived. Because early nations based their wealth on land and as taxation was levied upon its produce, it was necessary to mark land boundaries for assessment purposes. The earliest recorded cadastral surveys were made in Babylonia about 2300 B.C. and a very accurate system of land survey was developed in Egypt during the 14th century B.C., with permanent boundary markers to find land holdings after the annual flooding by the Nile.

The oldest map in existence today was found in the ruins of ancient Babylon. It was carved on a small clay tablet about the year 3500 B.C. It is interesting to note that the positions of north, east and west are shown by circular symbols. The Babylonians were possibly the first to divide the circle into 360 degrees.

To the Greeks we owe the foundation of our present system of cartography. Many of the ancient scholars recognized the earth as a sphere with its poles, equator and climatic zones; they developed the latitude and longitude system and calculated the earth's size. Philosophers of this pre-Christian era were slowly producing the key to our

*Reprinted by permission from The Canadian Cartographer [formerly The Cartographer], vol. 3, no. 2 (1966), 89-102. Published by B.V. Gutsell, Department of Geography, York University, Toronto.

knowledge of mother earth; it was contained in their many writings, which had fortunately been gathered together in the magnificent libraries of Alexandria. Twenty-five years before the birth of Christ, Strabo, a young Greek scholar, decided to compile man's knowledge of geography. He took up residence in Alexandria and commenced the gigantic task of sorting cartographic knowledge, often submerged in the most unlikely works of the philosophers. Strabo was a confirmed stoic, exemplifying a philosophy well suited to the task he was to perform. After some five years of intensive study he produced a history of cartographic knowledge which had been advanced to his time. It is not the intention to deal in detail with Strabo's work but simply to establish a few basic facts and his influence on cartographic development. Strabo traced man's knowledge of the heavenly bodies which, from earliest times, had provided the calendar for events. By the 7th century B.C. a great wealth of data had been gathered and Strabo rightly concluded that man's knowledge of the Universe was an important factor in developing his understanding of earth geography.

When the Greek philosophers were delving into the nature of things, it was natural that the earth was a much debated subject. Anaximander, a pupil of Thales of Miletus, founder of the Ionian School of Philosophy, advanced the theory that the earth was a thick section of a cylinder suspended in the circular vault of the heavens, supported by whirling balls of fire; this idea was possibly based on an early Babylonian concept. A pupil of Anaximander, by the name of Anaximenes, rejected his teacher's theory for that of a rectangular shaped earth supported in the heavens by the air it compressed, the habitable world being surrounded by a great ocean flowing into the Mediterranean.

Many philosophers followed, but Pythagoras the Ionian, founder of a school of philosophy at Crotona in the 6th century B.C., is credited with the nearest approach to the truth regarding the earth's shape. He argued against the generally accepted theory that the earth was disc-shaped and offered his theory that the earth was spherical; how he arrived at such a revolutionary idea is not known. Aristotle later came to the same conclusion when in summing up the various theories he stated that "the Universe is finite and it is spherical." From about the time of Pythagoras the earth began to take its rightful shape in the minds of a few men, and mathematicians endeavoured to calculate its size. Aristotle stated the mathematicians of his day estimated the circumference of the earth to be between 30,000 and 40,000 miles.

The first detailed account of how the earth's circumference was measured comes from the Greek scholar Eratosthenes of Cyrene in the 2nd century B.C. Having observed at Syene that the sun shone down a deep well, with no shadow at mid-day on the summer solstice, he assumed that the well was situated on the Tropic of Cancer. Using the measurements available from the Egyptian land surveys he estimated the distance between Syene and Alexandria to be 500 miles (expressed in stadia) and assumed that Alexandria was directly north of Syene, therefore on the same meridian. With the sun at its zenith on the summer solstice he measured the angle of a shadow cast by a pole in Alexandria as 1/50th of a circle. By applying Proposition 29 of Euclid, who lived in the 3rd century B.C., Eratosthenes concluded than an angle of 1/50th of a circle subtended an arc of 500 miles making the earth's circumference 25,000 miles. This was a remarkable achievement, taking into account that not all of his assumptions were correct. (The earth's circumference at the equator is approximately 24,899 miles.)

Eratosthenes produced a map based on a parollelogram having seven irregular meridians and seven parallels passing through specific places such as Meroe, Alexandria, Rhodes, etc. Topographical content was normal for this time, covering from the west coast of Africa to India across the Equator and from Scandinavia in the north to Libya in the south. This map remained in use despite its many errors until 30 A.D.

Hipparcus, the famous astronomer of the 2nd century B.C., criticized Eratosthenes' map, maintaining that the parallels and meridians should be equally spaced at intervals of one half-hour, and that all geographical information should be positioned by using latitudes and longitudes reduced from astronomical observations. Posidonius, who conducted a school on the island of Rhodes in the 2nd century B.C., made the second recorded attempt to measure the earth's circumference. He observed that the star Canopus just grazed the horizon at Rhodes; measuring the meridian height of the star as 1/48th part of a circle at Alexandria, which was accepted as 500 miles to the south and on the same meridian as Rhodes, he concluded the difference in latitude of the two places was 1/48th of a circle; therefore his calculation of the circumference of the earth was 500 X 48 =

24,000 miles. Posidonius also made certain assumptions which were not correct.

Crates of Mallus, a Stoic philosopher, constructed a globe in 140 B.C., reasoning that the spherical earth described by geographers did not comply with the Greek laws of symmetry. He added balancing land masses in the four quarters of the sphere. This globe was later to become a symbol in the regalia of Kings.

Strabo, in summarizing these calculations, attempted to fill in details assumed to be in error and established a revised measurement of 18,000 miles around the earth's circumference. He described the habitable world as a spherical quadrilateral washed on all sides by the sea. To construct such a map, he said one would require a very large sphere, so that the small area representing the habitable world would be large enough to show the required detail. Strabo also recognized the difficulties of representing the spherical co-ordinates of the sphere on a flat surface; he offered no solution of his problem, but maintained that for practical purposes meridians and latitudes could be drawn as straight lines.

Independent of the cartographic knowledge being developed by western philosophers, China was producing maps, reference being made in their early literature to one produced in the 3rd century B.C. Some of these maps followed the circular concept, China occupying most of the circle. Pei Hsiu in the 2nd century A.D. actually laid down the guiding principle for drawing maps. Local governors were required to have maps made covering their areas, these being drawn on paper.

Roman cartography differed considerably from that of the contemporary Greek. The Romans required maps for military and administrative purposes and were not concerned with any mathematical consideration. Their map of the habitable world was circular (Orbis Terrarum) with the Roman Empire occupying the greater portion of the map; Asia, much reduced in size, occupied the top segment (this is apparently where our term "orientation" is derived). These circular maps, often referred to as "T-O maps," were destined to be used extensively by early Christian cartographers. Roman topographical maps were actually diagrams of places and routes with little attention being given to actual latitude, longitude or scale.

Most cartographers after Eratosthenes were endeavouring to portray a more accurate map of the habitable world. Information was gathered from travellers, latitudes and longitudes were estimated, then plotted on maps. In the 2nd century A.D. a noted geographer Marinus of Tyre attempted to bring the mapping of the habitable world up-to-date, placing the northern extremity at the parallel of Thule designated as 63° north of the equator. This distance was approximately 3,150 miles according to his acceptance of 1° = 50 miles. He extended the southern limit to 24° below the equator. The east-west distance was one over which considerable controversy existed; however, Marinus extended the habitable world over 15 hours of longitude or about 11,250 miles at the equator. The map Marinus produced was crude and followed the early concept of parallels and meridians being straight lines intersecting at right angles. A copy of this map was reported as being seen in the 10th century A.D.

In the 2nd century A.D., Claudius Ptolemy was appointed curator of the library in Alexandria where he had access to Strabo's records. Ptolemy's influence was to be felt in cartography for many centuries to come. He was a prolific writer, more inclined to science than philosophy, delving into astronomy, optics, cartography and music. As a map compiler his topographic detail was not highly rated, but he laid down the foundations for an orderly system in the practice of cartography. If Ptolemy's geographic interpretation of the habitable world left much to be desired, his cartographic knowledge far surpassed his predecessors. His writings contained detailed instructions on how to construct the stereographic, orthographic and conic projections of a sphere to a flat surface. He produced a gazetteer listing all important places by latitude and longitude and made considerable studies on distances between places.

Ptolemy's map of the habitable world was constructed on a conic projection, recognizing the convergency of meridians towards the north pole. He estimated the habitable world to be about 180° around the equator, but accepted Strabo's figure of 1° = 50 miles thus reducing the equatorial circumference to 18,000 miles. As reports of travellers were received map-makers extended Asia eastwards until only 50° separated the Indies from Spain. This error persisted to the 14th century and possibly inspired Columbus to venture westward to the Orient and thus a new continent was discovered. After the collapse of the Roman Empire, the

Arabs became the heirs of Ptolemy's works, which they translated into Arabic. The Arabian mathematicians continued to add precision to earth measurements and although accepting a spherical earth, their world maps were crude and followed the circular concept.

With the growth of the Christian Church, monastic orders became established as seats of learning from which some of the great universities developed. We often hear the middle ages referred to unjustly as the Dark Ages, but one must consider conditions that existed at that time. The average person could neither read nor write, nations and states waged perpetual wars, and intrigue among the ruling classes was rampant. The monasteries provided the scholar with peace and quiet where he could pursue both religious and secular studies. These monks developed the skill of better writing, produced books on many subjects and drew maps. To them we owe the preservation of the sciences and the foundation for future development of knowledge.

There developed during this mediaeval time three distinct types of maps mostly all hand-drawn on vellum, some beautifully illuminated; like books, they were scarce due to the tremendous amount of time consumed to draw and write by hand. These maps might be classified as symbolic, topical and practical. In the last type is included the famous Portolano navigation charts, produced solely by sea captains. Their accuracy was extremely good and in time formed the basis for better knowledge of shorelines and distances.

Symbolic maps were developed from the Roman circular maps and were designed by ecclesiastics to instruct the faithful in church dogma. Jerusalem was usually shown at the centre. We are reminded that the ordinary person could not conceive of the earth as a sphere and the circular concept was a compromise. Some symbolic maps did attempt to become theoretical as explained by a 6th-century monk, Cosmas, in his Christian Topography. His habitable world was based on the biblical description of the tabernacle. Fortunately, these maps were not numerous and were soon forgotten.

Topical maps of this period were designed for specific purposes such as illustrating estates, routes of pilgrims, locations and place names. They were artistically drawn on parchment, often with illuminated text. These early map makers had to have a detailed knowledge of the map area, and the artistic skill to produce it. Many problems must have faced them: for example, the size of available parchment would affect the scale; how features were to be symbolized and which colours were to be used. The latter was based on nature; green for trees, blue for rivers, brown for roads, black for outlines and names. Such application of colours has not changed to any extent on our modern maps.

Let us pause at this point in the story of maps to consider what materials were available to the map maker on which to record his work. As already stated, the earliest known map was incised on a clay tablet about the year 3500 B.C.; more portable maps and diagrams were most likely produced long before this on skins of animals which have not survived the ravages of time.

Papyrus, which was processed by the Egyptians, was the first material that had good qualities for drawing and writing, records indicating its use as early as 3500 B.C. The papyrus plant flourished along the banks of the Nile. The portion used was the stalk, being cut into 16" lengths. The centre marrow was cut into thin strips and laid side by side with another layer placed at right-angles over the first, then treated with a gum solution, pressed and smoothed, the resulting sheets being approximately 12" X 16". If extra length was required in a roll, the sheets were pasted together.

Parchment made from splitting the skins of sheep or calves was known to exist by 500 B.C.; the calf skin produced the best writing surface and became known as "vellum." Due to the availability of papyrus, parchment did not come into general use until about 200 B.C. and then only due to an Egyptian embargo being placed on the export of papyrus to the King of Pergamum (Asia Minor) who was then forced to manufacture skins for writing. The process of splitting and curing skins had by this time been much improved, producing a more durable and better surface than the fragile papyrus. When these writing skins were exported to the Romans they called it pergamena from which the name parchment is derived. Parchment became the main medium for writing in Europe by the 4th century A.D. and had far-reaching effects on the development of writing techniques, due to its smooth surface allowing the easy movement of the quill pen in all directions.

Due to the skill and labour required for the manufacture of writing materials, it is little wonder that very few maps and records existed in early times. A more economical and simplified method of producing a writing material would have to be developed if dissemination of knowledge was to be extended to more people than the few learned scholars who were unfolding the nature of things. The manufacture of paper finally solved this problem, but from the time of its invention until its use in Europe many centuries elapsed.

The Chinese developed a system of bookmaking from engraved wood blocks nearly six centuries before printing was introduced into Europe. The reason for this amazing development was the invention of paper-making about 105 A.D. in central China credited to a man named Ts'ai Lun. By the 5th century A.D. paper had become the general medium for written documents in China. Examination of this original paper has proven it to be pure rag paper. The movement of the use of paper towards the Western World was slow, influenced by the powerful military and religious forces of Islam. Records reveal that paper was used in the following locations in its movement westward.

Central China	105 A.D.	Chinese use
Tun-huang	150 A.D.	"
Lou-lan	200 A.D.	"
Turfan	399 A.D.	"
Gilghit (Kashmir)	500-600 A.D.	
Samarkand	751 A.D.	Moslem
Baghdad	793 A.D.	"
Egypt	900 A.D.	"
Fez (Morocco)	1100 A.D.	"
Jativa (Spain)	1150 A.D.	"
Fabriano (Italy)	1270 A.D.	Christian
Nuremberg (Germany)	1390 A.D.	"
England	1494 A.D.	"
North America	1690 A.D.	"

Long before paper provided the impetus to printing books in Europe, it was playing an important role in Asia. The Arabs, inflamed with religious zeal to conquer the world for Islam, gained the knowledge of paper-making from prisoners captured in a campaign in Russian Turkestan. Their conquest denied Europe free access to the established trade routes from the east, and the Moslem world controlled the paper-making industry exclusively. Paper derived its name from papyrus, which it completely replaced by 950.

The invasion of Spain by the Moors introduced paper-making for the first time into Europe; a paper mill, operated by the Moors, was erected in the town of Jativa about 1150. Paper then became available to Christian Europe and was used for block printing and writing. Paper-making was established in Italy about 1270 at Fabriano which is still an important centre in the manufacture of high quality paper. The largest size of paper produced in these early mills was about 19" X 25", which naturally restricted the size of maps produced by printing methods that developed in the 15th century. Early in that century, the printing press was destined to change man's knowledge of the world in which he lived. Illustrations engraved on wood were being printed on paper on a press adapted from the wine presses of the Rhine. With the invention of moveable type by Johanne Gutenburg in 1440, it was not long before books dealing with scientific subjects were printed.

No record of man's ability to write and print would be complete without some mention of ink. The ancient scribes of Egypt used a reed pen-brush to apply an ink which was mixed when needed. For black ink, lampblack was mixed with an aqueous solution of vegetable gum, and for carmine ink, red oxide of iron was used; the red being used for initial words. This practice was later adopted by the Greeks and Romans, surviving in the rubrics of early manuscripts. This method of preparing ink remained in use as a writing medium, even being used to pull impressions from early woodcuts. Iron-gall ink was described by Theophilus about 1100 and often resulted in a brownish cast noted in many early woodcut prints. While this watery ink was excellent for writing it was of little use with the new metal moveable type introduced in 1440. However, at the turn of the 14th century, painters had commenced using drying oils and varnishes for colour pigments. It was a natural step for printers to use the oil paint developed by artists with certain modifications to suit the new art of printing.

The demand for cartographic knowledge had caused the works of Ptolemy to be translated into Latin by 1410 and, in the first 60 years of printing, several elaborate folio editions of his geography were published, spanning a period of little cartographic advance. Ptolemy's acceptance of Strabo's figures for the earth's measurement was again in evidence and Christopher Columbus, a dealer in maps and charts, became convinced that the quickest route to the Indies--so richly proclaimed by Marco Polo after his journey there in 1485--could be made by sailing from Spain across the western sea; he made his first voyage of discovery in 1492. The period following this epic event saw explorations to distant places, extending man's knowledge of the earth; old theories and traditions were slowly discarded and separate scientific disciplines emerged.

From the beginning of printing, maps required in quantity were reproduced from copper engravings, a skill developed by the goldsmiths of Italy who had for some time made records of their designs engraved on goblets, plates, etc. by rubbing a greasy ink into the incisions, then pressing an image to paper; it was a natural step to use their skill to engrave maps on flat sheets of copper and print impressions on paper.

Not all maps produced during this period were engraved on copper; many maps were still being hand drawn or wood engraved. Two examples come to mind: the first, produced by Juan de la Costa on an oxhide in 1501, showing the Western discoveries of Christopher Columbus; the other, a map produced by Martin Waldseemüller in 1507, engraved on 12 wood blocks (18" X 24 1/2") which when assembled measured 36 sq. ft. in size; records show that some 1,000 copies were printed. The latter map illustrated the Western discoveries and was the first to name the New World as America after Amerigo Vespucci, who was possibly the first man to recognize it as a separate continent after his voyage to South America in 1499. This map should never fail to intrigue the cartographer as to the method used to engrave the wood. Was it cut intaglio or were the non-printing areas cut away? The former would seem more likely due to the great number of intersecting lines and the large amount of fine lettering which might have been stamped with a die.

The skill of map engraving soon became a prerequisite of the map maker. Gerard Mercator (1512-1594), the famous cartographer, engraved four map sheets of Flanders, which he published in 1540, having first surveyed the country to obtain the entire compilation of data. The tremendous skill and patience required to engrave a map is so often overlooked as we examine maps produced during this period of cartographic renaissance. All work on the engraved plate was reverse reading; corrections were difficult to make, requiring hammering out from the back of the plate then resurfacing the work side. All colours had to be added by hand on the printed copy; over two centuries were to elapse before a solution to the problem of reproducing colours was to be found.

The method of printing engravings was also destined to advance slowly from simply rubbing ink into the incisions, polishing off the surplus ink and then placing dampened paper over the plate and rubbing or squeezing it in a Rhine-type screw press. William Jansjoon Blaeu (1571-1638), a printer and map maker of Amsterdam, developed a press which eliminated a lot of the back-breaking pressure required to print a copperplate impression. This press employed moveable parts which allowed the plate to be moved by a cranking handle under a stationary block that applied a constant pressure, the paper being protected by a metal tympan greased for easy movement. Copperplate engraving was used as a map making method well into the 20th century, being combined with other reproduction methods for quantity printing.

The 16th and 17th centuries witnessed a flourishing trade in maps and charts. They generally had a definite similarity in cartographic expression irrespective of their origin, due no doubt to the itinerant fraternity of map makers during this period. The great amount of detailed ornamentation of titles and borders was quite possibly engraved by non-cartographic artisans retained for that purpose. The introduction of conventional map symbols began to appear on maps towards the end of the 16th century, replacing to some extent descriptive notes and miniature pictures; however, few map makers considered the necessity of supplying the map reader with a reference.

A completely new system of printing was developed by Alois Senefelder about 1805, destined in time to provide the map maker with a much improved method of reproducing his maps. Senefelder was an amateur writer who, finding the cost of printing his works too excessive, began experimenting with a "do-it-yourself" method based on contemporary printing systems. He began experimenting with copper etching, which involved lettering in reverse with a scribing point through a waxy acid resist coated over the copper. His ability to reverse letter was not good and, having many corrections, he developed a correcting ink made of wax, soap and lampblack formed into sticks; when needed, it was rubbed down in a little water and applied with a brush. The high cost of copper for practicing his reverse lettering prompted him to look for a substitute which happened to be a highly polished flooring tile of kellheimer sandstone mined near his home in Bavaria. By mere chance he wrote a laundry list for his mother on a clean stone with his correcting ink stick and before cleaning the stone poured acid over it; the result was a raised image of the lettering which would print.

Having succeeded in producing a printing method which was not new, but one he could do himself, he set out to develop a method to eliminate reverse lettering. Using a thin paper coated with gum, he lettered right reading with his correcting ink. Wetting the finished work and rubbing it face down to a new stone, he transferred a greasy image in reverse which could be etched. He observed when wetting the work that water adhered only to the gummed areas and any grease on water adhered only to the inked letters. This observation was the birth of lithography. His next step was to transfer an image to a new stone and treat it with a mild acidulated gum solution that would not lower the non-image surface. Keeping the stone moist, he found that greasy ink applied with a roller would adhere to only the image area from which a reproduction on paper could be made.

Senefelder had now discovered a completely new technique by which an image could be printed that was neither above nor below the surface of the stone, based on the principle that grease and water will not mix. Lithography developed very rapidly, and, by 1845, lithographic prints in colour were appearing in many countries.

One might ask what all this has to do with mapping. The simply answer is that lithography provided the map maker with many advantages. As printing presses were designed to afford registration, the heretofore hand-coloured maps could now be printed in colour. In addition, quantity printing was cheaper and faster than copperplate reproduction. Maps and charts continued to be engraved on copper and were transferred to lithographic stones for printing. A precise date cannot be ascertained but, towards the end of the 19th century, line engravings were being colour separated, using blue for water features, brown for contours and black for culture.

The method of obtaining tint colours was to pull a paper impression of the engraving, dust it with ox-blood--a red powder--which adhered to the wet ink; this was then pressed to a clean stone, leaving a chalky non-printing image as a guide to draw the colours. The ink used was precisely the same as developed by Senefelder but referred to as "touch." Stipples and rulings could also be applied to the lithographic stone by gumming a mask and using transfer paper on which an image from an engraved ruling or stipple had been pulled. When pressed to the stone it left a printable image on the exposed areas. The stone then was washed with water to remove the gum mask.

These techniques naturally gave rise to a new type of map maker, and many maps were produced at the turn of the 19th century by lithographic draftsmen who drew maps directly onto stone, pulling transfers from one stone to another to provide keys for colour.

Photography may well be called the hand-maiden of cartography as its development provided the cartographer with many advantages in the reproduction of maps. During its early development in the 18th century, photographic images could be made by exposing nitrate of silver to light, but no way was known to "fix" the image. Joseph Niepce, a printer living in Paris, had become interested in lithography. Being an indifferent artist, he commenced experimenting in 1814 to produce transferable images by photography. By 1824, he actually produced proofs from photo-etched plates. His process was to coat a pewter plate with asphaltum and expose it to light under an etching, or in a camera. The asphaltum became insoluble when exposed to light in its normal solvent (oil of lavender) leaving an acid resist coating of hardened asphaltum allowing the plate to be etched.

By 1848, photographic coatings and processes were developing rapidly and glass was becoming the accepted medium for negative support. John Hershall had discovered sodium thiosulphate (Hypo) as a fixing agent for silver salts. Frederic Scott Archer describes in 1851 a process being used in London, employing wet collodian on glass sensitized by immersion in a silver nitrate bath and exposed while the plate was wet. This became known as a "wet plate" which was used by map makers well into this century and replaced only after stable base films became available about 1949.

Col. Sir Henry James, R. E. of the British Ordnance Survey, saw the advantages of photo-mechanical methods in map making, and from 1855 conducted experiments resulting in the photo-zincography which was perfected by Capt. A. de Courcy Scott in 1860.

The actual process of photo-zincography by which many maps were printed has not been too clearly documented. From available sources it appears this was a zinc etching following the Niepce process but using a wet plate negative to expose the prepared zinc plate (emulsion to emulsion); after etching, the line work would be in positive (right reading) relief from which a double transfer would be made to give a reverse reading image on a printing stone. However, as the wet plate process developed it was possible to strip the negative from the glass support which allowed the etching of a reverse relief reading image requiring only one transfer to the printing stone. This might appear to be an involved process but power-operated stone presses (capable of printing several hundred copies per hour), were available about 1860.

The use of grained zinc in place of stone commenced about 1889 with the introduction of rotary litographic presses. Up to the turn of the century all lithographic plates and stones had to be reverse reading in order to print, which was a definite disadvantage to photo-mechanical processes connected with map reproduction. In 1904, the first offset press was developed allowing the use of right-reading images on zinc printing plates; however, stone flat bed presses continued to be used well into the first quarter of the 20th century.

Map makers during the first quarter of the 20th century employed a variety of methods to reproduce maps. Copper engraving continued to be used but pen and ink drawings were being produced in greater quantities and by 1920 had become a standard practice. The introduction of type for map nomenclature was a natural step and by 1925 most map makers were employing some method of preprinted lettering.

The great demand for maps after World War II forced the cartographer to develop faster reproduction methods in order to keep pace with the advancement made in both equipment and method employed by surveyors and photogrammetrists. An average map draftsman employing the pen and ink method could produce only two or three maps per year. The development of thin stable base plastic sheets provided the impetus to studies being conducted in the United States and Canada on faster map reproduction methods. The first step in utilizing plastic sheets was to eliminate the making of map tints on metal printing plates. Using a blue line image on vinyl plastic the tint areas were filled in with water soluble opaque. When dyed and washed, an open-window negative was obtained. The map maker could now provide all reproduction material and eliminate long delays when colour tint plates broke down during printing. This development occurred about 1949.

By 1952, map makers commenced map scribing on plastic sheets (which is the removal of a surface coating with a scribing tool). This was a breakthrough in the history of map making in Canada and, for the record, was first developed and used in this country by map makers in the Map Compilation and Reproduction Division of the Surveys and Mapping Branch, Department of Energy, Mines and Resources, Ottawa, Canada. The overall advantages of this new technique are many. To enumerate a few:

(a) the average draftsman doubled his annual output of finished maps.
(b) the instruments are simple, line weights can be maintained and difficult symbols can be easily drawn with templets.
(c) the basic tools are the rigid scriber and the swivel scriber; scribing cutters in single and double lines are commercially made to rigid specifications.
(d) draftsmen can be trained, in less than a year, to perform acceptable work under supervision.
(e) the idiosyncrasies of individual penmanship are eliminated, permitting more than one person to work on a specific map.

To describe the various scribing materials and methods in detail would be impossible in this paper. They have, however, given the cartographer the greatest flexibility he has ever had in map design and production.

The advancement in photo-mechanical processes has provided the very necessary support to these new techniques. It has also eliminated a considerable amount of hand drawing. What the future holds for map-making in this age of automation only time can tell, but whatever transpires, printed maps will require the artistic skill of the cartographer to present a readable and attractive product to the map user.

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