Cartography in the Twentieth Century, Volume Six of The History of Cartography (sample galley pages)

Paper. Paper's importance throughout the twentieth century as a medium for reproducing, disseminating, and storing cartographic information is matched only by its neglect in the literatures of practical cartography and post-Enlightenment map history. Hundreds of articles have addressed the future of the paper map, but its transport medium seems to have eluded scholarly scrutiny, except among archivists and librarians concerned with preservation (Melfa 1990). This short entry offers a few general insights about the kinds of paper used in map printing as well as structural changes in the paper industry between 1900 and 2000 that would have affected the papers used to print maps.

By 1900, the paper used for printing maps as well as for map drawing was entirely machine made. The most significant breakthrough occurred around the beginning of the nineteenth century when papermakers in England and France learned to make paper in continuous rolls rather than in individual sheets. The brothers Sealy and Henry Fourdriner, who ran a stationery business in London, cut the manufacturing time from three months to one day with a multistage machine that converted a slurry of rag or wood fibers into a dry roll of uniformly thick paper, which was then cut into individual sheets (Munsell 1876, 69–61). Machine speed increased progressively throughout the nineteenth and twentieth centuries, and paper manufacturers experimented with numerous improvements to the technical processes for preparing, pressing, chemically modifying, and drying the pulp and for bleaching and coating the paper to meet buyers' requirements for whiteness, opacity, thickness, smoothness, weight, tolerance for folding, and resistance to heat, sunlight, and humidity (Libby 1962).

Although commercial and government mapmakers benefited from ever wider paper-making machines, the market for large sheets of high-grade paper was dominated by book manufacturers, who typically printed signatures of sixteen, thirty-two, or sixty-four pages on the same sheet. The substantial growth in newspaper circulation in the late nineteenth century followed the development of steam-powered rotary web presses that printed directly onto a continuous roll (web) of newsprint, manufactured inexpensively from wood pulp. Until the rise of online cartography in the 1990s, news and weather maps distributed on cheap, acidic newsprint, which readily yellowed, outnumbered all other cartographic images.

Paper for printing maps was typically ordered in comparatively small lots according to specifications that reflected the intended use. Aeronautical and nautical charts, for instance, had to accommodate frequent annotation, and paper for the latter had to resist humidity. Military maps intended for field use were printed on waterproof paper, whereas paper for atlases and double-sided map sheets had to be relatively opaque. Because most sheet maps were printed on only one side of the paper, mapmaking agencies could cope with wartime shortages by printing new maps on the back of obsolete stock.

Salient trends in the pulp and paper industry have affected the quality and durability of the high-grade paper used for map printing. For example, the need for a setting agent to resist water penetration was a key concern. Maps intended for outdoor use require a highly permanent size, such as melamine formaldehyde, which was common in both 1900 and 2000, but a wider variety of materials was in use at century's end. In 1900 the paper might also have been coated with animal glue, a very robust coating.

Throughout the century, paper for indoor maps was produced using a mixture of hardwoods and softwoods in roughly a 40:60 ratio. Hardwoods provide opacity, smoothness, and resiliency, whereas softwoods provide tensile strength and resistance to tearing along folds. If a folded map were to be opened and closed repeatedly,
the paper would typically contain even more softwood and perhaps some long plant fibers. In 1900 most paper manufactured in the United States was made in the Northeast from species such as black spruce and maple using the sulfite process, which produces bright, hard, and somewhat weaker paper. In 2000 virgin (non-recycled) paper was made using the kraft process, in which the pulp needs more bleaching but is stronger and less troublesome for the machinery. The major reason for the demise of the sulfite process was the cost and pollution associated with the recovery of the pulping chemicals—problems solved with the modern kraft mill, which is a closed system that can be run with little air or water emissions. With the kraft process, the industry was able to pulp southern pines, but these species were not used in printing grades and found their forte in packaging grades.

Perhaps the most significant difference between 1900 and 2000 is the amount of recycled fiber used in printing. In 1900 little fiber was recycled, but by century’s end about 50 percent of the fiber was recycled. Even so, because recycled fiber is weaker than virgin material, higher-quality map papers often contained no recycled fiber.

A second major change concerns the internal sizing and fillers used in the paper. In 1900 the internal size was an aluminosilicate system, which required a pH of 4.5 to 5.0 to function properly. Achieving this pH required treating the stock with sulfuric acid, which attacks the glycosidic bond in the cellulose molecule so that these papers eventually became very brittle. In 1980 clay was the principal filler added to the pulp. In the 1970s synthetic sizing agents allowed the use of calcium carbonate as the filler, which produced a stronger paper at a lower cost. In addition, the paper was now buffered at a moderately alkaline pH. Even though the air contains sulfur dioxide, which is detrimental to paper, it is neutralized by the calcium carbonate so that the paper is now permanent.

Although a clay coating could be used together with calcium carbonate to provide a smooth finish, the exact ingredients were usually a trade secret. All maps are not the same, and the papermaker can design a special grade of paper containing a mixture of specific species and additives to meet the product’s needs. As with most products, there is always a trade-off between cost and quality.

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See also: Drafting of Maps; Drawing Media; Maps; Printed Maps; Reproduction of Maps; Reproduction of Maps by Printing

REFERENCE:
