Images as Maps

The image—defined here as a photograph, drawing, or print not explicitly designated as a map—began to occupy a prominent place in cartography during the twentieth century. An abundance of aerial images mushroomed following the invention of photography in the late 1820s, and the airplane and airship in the early 1900s, in addition to the continued use of kites and hot air balloons as overhead platforms. Partly because cameras set visible patterns mechanically through their lenses' geometric transformations of light, photographs were believed to communicate geographic relationships and empirical data more realistically than traditional maps, and they began to be adopted for cartographic purposes in many regions. In 1876 Aimé Laussedat, a colonel in the French army, exhibited the first maps made from photographs taken from elevated points on the ground, while Cesare Tardivo, an Italian military surveyor, directed the first geographic survey by plane in the early 1900s (Birdseye 1940, 2–5).

Aerial images soon began to accompany articles in the popular and scholarly press. The first photograph ever published in *National Geographic Magazine*, in 1889, was an overhead view of a miniature topographic model of North America that boldly provided readers a sense of visual ownership of the entire continent. Building directly upon developments in surveillance technology during World Wars I and II, private and government surveys embraced the use of overhead imaging as well. In 1929 C. H. Birdseye, chief topographic engineer at the U.S. Geological Survey (USGS) and founding president of the American Society of Photogrammetry, conducted an extensive aerial survey of the future site of the Hoover Dam (Birdseye 1940, 3, 11). In 1934, Harriet Shanks Platt and Robert S. Platt completed some of the first academic

experiments with the new media, employing photographs they captured from the windows of commercial flights across Central America (Platt 1934).

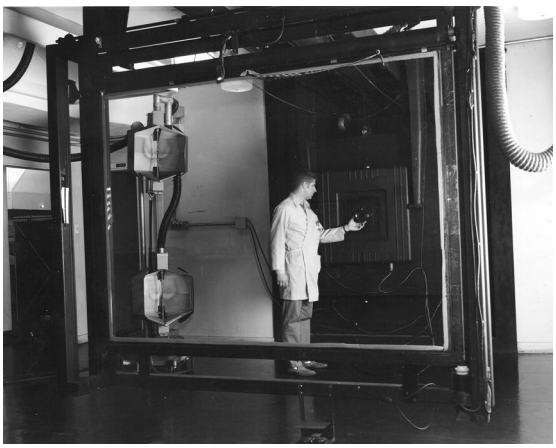

Fig. 1. Robertson copy camera used for transforming the scale of images during the production of orthophotographs, seen here being adjusted by photographer Jay Prendergast. The sheer size and cost of the analog machinery initially developed to produce high-resolution orthophotographs was one reason that a full orthophoto series for the United States was not near completion until 2002. Size of the original: 74 × 59 cm. Menlo Park, Calif., U.S. Geological Survey Western Region, 1965.

Nevertheless, photographic images highlight only the visible features of the landscape, and these vary widely depending on weather and other factors. Therefore, interpretation and annotation, including the addition of labels and boundaries, are often necessary to distinguish photographs in their capacity as maps. By the 1930s the use of photographs for cartography had enabled a much greater role for land cover and sea surface maps, including depictions of built-up areas, vegetation, ocean level, and clouds. Simultaneously an entire body of research emerged to analyze mosaics of overhead images in order to describe relationships between visible features and underlying soils (McCracken and Helms 1994, 301–4).

One way to standardize the use of images as maps is to recast the image within a geographic framework. Orthophotographs are corrected so that they exhibit a uniform scale and plane projection, similar to a map. Ongoing development of the orthophotoscope starting in the

1930s led to the automated production of orthophotographs, and in 1965 the USGS began publishing a series of 7.5-minute orthophoto quadrangle maps, sometimes called orthophoto quads. However, the process was labor intensive and required massive machinery (fig. 1), and a series of high-resolution orthophotos for the entire United States was only near completion in 2002, roughly a decade after the introduction of digital orthophotography (USGS 2002).

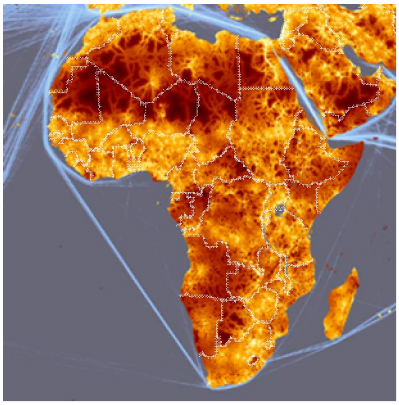

Fig. 2. Detail of Africa from a map of estimated travel time to the nearest city of 50,000 or more people in the year 2000, by A. Nelson. ESRI Grid format, 30 arc seconds resolution. Images have become so influential in cartography that maps have begun to mimic images; despite consisting of a map that contains no aerial image data, this raster plot of accessibility estimates in Africa distinctly resembles a nighttime satellite photograph. Global Environment Monitoring Unit, Joint Research Centre of the European Commission, Ispra, Italy, 2008.

Satellites developed in the context of Cold War surveillance allowed for imaging at much broader scales as well as the collection of data outside the spectrum of visible light. After the 1960 launch of the Television Infrared Observation Satellite (TIROS), the U.S. Weather Bureau provided cloud-cover data free of charge, and photographic images began to replace maps in weather forecasts. In the early 1990s the artist Tom Van Sant led a team that pieced together thirty-five million separate pixels of satellite data to create the first high-resolution aerial image of a cloudless globe bathed entirely in sunlight (Pickles 2004, 62–63). As Internet maps proliferated, the composition of diverse data proved to be an persistent challenge. By 2011 most

virtual earth maps included an overlay that was labeled only as a 'satellite' layer despite the fact that it generally contained a patchwork of both satellite and aircraft imagery; often the seams were even visible as the user zoomed in toward ever finer scales (Taylor 2009).

The resolution of geospatial data grew exponentially during the 1990s, and raster images—grids in which each pixel represents a numerical value—began more closely to resemble photographs, which are essentially rasters that depict visible light (fig. 2). As a type of graph scaled to a map of the region it portrays, a raster is reminiscent of Argentinean essayist Jorge Luis Borges's apocryphal description of a map of an empire that coincides "point for point" with the empire itself (Borges 1999). Nonetheless, the widespread use of images as maps is one of the most significant developments in twentieth-century cartography, a process that productively blurs the boundaries between graphs, maps, and images.

—Jess Bier

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