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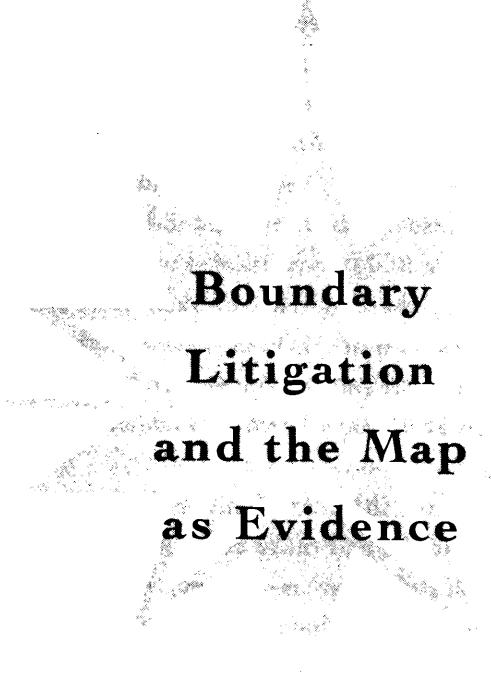
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Boundary Litigation and the Map as Evidence

Maps make good witnesses. In lawsuits over boundaries and land ownership, maps can testify with authority and conviction. Some might describe how the land looked decades or centuries ago, when a sovereign, government department, or land company established the original boundaries. Others narrate the history of subdivision and transfer, depict a resurvey, or explain the movement of monuments, walls, or rivers. Maps can portray what the seller purported to sell and what the buyer presumed to buy. The authority of maps in boundary litigation is long-standing and deep-rooted: maps are so closely entwined with Western civilization's concept of real estate that the owning, selling, and buying of land would be

impossible without them. More than signatures and deeds, surveys and property maps make real estate a reality.

Some maps are better witnesses than others. Like human witnesses, maps do not always speak coherently and reinforce one another. Surveyors' representations of a land grant or subdivision can vary as widely as the testimonies of eyewitnesses frightened during a holdup. Careless or willful omissions, faulty measurements, sloppy drafting, imprecise labels, vanished landmarks, and inconsistent use of symbols present legal adversaries with convenient opportunities for undermining the credibility of each other's cartographic evidence. Thus lawyers who use maps as proof often need to introduce experts to interpret them in their favor. In conjunction with expert testimony, however, maps become powerful courtroom propaganda.

This chapter examines the role of maps in boundary disputes between nations, neighbors, and other contestants. It begins with a concise look at the roles of maps and surveys in the European conquest of North America and the partition of the continent into colonies, land grants, farms, and building lots. Surveys that helped kings and presidents replace indigenous peoples with Euro-Caucasian settlers sometimes left a legacy of imprecision, confusion, and costly litigation between states. Early land surveys based on a first-come, first-served pattern of settlement produced equally contentious boundaries between private holdings. The next section examines the use of maps as evidence in state and federal courts and the role of surveyors, cartographers, and historians in corroborating their silent testimony. The third section looks at the law of the sea and the role of maps in extending international boundaries into the oceans. Applying modern mapping technology to the sea floor and the continental shelf through Exclusive Economic Zones perpetuates the fifteenth-century notion that maps make territory real. Examples throughout the chapter illustrate how maps can precipitate boundary disputes as well as help decide them.

Subjugation, Subdivision, and Surveying in North America

Cartographic historians have long ignored the maps of North America's pre-Columbian inhabitants. Although careful examination of American Indian rock art and folk narratives reveals they indeed had what cartographic historian J. B. Harley called a "mapping impulse," the cartography of these first Americans was markedly different from the highly practical and technical mapmaking of fifteenth-century Europe. Indigenous Americans communicated information about space and places through folktales, gestures, dances, and ephemeral drawings, but theirs was not the cartography of commerce, navigation, and warfare. Land ownership in the profane European sense of buying, selling, inheriting, recording, and taxing was an alien concept. American Indians, who considered land sacred and not "ownable," never developed a formal cartography focused on boundaries and surveys. This lack of maps—really a lack of what the European invaders recognized as maps—was one of many technological disadvantages that made the conquest of the New World not only quick and easy but also morally right in the minds of the colonists and their priests.

When Columbus returned from his first voyage in 1493, Europe lost no time asserting its own mapping impulse. Within two months Queen Isabella had persuaded Pope Alexander VI to draw an imaginary north-south "line of demarcation" awarding all non-Christian territory on its west to Spain and all heathen lands and oceans on its east to Portugal. Anchored at a point 100 leagues (roughly 340 miles) west of Portugal's colony in the Azores, the Pope's original line—although no one knew it—barely touched the easternmost tip of South America. But sensing a faulty papal estimate of the distance between Columbus's landing point and the Azores, Portugal convinced Spain to sign the Treaty of Tordesillas in 1494, which moved the boundary westward to a point 370 leagues (approximately 1,250

miles) west of the Cape Verde Islands. It mattered little that the line's anchor point was difficult to locate, much less to relate to the yet uncharted eastern coast of the yet unnamed American continent. Easily plotted at the left edge of world maps, in perfect alignment with the navigator's grid of latitude and longitude, the Tordesillas line established Spain's claim to the New World. British, Dutch, and French mapmakers defiantly ignored it, but the Portuguese cartographers who drafted the Cantino world map of 1502 boldly extended the line of demarcation through Newfoundland, which John Cabot had claimed for England in 1497. Although the Portuguese never occupied eastern Newfoundland, they used the line to claim and colonize the huge territory that is now Brazil.

Cartography helped Europe's eager empires divvy up the New World and get down to the profitable business of settlement and exploitation. As exploration progressed, maps became more geographically detailed. Cartographers made their coastlines more precise with additional rivers, bays, inlets, islands, and place-names. They added little flags and coats of arms to keep track of each country's claims and used pictures of saints and other religious symbols to signify the blessing of the Church and the approval of the Almighty. England and Spain carried divide-and-conquer even further through land grants to local governors responsible directly to the Crown. Many of the British colonies that rebelled against King George in 1776 were originally plotted by mapmakers with only a vague knowledge of inland geography. Boundaries easily established on paper by meridians, parallels, and the mouths of the Potomac, the Delaware, and other significant rivers could always be stamped on the landscape by surveyors once the king's administrators and colonial subjects were in place. In the meantime, paper maps with inked boundaries helped Lord Baltimore, John Endecott, William Penn, and other colonial governors market their unique brands of Utopia to oppressed Catholics, Puritans, Quakers, and other recruits eager for religious freedom and a piece of real estate.

• • •

Faulty knowledge of overseas territory occasionally resulted in overlapping land grants. Perhaps the best-known example is the dispute between Maryland and Pennsylvania, ultimately resolved by the famous Mason-Dixon line. Like most boundary controversies, its history is complex. In 1632, King Charles I of England awarded Cecil Calvert, the second Lord Baltimore, a patent for all land "hitherto unsettled" from the Potomac River north to the 40th parallel and running westward from the Atlantic Ocean to a meridian through the "first fountain" of the Potomac. A half-century later, in 1681, Charles II granted William Penn title to adjoining territory bounded on the south by the 40th parallel. Controversy arose when surveyors discovered that early seventeenth-century maps had placed the 40th parallel too far south. If the boundary were fixed at 40 degrees north, as called for by both Calvert's patent and Penn's charter, Maryland would include a nineteen-mile-wide strip of what the king's administrators had assumed would be Pennsylvania.

At the root of the controversy was a map included with a 1608 report by Captain John Smith, one of the founders of the Virginia colony and the first European to explore Chesapeake Bay. In the early seventeenth century most of what the English knew—or thought they knew—about the region was based on Smith's map. As the facsimile in Figure 4.1 illustrates, Smith oriented his map with west at the top and north at the right so that opposing tick marks along the top and bottom edges identified the 40th parallel. A vertical line connecting these two 40-degree tick marks would pass somewhat north of where the Susquehanna River enters the Chesapeake. Is the 40th parallel really where Charles I wanted the boundary? Or was he, like many people lacking the means or rationale for greater precision, merely asserting a cavalier preference for round numbers?

Unfortunately for Maryland, Lord Baltimore, who in 1635 drew up his own map to guide the colony's development, apparently not only accepted Smith's placement of the 40th parallel but also located



Fig. 4.1. John Smith's 1608 map of Virginia. (From J. Thomas Scharf, *History of Maryland from the Earliest Period to the Present Day* [Baltimore, 1879], Vol. 1, plate facing p. 6.)

his own northern boundary noticeably below the upper end of the Chesapeake. Had the Calverts acted quickly to survey the boundary and settle the northernmost parts of their patent, present-day Maryland might well include Gettysburg, York, Chester, and most of Philadelphia.

Disagreement between the Calverts and the Penns also included the border between Maryland and Delaware. In 1682 Penn acquired additional territory on the west shore of Delaware Bay, in an area settled by the Dutch in 1631 and by the Swedes several years later. Charles I, who concluded that the earlier presence of these Christian settlers excluded the Delaware counties from Lord Baltimore's original Maryland patent, retroactively decreed that the land between the Chesapeake and Delaware bays "be divided into equal parts by a line

from the latitude of Cape Henlopen to the fortieth degree of north latitude." Unfortunately for Maryland, the "Cape Henlopen" portrayed on the map as Delaware's southern boundary was roughly twenty-five miles south of the real Cape Henlopen. Maryland historians later claimed this map was a forgery and a fraud, rather than a mistake.

Eighty years of intermittent yet costly litigation began when Charles Calvert, the third Lord Baltimore, led a small contingent of armed officials up the Delaware, measured latitude at various places with a sextant, and warned the citizens of Newcastle, Marcus Hook, and Chester to pay taxes to him, not Penn. Years later, Pennsylvania constables thwarted Thomas Cresap's attempt to survey the border after Cresap called Philadelphia "the finest city in Maryland." Border skirmishes occurred periodically until the Mason-Dixon line ended the controversy.

England's chief judge finally resolved the conflict—on paper, at least—with a decision announced in 1750 and accepted by the parties in 1760. His decree established Fenwick Island as the official "Cape Henlopen" and authorized a northern boundary for Maryland running along a parallel of latitude fifteen miles south of Philadelphia. The Lord Chancellor also fixed Maryland's eastern boundary with the Delaware counties along a line running north from the midpoint of the peninsula opposite Fenwick Island and tangent to a circle with a twelve-mile radius centered in the middle of Newcastle. (Another point of controversy was whether the "twelve-mile circle" referred to in the charter described a circumference or a radius.) The boundary now had exact specifications based on unambiguous landmarks.

Resolving a boundary in a London court proved far simpler than following straight lines, measuring distances, and placing boundary markers in a distant land often thick with trees and punctuated by swamps. Requiring precise measurements of latitude for much of its length, the Maryland-Pennsylvania border called for considerable mathematical skill, a knowledge of astronomy, and experience with precision surveying instruments. Dissatisfied with the work of local surveyors who had tried to locate the tangent line down the middle of

the Delmarva Peninsula, the colonial proprietors in 1763 hired Charles Mason and Jeremiah Dixon, English astronomers trained in mathematics and surveying.

Mason and Dixon worked on the boundary from 1764 through 1767, starting with the north-south tangent line and then working westward along the southern border of Pennsylvania. They described the land surrounding the boundary on a map, and every mile they set in place a limestone monument imported from England. Figure 4.2, a portion of their 1768 map, shows the northeast corner of Maryland and the tangent point where the north-south boundary with Delaware touches the twelve-mile circle centered on Newcastle. Uncertain about Maryland's western boundary, the surveyors extended their line westward until turned back by Indians from the Five Nations, who objected to European penetration west of the Allegheny Front. A resurvey commissioned by Maryland and Pennsylvania in 1900 to check the boundary's accuracy and reset missing or vandalized markers found no need to adjust or correct the work of Mason and Dixon. The east-west portion of their border, known to historians and journalists as the Mason-Dixon line, has endured as a symbolic sociocultural divide between North and South.

Real estate boundaries in the United States commonly reflect a "chain of title" extending back to the American Revolution or predating the formation of the state in which the land is located. The War for Independence left a loosely organized confederation of states holding huge amounts of land confiscated from the British Crown, assorted English lords, and vanquished loyalists who had fled to Canada. After resolving boundary disputes with their neighbors—more quickly than did Maryland in most cases—the states partitioned those forfeited lands within their borders into large tracts, with some reserved for soldiers paid in scrip to fight in the Revolution and others sold to private land companies and speculators. Land titles in the western portions of the Atlantic states often reflect these two types of transfer. Westward from the thirteen colonies to the Mississippi

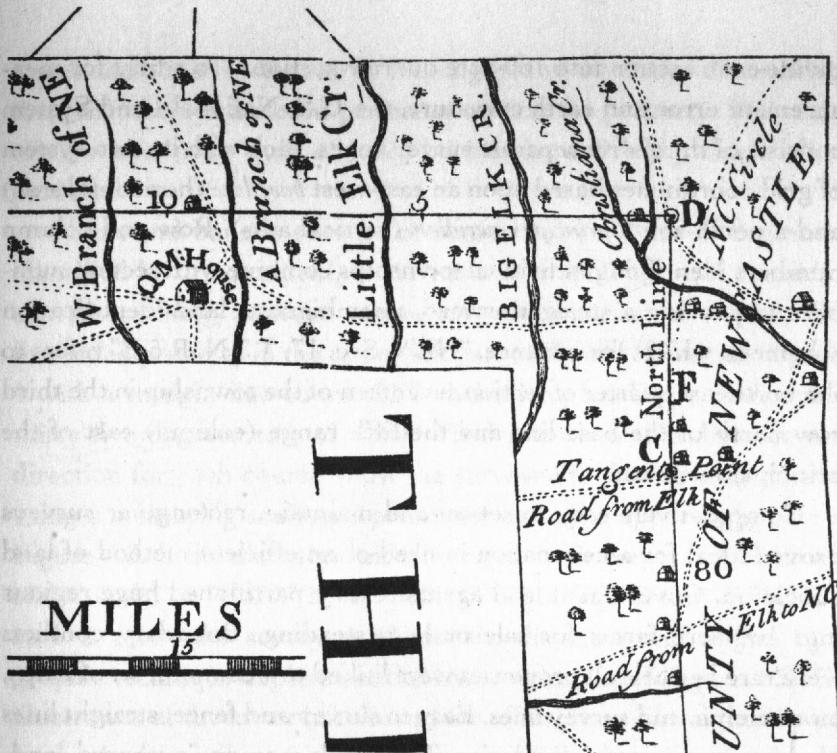


Fig. 4.2. Portion of 1768 parchment map of the Mason-Dixon line. (From *Maryland Geological Survey*, Vol. 7 [Baltimore, Md.: Maryland Geological Survey, 1908], plate 83.)

River, the federal government assumed title to a vast "public domain" larger in area than the original states. To promote settlement and raise revenues, the central government sold most of these congressional lands in rectangular blocks, large and small, and made additional grants to reward military service, support education, and promote the building of canals and railroads.

The United States has two basic types of land survey: systematic and unsystematic. Systematic land surveys, which cover most of the country west of the Appalachians, are based generally on a grid consisting of rows and columns of square *townships*, each six miles on a side and subdivided into a six-by-six array of square-mile *sections*, numbered one to thirty-six. Intersecting horizontal and vertical lines

divide each section into 160-acre quarter-sections. To adjust for measurement error and earth curvature, the U.S. National Land System consists of thirty-five separate survey zones, each with its own system of grid coordinates based upon an east-west *base line* (horizontal axis) and a north-south *principal meridian* (vertical axis). Row and column numbers identifying individual townships combine with section numbers to provide a straightforward, unambiguous land-identification scheme in which, for instance, "NE $\frac{1}{4}$, Sec. 17, T 3 N, R 5 E" refers to the northeast quarter of section seventeen of the township in the third row north of the base line and the fifth range (column) east of the principal meridian.

Comparatively easy to set up and maintain, rectangular surveys proved ideal for a new nation in need of an efficient method of land allocation. Government land agents readily partitioned huge regions into 160-acre farms for sale or homesteading. Boundary conflicts were rare because all properties were linked to a common set of maps, monuments, and survey lines. Easy to survey and fence, straight lines became recognized boundaries. The result was an "authored landscape" in which the survey grid had a marked effect on settlement patterns and the shapes of counties and smaller political units. In the typical Midwestern county, roads commonly follow section lines, the rural population is dispersed rather than clustered, and the landscape has a pronounced checkerboard appearance. Similar regularities occur in western New York State and other parts of the original thirteen states where land companies used their own rectangular grid systems to expedite subdivision and settlement.

Contentious litigation between neighboring landowners is far more likely where land surveys are unsystematic and independent of one another. Common in the Atlantic states, Kentucky, Ohio, Tennessee, Texas, Vermont, and West Virginia, unsystematic surveys often reflect a first-come, first-served form of land allocation in which the first settler claimed and marked off the most fertile and attractive land and those who followed took what they liked of what was left. Each claimant surveyed and sought title to a parcel described by its

metes and bounds—that is, by the lengths and directions of boundary lines that formed a closed perimeter around the property. The result often was a crazy quilt of jerky boundaries and oddly shaped land parcels.

Metes-and-bounds surveys commonly have a point of beginning identified by a monument, either natural or artificial, and consist of courses running between consecutive monuments, or *corners*. The five-sided property in the upper-left part of Figure 4.3 begins at point 1 with a straight-line course 2.70 chains long heading in a direction thirty-five degrees east of north. Field records of the distance and direction for each course allow the surveyor to draw a map, or *plat*, using a measuring scale and protractor, as in the upper-right part of Figure 4.3. If the distances and directions are accurate, course 5 will end exactly, or "close," at the point of beginning. If not—exact closure is rare—the surveyor adjusts the distances and angles by a graphic technique depicted in the lower-right part of Figure 4.3. The illustration at the lower left shows how offsets from a straight line can be used to describe winding courses that follow creeks, riverbanks, roads, or ridge tops. Metes-and-bounds is widely used throughout the country in surveys of mineral claims, Indian reservations, and irregularly shaped lots.

Retracing an old metes-and-bounds survey usually challenges the surveyor's knowledge of both local history and eighteenth-century surveying. Old surveys show the combined effects of imprecise instruments, personal idiosyncrasy, and expedient techniques for measuring directions and distances. Old bearings measured with a magnetic compass do not accord with modern bearings measured to "true" north, as defined by the polar star and the earth's axis. This effect is apparent in the street grids of some older cities such as Baltimore, where north-south streets are tilted about three degrees east from true north. Often based on obsolete units, old distances can be equally troublesome. Although surveyors usually measured length with chains consisting of one hundred long, thin links, different types of surveys could be conducted with a variety of longer and shorter

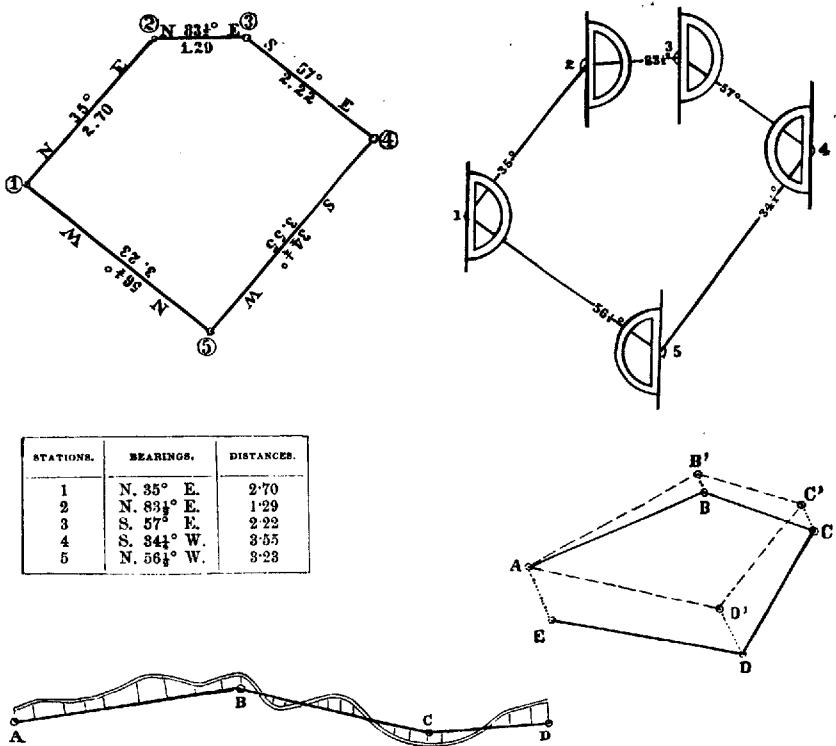


Fig. 4.3. A metes-and-bounds survey describes a land parcel with a closed traverse of courses. Graphic adjustment (lower right) can make the traverse close if the last course does not return to the point of beginning. Offsets measured from a straight line (lower left) can be useful in describing a winding course. (From William M. Gillespie, *A Treatise on Surveying Comprising the Theory and the Practice*, revised and enlarged by Cady Staley [New York: D. Appleton and Co., 1888], pp. 121, 125, 129, 131.)

chains. Moreover, because length itself was not standardized, the foot or mile mentioned in the old survey might well differ from the modern foot. In the early 1960s, for instance, a precise resurvey of the Delaware-Maryland boundary found that Mason and Dixon had consistently underestimated distances by about ten to twelve feet per mile, suggesting that a foot in the mid-eighteenth century was as much as a quarter percent longer than the present-day foot.

A resurvey is necessary when property is sold and the seller cannot provide a current map. A licensed surveyor can usually verify and

validate recent surveys with little effort, but if the last sale occurred in the mid-nineteenth century or earlier, finding the point of beginning and other markers described in the title can be difficult at best. Trees and fence posts decay, hill slopes and stream banks erode, and "corners" and other monuments move or vanish. The surveyor must attempt to reconstruct and reestablish the original survey, mark the boundary with new, durable markers, and describe it with new bearings estimated to the nearest second ($\frac{1}{3600}$ of a degree) and new distances measured to the nearest hundredth of a foot.

A surveyor starts to reconstruct a boundary by looking for and correcting systematic errors and gross mistakes in the latest map. Because the earth's magnetic field changes slowly but systematically, the surveyor can consult a map showing rates of change for different areas, use the local rate to compensate for dated compass bearings, and then attempt to retrace the original surveyor's footsteps. The grantor's or claimant's original instructions to the surveyor as well as the surveyor's notes, if either can be found, are useful in following the original traverse. Relating the old survey to the current landscape is akin to solving a puzzle or a murder mystery. When one original corner or boundary line is evident, the surveyor can often reassemble the entire boundary bit by bit, with each new piece suggesting where to look for the next. Carefully planned digging might reveal systematically spaced remains of fence posts, for instance. A discoloration in the soil might mark the buried remains of an important tree described in the survey, and differences in vegetation can reflect field boundaries and roads. Historical records and longtime residents can yield additional clues. Careful records of field observations and archival research are important because the surveyor might later need to testify in court if an adjoining landowner files a legal objection to the reconstructed boundary.

Early in the twentieth century, many cities in the metes-and-bounds states established relatively precise control surveys to which property and other surveys could be tied. These municipal surveys consist of

strategically located *street lines* set back from the curb line, anchored by carefully placed monuments, and described on maps readily available at the city hall and the county courthouse. Developed in part to avoid troublesome litigation among landowners, they not only provide a convenient reference grid for fixing and describing property boundaries but also support construction, utilities, and maintenance surveys as well as other engineering and mapping activities, such as land-use maps and zoning maps.

Modern property maps reflect a variety of necessary limitations on the use of real estate. Foremost among these restrictions are easements for sewer lines, gas lines, and other underground facilities. Acquired through the government's power of eminent domain, an easement allows a municipality or public utility to dig a trench and install pipes or cables. Although the utility must restore the surface and compensate the owner for damage, the easement becomes a permanent encumbrance on the property—that is, the landowner cannot readily build atop a gas or sewer line, and the utility can reenter the property to make repairs or improvements. Because a buyer must be made aware of these legally binding restrictions on how the property can be used or modified, survey drawings must note and describe all easements.

Surveyors must be wary of the landowner who allows a neighbor easier access to a highway or who fails to contest a misplaced fence. Many owners fail to realize that the neighbor who uses a driveway, parking lot, fence, porch, or other “encroachment” for seven to twenty years—the period varies from state to state—acquires a permanent right to continued use. To warn a prospective buyer of so-called prescriptive easements based upon the legal principle of adverse possession, the conscientious surveyor observes and plots on the survey map all visible and potentially prescriptive encroachments—even wires connecting a neighbor’s house to utility poles.

Few maps of real estate generate as much anguish, anger, and litigation as zoning maps. A consequence of the “City Beautiful” movement of the early twentieth century, zoning ordinances are essential

to effective urban planning and empower local zoning boards to divide a city into districts similar in activity and appearance. Each district is assigned a category that regulates the use of land and buildings, limits the size and architectural design of buildings, and controls population density and the amount of open space. Zoning prohibits retailing and manufacturing in residential districts, for instance, and the various residential categories usually specify a minimum area and width for each building lot as well as a maximum number of households for each structure. Civic leaders generally support zoning ordinances that discourage the spillover of commercial districts and the intrusion of apartments into expensive, low-density residential areas. Zoning maps thus become bitter battlegrounds between developers who want larger profits and residents who want secure investments in pleasant neighborhoods.

Zoning is an intensely political process in which board members appointed by elected officials hold open hearings on classification changes and exceptions requested by property owners. Most applicants apply for a variance, which leaves the parcel's classification intact but approves a specific "nonconforming use." Individuals, corporations, and citizens' groups can challenge these requests at the hearing, and the loser can appeal the board's decision in court. The petitioner typically describes an adverse decision as "arbitrary and capricious," and the board must then demonstrate in court that it employed procedural due process and accurately interpreted state and local zoning regulations. Lawyers specializing in real estate law often spend much of their time representing clients at zoning hearings and litigating the decisions of zoning boards.

Zoning hearings are good places to find propaganda maps, and most hearing rooms have an easel or tackboard for exhibiting them. Because location is of paramount concern in almost all zoning cases, maps help petitioners explain their plans and let residents describe their objections. Words alone are notoriously inefficient in describing spatial relationships; speakers and board members need maps for identifying features, raising questions, and illustrating arguments. In

many instances, a map presents the case's most compelling argument. In straightforward contests, maps may simply reinforce the obvious. For example, a zoning board is as likely to approve extending a commercial district one lot farther into a seedy residential area as it is to reject placing a laundromat in the middle of a solidly noncommercial medium-density residential neighborhood. When the debate is less clear-cut, however, both parties might rely on conveniently selective cartographic generalizations, which exaggerate positive features and downplay negative ones. In turn, each side challenges the opposition's maps by exposing attempted distortions, ridiculing flaws, and suggesting less favorable interpretations.

Maps in Court

Trials are more formal than zoning hearings, and established principles of evidence and judicial procedure require a more rigorous use of maps as exhibits in both courtrooms and legal briefs. When arguing a boundary dispute in court, a lawyer must first determine whether a relevant map is readily admissible as evidence. In most instances, the survey's measurements and monuments and the associated deed are higher forms of evidence than the survey drawing. Moreover, a map that is not an official government survey map usually requires the testimony of the surveyor who prepared it. The lawyer who wants the court to admit the map as evidence must ask the surveyor to describe his qualifications, how he conducted the survey, and his interpretation of the deed or other relevant documents. Opposing counsel may then cross-examine the surveyor and attempt to raise doubts or have the map ruled inadmissible. Although the "ancient document" exception to the hearsay rule allows the court to accept an old map that predates the controversy, expert testimony can be useful in both authenticating the map and demonstrating a relevant link to the case.

When a surveyor testifies as an expert witness, the court not only examines the map and its author but watches the map evolve under

direct and cross-examination. The surveyor typically prepares his own maps and diagrams. In an essay on effective expert testimony, California attorney Breckinridge Thomas advised surveyors, "Do not attempt to testify from someone else's work. Even if it is admitted into evidence, it detracts from your effectiveness." The surveyor must also follow the court's instructions about drawing and marking features on a map or diagram. To integrate graphic evidence with verbal testimony in the trial record, the judge typically assigns each feature pointed out by the witness a unique letter-number identifier. If the surveyor's name is Brown, for instance, the features are marked B-1, B-2, and so forth. Thomas cautioned his readers never to draw lines or mark features until instructed: "I know of one judge who would be delighted to get down there and help draw the lines. It is their prerogative to control what happens to the evidence. . . . So wait until the judge tells you to mark it before you do. Otherwise, he will think you officious, and the jury might think you are being a little overly eager too."

Maps can sometimes explain why a modern resurvey does not accord with the legal description of the property in an old deed. Most discrepancies reflect either imprecisely measured angles and distances in the original survey or an improperly copied description. Gordon Ainsworth, a Massachusetts surveyor familiar with the pitfalls of metes-and-bounds description, blamed some disputes on sloppy work by attorneys who insist upon rewriting the surveyor's description. "If a technical description by metes-and-bounds of a tract of land were submitted to a dozen different law offices," he alleged, "it would eventually wind up with the same number of interpretations on a legal form of conveyance." In one egregious case, an attorney preparing deeds for a subdivision described a building lot 180 feet wide as only 60 feet in width—apparently he was thinking in yards (180 feet = 60 yards). In another case, a lawyer who rewrote the description of a traverse inadvertently enclosed much of an adjoining tract. But Ainsworth was equally critical of surveyors with obsolete equipment who "fudge notes and fail to close traverses." A

map presenting a logical, legally cogent argument for the parcel's intended boundaries can be a particularly useful prop for the expert witness whose resurvey contradicts a faulty deed or flawed survey.

As in any trial, the witness who radiates confidence is preferable to one who exudes doubt. Legal textbooks on boundary disputes underscore the importance of selecting as an expert witness a surveyor who is not only experienced and technically competent but also confident, poised, and well-spoken. The expert must carefully and courteously explain technical issues to jurors, not talk down to them. Moreover, the lawyer trying the case must not only orchestrate the expert's testimony but also make the jury comfortable with the witness. Equally important is how well the expert's testimony can survive cross-examination. If the surveyor seems even slightly hesitant about the case, or if the lawyer feels uneasy about the surveyor, the safest strategy is to find another expert witness. As the fifth edition of *Clark on Surveying and Boundaries* points out, "The use of a qualified, experienced, well-rounded expert can bring to the client hope, but the use of the wrong individual for an expert will only bring disaster."

A competent real estate lawyer will protect the client by carefully reviewing the survey and related documents before the sale. To show lawyers how to conduct a proper review, attorneys Richard White and Harlan Onsrud prepared a "survey checklist" containing 142 specific items, any of which might later become a point of controversy for the unwary buyer. Careful analysis of the survey might reveal potentially troublesome secondary boundaries that extend within or beyond the property itself. Because a landlocked lot could be largely useless, for instance, the survey drawing should show access to a public street either directly or via a right-of-way included in the sale. The map should also alert the buyer to rights-of-way and easements crossing the land, to encroachments from and protrusions onto neighboring properties, and to municipal restrictions, such as setback lines prohibiting new buildings within a specified distance of the street or adjoining properties. Since flooding and standing water also restrict use of the property, the survey should identify all water bodies on the

property and delineate floodplains. In areas covered by the National Flood Insurance Program, a competent surveyor will indicate whether the property falls within the flood-hazard zone.

Water bodies make especially troublesome boundaries. Not only can boundaries shift as streams meander, lake levels fluctuate, and coasts erode, but conflicts can arise over the use of inland waters for recreation, navigation, or irrigation. Particularly important to landowners and potential buyers is whether the title explicitly mentions the water body as part of the boundary. If so, the owner may claim what are called riparian rights, which vary somewhat from state to state but usually include use of the lake or river for boating, dockage, fishing, and swimming.

Since recreational use of the water is often an owner's prime concern, the doctrine of riparian rights conveniently avoids having to find precise water boundaries. In states where the lots surrounding a pond or small lake are assumed to extend to the center, survey maps often plot straight-line boundaries from the points where property lines intersect the shore to a common intersection assumed to be the deepest point. Unless the lake level were to drop drastically, these lines are of little significance, because riparian rights provide recreational access to all shoreline residents and environmental laws prevent an individual landowner from filling in or mining part of the lake bed. River boundaries can be similarly vague. Along a nonnavigable stream, the center line or the line of fastest current marks the official, theoretical boundary, but unless the stream suddenly shifts its course, no one needs to determine the exact center. Although survey maps might show a similar division separating properties on opposite banks of a navigable waterway, each owner typically only controls the land above the high-water mark.

Water bodies occasionally shift position—slowly in most cases, rapidly in others. When erosion claims land, the owner can do little but assess the damage, file an insurance claim, and take a tax write-off. But when alluvial deposition produces new land, the owners of

adjoining property can usually claim the “accretion” as a riparian right. Figure 4.4 describes the riparian allocation of new land along a portion of the south bank of the Ohio River, which shifted northward between 1830 and 1867. As a Kentucky court ruled in 1871, landowners could not merely project existing straight-line boundaries northwestward across the new land, as one landowner wanted to do. Instead, because rights to the alluvial accretion arose from titles granted when the land was originally surveyed and subdivided in 1830, surveyors first had to establish “division points” for allocating riparian rights along the old riverbank. Located where the original boundaries intersected the 1830 riverbank, these division points anchored a new set of straight-line boundaries drawn perpendicular to the “thread,” or deepest part, of the river.

Riparian principles sometimes seem grossly unfair, especially when a river’s arbitrary wandering creates big winners and big losers. Figure 4.5 illustrates the basic facts in a 1900 Kansas lawsuit that hinged on cartographic evidence. As the multiple channels and dates indicate, this portion of the Missouri River meandered first toward the northeast between 1855 and 1870, and then toward the southeast between 1870 and 1900. In 1855 subdivision of the large square created Lots 1, 2, 3, and 4 bordering the river and Lot A well back from the bank. By 1870 the river had moved eastward, placing Lot 1 entirely on its west bank and cutting through Lots 2 and A, among others. But by 1900 the river had receded westward, placing Lot A much farther from the bank. Nonetheless, the plaintiff, who owned Lot A, claimed a riparian right established by the easternmost, 1870 position of the river. This riparian right, the plaintiff argued, included all alluvium accreted to Lot A as the riverbank receded westward, even though some of the new alluvium lay within the original boundaries of Lots 1 and 2, owned by the defendant. In its decision, the court affirmed the plaintiff’s riparian right to accreted alluvium, as established by Lot A’s 1870 riverbank, labeled *de* in Figure 4.5. In apportioning the new lands, the court recognized each lot’s portion (*ad*, *de*, and *eb*) of the west bank of the 1870 riverbank. The decision extended new straight-line bound-

Thread of the river

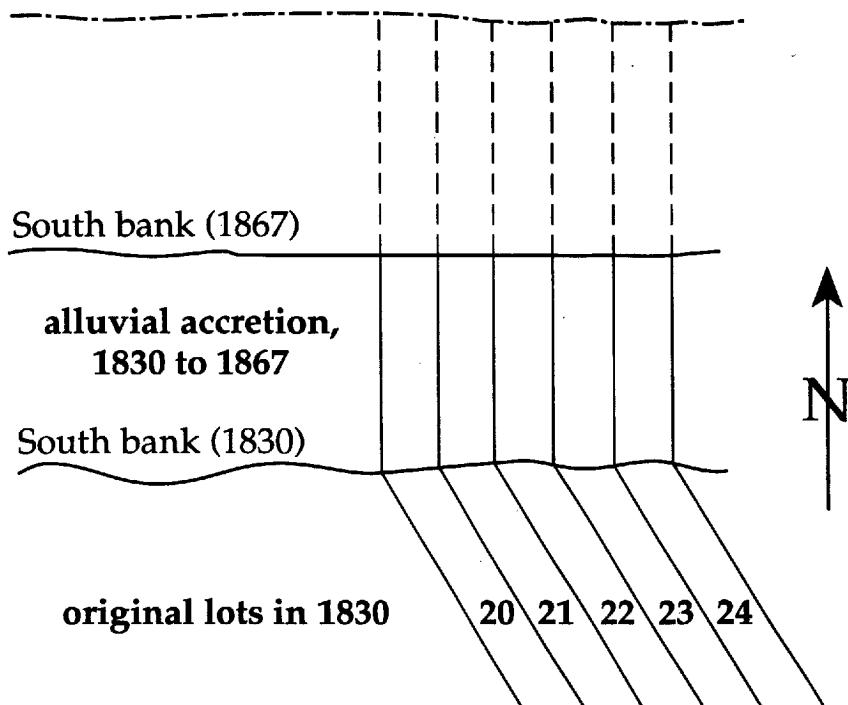


Fig. 4.4. Riparian principles for allocating new land formed by deposition along the south bank of the Ohio River. (Redrawn from Frank Emerson Clark, *Fundamentals of Law for Surveyors* [Scranton, Pa.: International Textbook Co., 1939], p. 33.)

aries westward toward the river as shown, thereby awarding *adcb* to Lot 1, *defc* to Lot A, and *ehgf* to Lot 2.

The Kansas court did not act arbitrarily either in making these awards or in failing to consider the owners of lots that once existed between the 1870 and 1900 positions of the river. When erosion consumed each lot's last, southwesternmost portion of dry land, these owners' legal rights disappeared forever. In contrast, the owner of Lot A was fortunate the river had meandered exactly that far east—far enough to confer riparian rights yet not sufficiently far to obliterate the lot as a legal entity. According to Frank Emerson Clark, who described these two cases in his *Fundamentals of Law for Surveyors*,

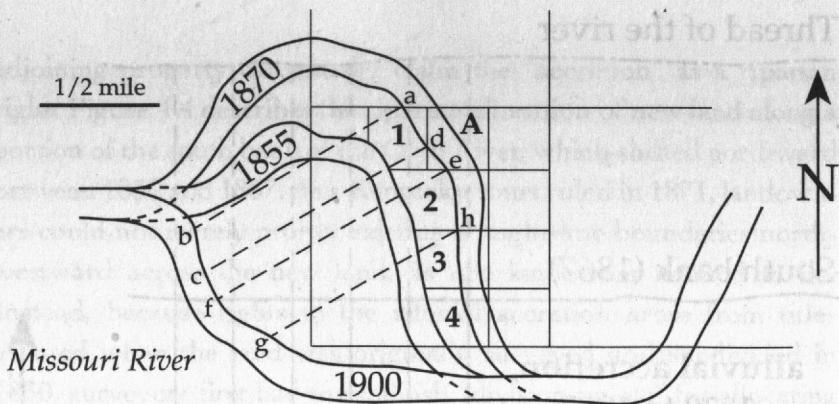


Fig. 4.5. Riparian principles for allocating new alluvial lands on the northeast (Kansas) side of the Missouri River. (Compiled from Frank Emerson Clark, *Fundamentals of Law for Surveyors* [Scranton, Pa.: International Textbook Co., 1939], pp. 34–35.)

"Once a tract of land acquires riparian rights, any land that is added to the shore line becomes a part of the tract, even though such land occupies space that was formerly included in another tract." As the Kansas decision demonstrates, a case's outcome and the size of an award depend on surveys and maps showing the location of the river when the tract acquired its ultimate riparian rights.

The Mississippi, a large river with a huge floodplain, requires a markedly different treatment of riparian rights. Draining an area of roughly 1.15 million square miles, the lower Mississippi meanders sluggishly along a broad floodplain more than a hundred miles wide in places. Topographic maps of Louisiana and Mississippi show huge, horseshoelike meanders and a course that twists and turns, sometimes even flowing due north, away from the Gulf of Mexico. Although these meanders usually migrate slowly, with erosion along the outside bank balancing deposition along the inside bank a mile or so downstream, during severe floods the Mississippi can defy the best efforts of the Army Corps of Engineers by breaching its levee and gouging a shorter, radically different path through its floodplain's malleable alluvial soils. Because the old riverbed might be miles away

from the new channel, farms and towns that were west of the Mississippi before the flood might be east of the river when the waters subside. As Figure 4.6 illustrates, part of the old channel typically survives as an oxbow lake, such as Lake Providence, an abandoned meander loop in northeast Louisiana. In this example, the present-day river runs roughly perpendicular to its former channel, and deposition accompanying later floods filled in part of the lake and helped create Bayou Providence. The abundance of oxbow lakes on the Mississippi floodplain testifies to the river's instability as a boundary.

To avoid widespread confusion about ownership, taxes, law enforcement, and government services in general, the courts call such radical shifts *avulsion*, and leave property and political boundaries

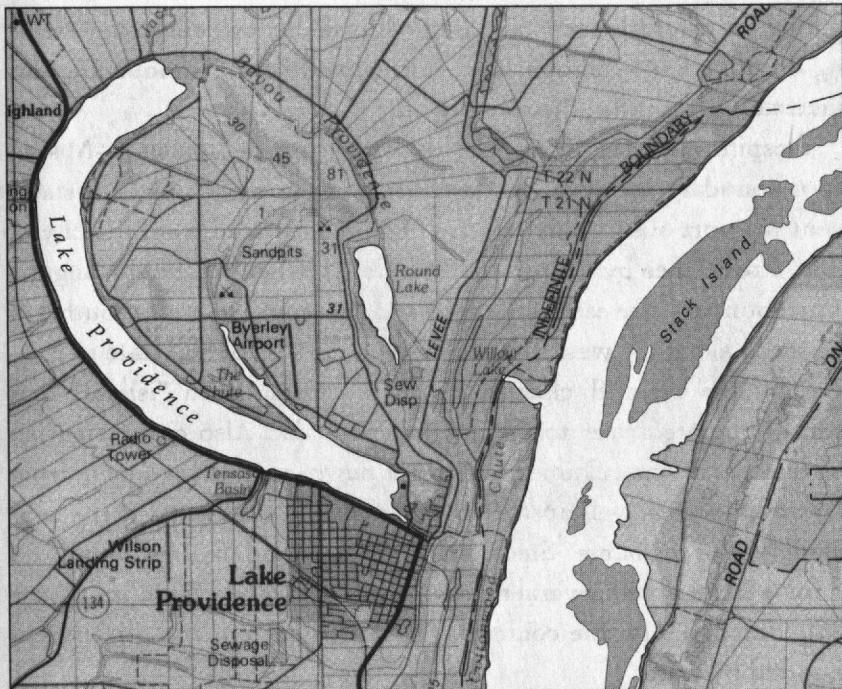


Fig. 4.6. 1982 map of the Mississippi River near Lake Providence, Louisiana. (Portion of the U.S. Geological Survey's Bastrop, Louisiana-Mississippi 1:100,000-scale metric topographic map, 1982.)

intact wherever possible. State boundaries thus run through some of the more recent oxbow lakes and occasionally place portions of the state of Mississippi uncharacteristically on the west side of the river. Because the boundary between Louisiana and Missouri ignores Lake Providence, this oxbow lake most certainly predates Mississippi's admission to the union.

Based on maps from the early nineteenth century, the dashed line labeled "Indefinite Boundary" on the 1982 map in Figure 4.6 represents the approximate thread of the river in 1817, when Mississippi became a state. Establishing the precise location of the original water boundary was difficult—flooding destroys landmarks and survey monuments, and old maps are often unreliable. The U.S. Geological Survey, which produces most of the nation's detailed topographic maps, handles an uncertain boundary with cautious neutrality, estimating its plausible location based on available evidence, representing it with a line symbol half the normal width, and announcing this uncertainty with the adjective *indefinite*.

Despite the historic roots of the approximate Louisiana-Mississippi boundary shown on modern maps, in the late 1980s both states went to court over a narrow strip of land separated from the city of Lake Providence by Cottonwood Chute (the small channel along the state boundary due east of the city) and extending six miles south (off the map) along the west side of the river. Backed by the state of Mississippi, the plaintiff claimed a riparian right to an "island" that merely migrated over to the river's west bank. Also citing riparian doctrine, Louisiana claimed the land as newly accreted sediment from unknown origins well upstream. Complicating the case was the confusing use of the name "Stack Island" for the land in question as well as for a large island several miles upstream on modern maps (Figure 4.6). Furthermore, the contested "island" is seldom completely surrounded by water.

As the 1909 Geological Survey map in Figure 4.7 illustrates, the city of Lake Providence, Louisiana, did not always have the state of Mississippi in its front yard. The clearly marked boundary between

East Carroll Parish and Issaquena County indicates that the state boundary accepted early in the century followed the thread of navigation and passed east of a feature labeled "Stack Island." Mississippi argued that this earlier Stack Island gradually moved westward to the Louisiana side of the river, whereas Louisiana challenged that erosion had slowly destroyed the original Stack Island (as shown on the 1909 map) while accretion of alluvium from upstream gradually added new land along the west bank.

Mississippi v. Louisiana evolved from a private lawsuit in which the plaintiff not only sought clear title but petitioned to have Stack Island declared part of Mississippi. Louisiana objected and joined the law-

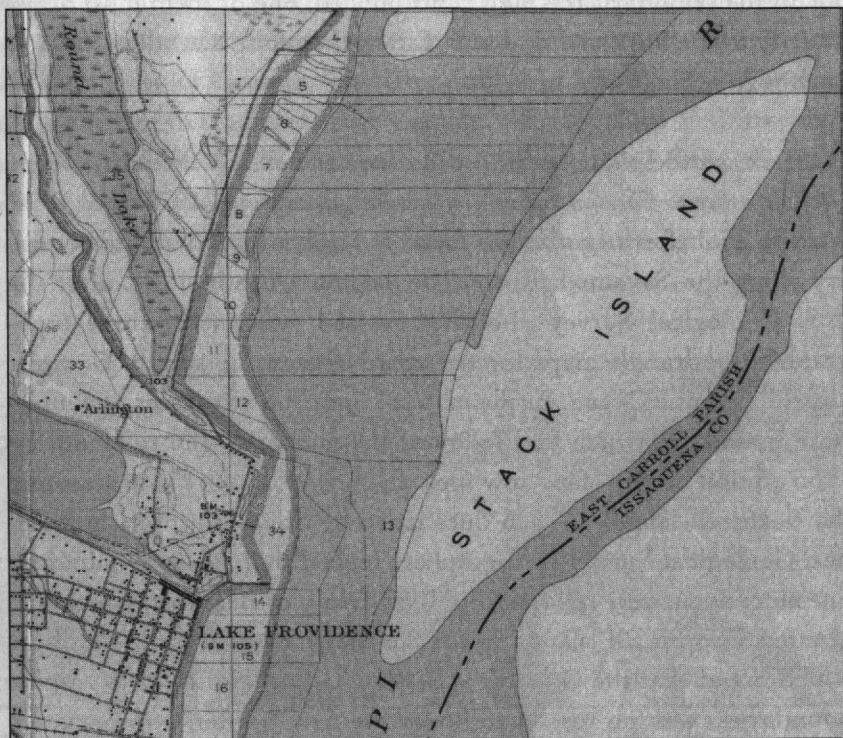


Fig. 4.7. 1909 map of the Mississippi River near Lake Providence, Louisiana. (Photoreduction of portion of the U.S. Geological Survey's 1:24,000-scale topographic map of the Lake Providence, Louisiana, quadrangle, 1909.)

suit, but a federal district court awarded the land to the plaintiff and jurisdiction to Mississippi. Louisiana took the dispute to the U.S. Court of Appeals, which reversed the district court. Mississippi then appealed to the Supreme Court, which distinguished between two very different issues: title to the land and the state boundary. In a unanimous decision, the high court agreed with the district court's decision on land ownership but held that the lower court had no jurisdiction over state boundaries. Noting that federal law gives the Supreme Court "original and exclusive jurisdiction of all controversies between two or more states," the justices asked the court of appeals to decide whether further proceedings were needed to resolve the ownership claim. If Mississippi or Louisiana wants a ruling on the boundary, the high court implied, one of them must apply directly to the Supreme Court. So far, neither state has taken the case back to Washington.

Maps can precipitate boundary disputes as well as help decide them. *Georgia v. South Carolina*, which was in litigation from 1977 until 1990, went to trial after negotiations failed to resolve the interstate boundary along the Savannah River. The dispute arose in 1971, after the U.S. Geological Survey published revised versions of three topographic quadrangle maps for the area between Savannah, Georgia, and the Atlantic Ocean. As the map in Figure 4.8 illustrates, the interstate boundary, which had followed the middle of the river on the 1955 edition of this map, now took an abrupt jog northward around the Barnwell Islands. When questioned by South Carolina authorities, Geological Survey cartographers replied that the new boundary line more accurately reflected the 1787 Treaty of Beaufort, which had granted Georgia all islands in the Savannah River. South Carolina, which noted that the Geological Survey had no authority to resolve boundaries, saw no reason to honor the new border, appropriately labeled "indefinite" on the Geological Survey's maps. Recognizing the potential of the Barnwell Islands for industrial development and eager to secure water rights farther downriver for its shrimp fisher-

men, Georgia attempted to work out a compromise with South Carolina. In 1977 the states seemed close to signing an agreement, when Georgia conservation rangers tried unsuccessfully to arrest a South Carolina fishing captain for illegal commercial fishing in Georgia waters. After South Carolina rejected a request to extradite the fisherman, Georgia filed suit before the Supreme Court and attached the Geological Survey's 1955 and 1971 maps as exhibits A and B.

As with many interstate boundary disputes, the Supreme Court moved slowly. Its first action was to appoint federal district court judge Walter Hoffman as a "special master" to conduct hearings, examine the evidence, and propose a solution. To allow the parties time to prepare their arguments, Hoffman delayed the hearing until 1981. Several prominent historical geographers and cartographic historians testified as expert witnesses. Georgia called Louis De Vorsey, a geographer at the University of Georgia, who later published a book about historic maps relevant to the case. South Carolina called William P. Cumming, a historian and author of *The Southeast in Early Maps*, and Arthur Robinson, a professor of geography at the University of Wisconsin widely respected for his research on both map design and the history of car-

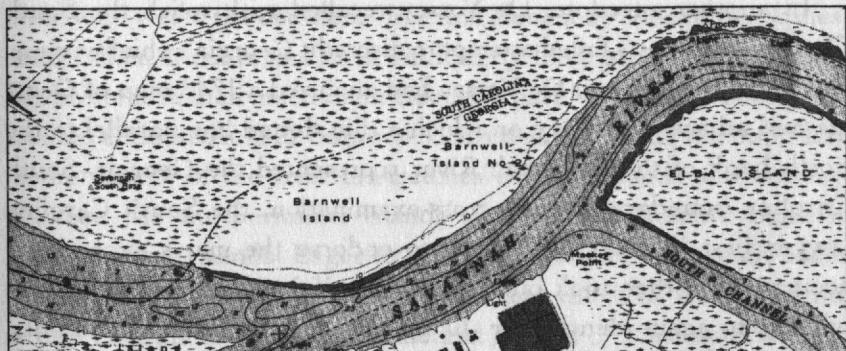


Fig. 4.8. Northward diversion of the Georgia-South Carolina border around the Barnwell Islands on 1971 U.S. Geological Survey topographic map. (Photoreduced from the Savannah, Ga.-S.C. 7.5-minute topographic quadrangle map, 1:24,000, photorevised 1971 edition.)

tography. These and other experts produced thousands of pages of transcribed testimony about the authenticity and relevance of nearly two hundred eighteenth-, nineteenth- and twentieth-century maps introduced as evidence.

Because of the need to mark exhibits as well as the reluctance of archives to loan valuable documents for an indefinite period, the expert witnesses examined photocopies of rare maps, not originals. In an article for *The Map Collector*, De Vorsey described with regret an incident during his testimony on a detailed German map showing the Savannah area during the 1730s. His research indicated that James Oglethorpe, founder of the Georgia colony, was the mapmaker's principal source. Because the map carefully described the islands in the Savannah River and identified most of them by name, De Vorsey concluded that the mapmaker considered these islands part of Georgia. In contrast, the map labeled the sparsely detailed area north of the river "Part of Carolina." When Judge Hoffman asked whether the "white shading" for a large, triangular island in the lower part of the river would suggest the island belonged to Carolina, De Vorsey agreed. He later regretted this "hasty response" when examination of the original map revealed the photostat had failed to capture the mapmaker's delicately detailed symbols for marsh grass.

In another anecdote, De Vorsey recalled with relish the South Carolina attorney's failed attempt to discredit Georgia's chief witness. Earlier in the hearing, De Vorsey had analyzed a 1748 map of Georgia and adjacent territory on which a thin dotted line parallel to the north bank of the Savannah River represented the Georgia-South Carolina boundary. During cross-examination, the South Carolina lawyer first induced De Vorsey to endorse the map's exceptional accuracy. He then took out a large magnifying lens, and asked the witness to again identify for Judge Hoffman the line of fine dots. When De Vorsey complied, the lawyer approached the witness in classic Perry Mason style and challenged dramatically, "Don't you know that those dots are Indian traders' trails?" De Vorsey looked at the map, paused, and retorted with authority, "They are not!" Appar-

ently the South Carolina counsel, in an eager effort to undermine De Vorsey's credibility, had confused the mapmaker's double-dotted-line symbol for trails with the single-dotted-line symbol for boundaries.

However hasty the witnesses and attorneys might have been in the courtroom, the judge was in no hurry. Weeks of hearings had produced boxes of evidence and testimony. Judge Hoffman, who had other responsibilities, examined the material for several years and issued two sets of rulings. His 1986 decision addressed the boundary in the Savannah River, and his 1989 report resolved the seaward boundary, which included offshore fishing rights. As is common in cases requiring a special master, the parties then filed "exceptions" to Hoffman's rulings, and the Supreme Court announced its final decision on June 25, 1990, nearly thirteen years after Georgia had initiated the suit.

With unanimity marred only by four partial dissents on comparatively minor points, the Court supported almost all of the special master's recommendations and rejected most of Georgia's claims. In one of the complex decision's seven rulings, the Court agreed that South Carolina had acquired sovereignty over the Barnwell Islands "by prescription and acquiescence, as evidenced by . . . its taxation, policing, and patrolling of the property." According to Justice Harry Blackmun, who wrote the decision, "Inaction alone may constitute acquiescence when it continues for a sufficiently long period . . . and there has been more than inaction on Georgia's part." In another ruling, the justices endorsed a 1922 Supreme Court decision fixing the boundary in the middle of the river in stretches without islands and midway between the northernmost islands and South Carolina's bank in stretches with islands. Eager to avoid "a regime of continually shifting jurisdiction," the 1990 Court ruled that the 1787 treaty did not entitle Georgia to islands that emerged after 1787. Characteristically wary of contradicting an earlier Supreme Court decision, Justice Blackmun noted that "the Court, in its 1922 decision, did not expressly determine the treatment to be given islands that emerged after the Treaty of Beaufort."

Although maps were hardly mentioned, the mass of cartographic evidence presented at the hearings influenced the Court's decision both directly and indirectly. Directly, maps documented South Carolina's de facto control of the Barnwell Islands as well as helped the special master decide which islands were extant in 1787, and thus subject to Georgia's sovereignty. Indirectly, maps demonstrated the need for a more stable interstate boundary, by showing the effects of a whimsical river in which new islands, however small, "would alter the boundary lines to a degree that could be dramatically out of proportion to the physical change brought about by the formation of the island itself." Moreover, cartographic principles established in the special master's report will help officials fix the boundary elsewhere and grapple with future changes in the river, both natural and artificial. As it often does in boundary cases, the Supreme Court responded with a pragmatic, arguably fair-minded solution intended to avoid further litigation.

Boundaries at Sea

Georgia v. South Carolina went a bit further than most interstate boundary decisions. In determining who controlled Oyster Bed Island (Figure 4.9), the Supreme Court had to establish the mouth of the Savannah River, and in settling this issue the justices extended the boundary seaward onto the continental shelf. Figure 4.10 summarizes the arguments of the litigants and the special master's decision, which the Court endorsed.

Georgia had argued for a seaward boundary through A, the mid-point of the headland-to-headland "closing line" separating internal from oceanic waters. This was the usual method of defining the mouth of a river, and seemed appropriate for Oyster Bed Island, which had emerged after 1787. In an exception to the special master's report, Georgia also noted that dredging by the Corps of Engineers in the 1870s had diverted the main navigation channel from the north to

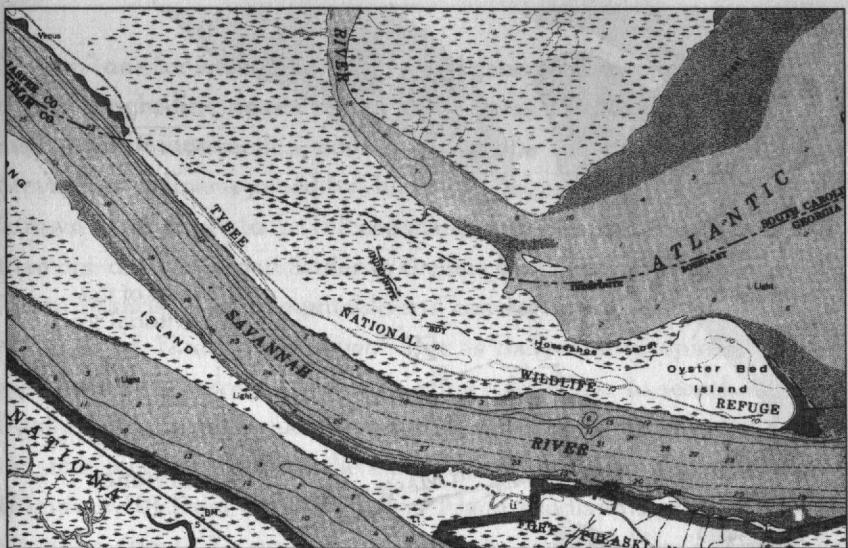


Fig. 4.9. Northward diversion of the Georgia-South Carolina border around Oyster Bed Island on 1971 U.S. Geological Survey topographic map. (Photoreduced from Fort Pulaski, Ga.-S.C. 7.5-minute topographic quadrangle map, 1:24,000, photorevised 1971 edition.)

the south side of the island. In contrast, South Carolina had proposed a division point farther south, at B, where the closing line linking Hilton Head and Tybee islands intersected the middle of the main navigation channel. A submerged shoal closer to Georgia seemed the natural northern boundary of the navigation channel and the counterpart to Tybee Island, the southern headland at the river's mouth. The Supreme Court agreed with this functional delineation of the river's mouth, awarded Oyster Bed Island to South Carolina, and anchored the state boundary at point B.

Judge Blackmun revealed the Court's willingness to accept unconventional solutions in order to avoid appearing unfair. "Given this somewhat uncommon type of river mouth," he wrote, "the Special Master's conclusion that the northern side of the Savannah's mouth is the underwater shoal is not unreasonable. To accept Georgia's proposition here would result in having Georgia waters lie directly seaward of South Carolina's coast and waters."

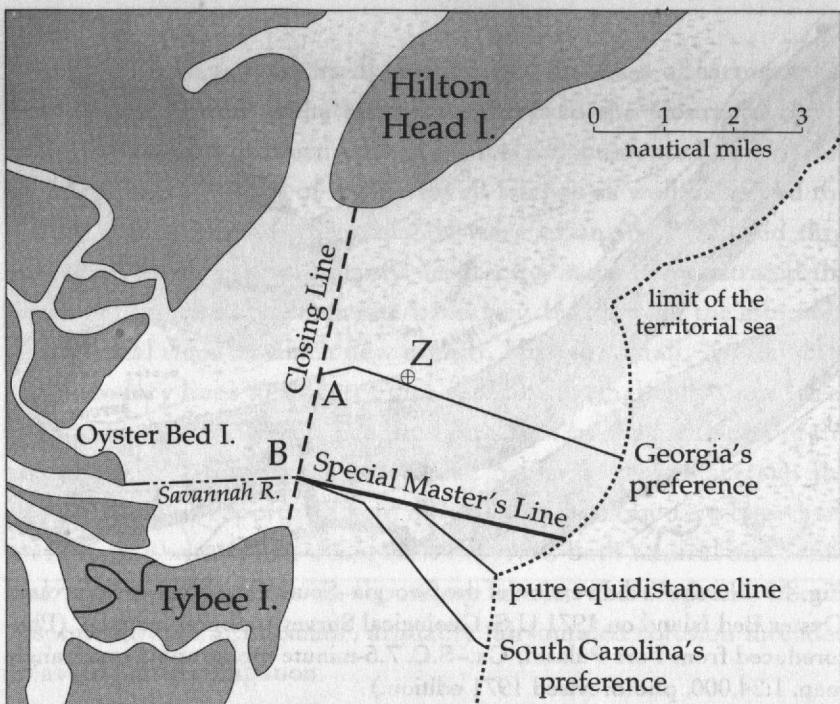


Fig. 4.10. Proposed seaward extensions of the Georgia–South Carolina boundary. (Compiled largely from Map 1 in David J. Bederman, “Georgia v. South Carolina, 110 S.Ct. 2903,” *American Journal of International Law* 84 [1990], p. 911.)

The various lines seaward from points A and B in Figure 4.10 (and roughly perpendicular to their respective coastlines) reflect the marked difference between Georgia’s comparatively vertical coast and South Carolina’s more northeasterly shoreline. The closing line connecting the headlands provided a compromise direction that seemed equitable to Judge Hoffman, who proposed a perpendicular boundary outward from point B. In approving the special master’s solution, the Court recognized the “equitable balance” between the widely different boundaries favored by Georgia and South Carolina.

The majority of the justices rejected South Carolina’s proposed “coastal front” model, which bent the state boundary toward the southeast by projecting seaward two overlapping sets of straight-line coastal

"fronts," one for each state. (The model generated successive images of these straight-line coasts at equal distances offshore and then connected their intersection points to describe the boundary.) Justice Stevens, in a dissent joined by Justice Scalia, asserted that a boundary "drawn in reference to the full coastlines of the respective States, rather than one drawn perpendicular to the line connecting Hilton Head and Tybee Islands, is more equitable and consistent with the equidistance principle of *Texas v. Louisiana*." But as the majority opinion noted, equidistance is merely a principle, not a rule of law. In searching for a legally sound, geographically equitable compromise that fit the special circumstances of the case, the Court also rejected the line equidistant (Figure 4.10) from both the Tybee Island headland and the low-tide elevation (point Z) used to delineate the territorial sea's three-mile limit. (The dotted line representing the three-mile limit bulges outward along the arc of a three-mile circle centered at point Z.)

As a state boundary extending only three miles seaward from the coast, the special master's perpendicular line seems little different from the "equidistance line" in Figure 4.10. But as Justice Stevens observed in his dissent, the Georgia-South Carolina boundary might eventually be projected much farther. On December 27, 1988, in fact, President Reagan expanded the territorial sea to twelve nautical miles, and the special master's line could be projected that far as well if the federal government awards states specific rights in the region. Future legislation or litigation could even project interstate boundaries into the 200-mile-wide Exclusive Economic Zone, which also remains federal territory. As Justice Stevens argued, a map extending the special master's line 200 nautical miles into the Atlantic would appear grossly unfair to South Carolina.

Technological advances since 1950 in deep-sea mining, submarine-launched weapons, electronic communications, and sonar mapping have encouraged nations to claim and defend ever wider strips of adjacent coastal waters. Although countries have contested marine navigation and fishing rights for centuries, new prospects for seabed

mining and offshore broadcasting demanded a more consistently applied hierarchy of maritime boundaries defining a broad range of rights and jurisdictions. Decades of work by international lawyers and political geographers, and numerous widely attended Law of the Sea conferences sponsored by the United Nations, led to detailed standards in 1982 for redrawing the world's maritime boundaries. Despite the reluctance of the United States to join the more than fifty-six nations that have ratified the pact, several provisions of the UN Convention on the Law of the Sea (CLOS) have already affected America's offshore territory.

The convention recognizes five national maritime zones between the land itself, where aliens have no rights, and the high seas, where all countries have equal rights and responsibilities in fishing, mining, navigation, overflight, and scientific research. Within *internal waters*, including bays and the mouths of rivers, aliens have no rights except for the "innocent passage" of ships in designated sea-lanes. Within a nation's *territorial sea*, usually extending twelve nautical miles from the coastal baseline, aliens have few rights beyond controlled use for air and sea navigation. In the *contiguous zone*, which normally extends twenty-four nautical miles from the coastal baseline, aliens have full rights for navigation and overflight, some rights for scientific research and laying submarine cables, and whatever fishing rights apply in the *Exclusive Economic Zone* (EEZ). Extending 200 nautical miles out from the coast and overlapping the territorial sea and contiguous zone, the EEZ grants the coastal state full control over mining and substantial control over fishing. Within the *continental margin*—a geologically determined zone extending sixty nautical miles beyond the foot of the continental slope—aliens may fish and conduct scientific research in the "water column" but cannot mine or catch "sedentary" (nonmigratory) species. Only coastal nations with a broad continental shelf enjoy the rights of a continental margin extending beyond the EEZ. Additional rules apply to *archipelagic waters* surrounding "wholly archipelagic states," which enjoy less control than continental nations over navigation and overflight.

The Convention on the Law of the Sea calls for standardized zone boundaries at 12, 24, and 200 nautical miles. Prior to 1982 many nations had much narrower zones, whereas several Latin American and African countries claimed a 200-mile territorial sea—on paper at least. Most nations eagerly adopted the convention, which generally sanctioned their current claims or conferred new ones, but the United States clung to its traditional three-mile territorial sea until 1988. Seeing others' gains as its own losses, the U.S. government had long and adamantly opposed expanded maritime territories. In 1969, for example, after Peru detained several American tuna boats and fined their captains about \$2,000 apiece for invading its recently proclaimed 200-mile exclusive fishing zone, Washington suspended arms sales to the highly nationalist yet fiercely anti-Communist Peruvian regime. Although declining to sign the convention, the United States nonetheless established its own 200-mile EEZ in 1983 and enthusiastically started to map it with sonar sensors. Almost all coastal states now have a 200-mile EEZ, and over sixty countries have formally signed the agreement.

Because most nations never had 200-mile economic zones before, the EEZs often created new maritime neighbors. The United States, for instance, has had to work out maritime boundaries in the Atlantic with the Bahamas, Canada, Cuba, and Mexico for the EEZ adjacent to its mainland and with the Dominican Republic, the Netherlands, the United Kingdom, and Venezuela for the EEZs centered on Puerto Rico and the Virgin Islands. In addition to extended boundaries in the Pacific and Arctic Oceans with Canada, Mexico, and the Soviet Union, the United States also found itself a maritime neighbor of Japan, Kiribati, New Zealand, and Samoa. The UN encourages nations with overlapping EEZs to negotiate whatever adjustments might be needed, draw up a map delimiting the agreed-upon legal definition, and sign a treaty renouncing other claims that might undermine the boundary's permanence.

To minimize conflict, the UN Convention on the Law of the Sea defines the baseline for a territorial sea as the tide's low-water line delin-

eated on the coastal nation's existing navigation charts. Use of these charts was not only efficient and expedient but also discouraged countries from concocting new maps solely to exaggerate their maritime territory. The convention also permitted the territorial sea to bulge outward in twelve-mile arcs around "low-tide elevations"—offshore patches surrounded by water at low tide but inundated at high tide. But this provision applied only to low-tide elevations otherwise within the territorial sea defined by the mainland. Precise language also allowed a baseline along the seaward side of the fringing reef surrounding an atoll or other island, and allowed straight closing lines across bays and the mouths of rivers as well as along coasts that are deeply indented or fringed with islands. Although closing lines and other straight-line portions of the baseline generally should not exceed twenty-four nautical miles in length, the convention pragmatically permits exceptions. As guidelines published by the UN Office for Ocean Affairs and the Law of the Sea urge, "By judicious selection of a system of straight baselines it may be possible to eliminate potentially troublesome enclaves and deep pockets of non-territorial seas without significantly pushing the seaward limits of the territorial seas away from the coast."

Where two nations' territorial seas, continental margins, or EEZs overlap, the convention calls for median boundary lines based on the well-established equidistance principle. Grounded in a rigidly mathematical notion of fairness, the equidistance principle raises the question "Equidistant from what?" As Figure 4.11 suggests, protruding headlands can exert enormous territorial leverage and offshore islands act as nuclei for their own territorial seas and EEZs. But how much land must not be inundated at high tide for a "rock" to qualify as an island? Size, name, geology, and maximum elevation above the high-tide line are not consistently reliable criteria for distinguishing a rock from an island, and the UN requirement that the island be capable of "sustaining habitation or economic life" begs equally vexing questions. Although controversial rocks could be obstacles to resolving maritime boundaries, these flukes of marine geology can also be useful bargaining chips.

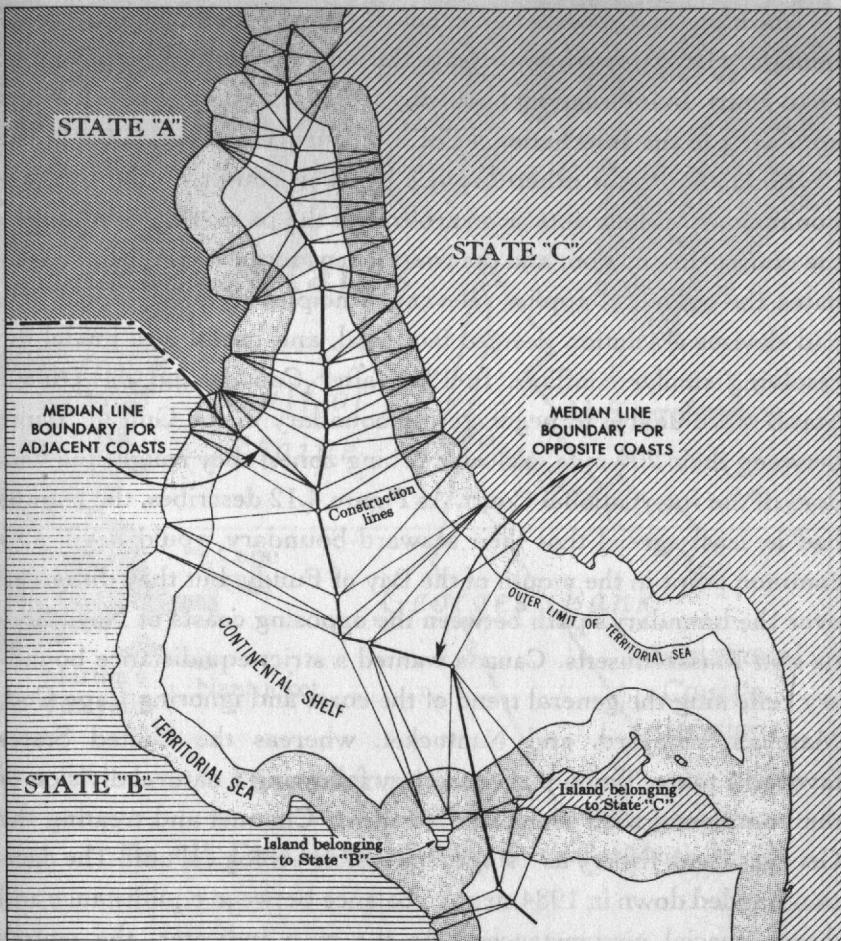


Fig. 4.11. Median boundaries between hypothetical sovereign states with adjacent and opposite coasts. (From U.S. Department of State, Office of the Geographer, "Sovereignty of the Sea," *Geographic Bulletin* no. 3 [October 1969], p. 33.)

Maritime neighbors who cannot negotiate a permanent seaward boundary have three options: leave the issue unresolved, go to war, or go to court. In international boundary disputes, going to court means appealing to the International Court of Justice at The Hague in the Netherlands. As for other disputes between countries, the International Court usually acts as an arbitrator: the parties agree to accept the court's jurisdiction; and the court listens to their arguments, evaluates the evidence, applies relevant principles of international law, and devises a solution deemed fair, legal, and useful as a model for resolving similar conflicts. In 1981, after Canada and the United States were unable to negotiate the boundary in the Gulf of Maine between their 200-mile exclusive fishing zones, they sought the wisdom of the International Court. As Figure 4.12 describes, the nations had at least agreed that their seaward boundary would begin at a common point in the mouth of the Bay of Fundy, but they disagreed over the boundary's path between the opposing coasts of Nova Scotia and Massachusetts. Canada wanted a strict-equidistance boundary reflecting the general trend of the coast and ignoring Cape Cod, Martha's Vineyard, and Nantucket, whereas the United States favored a more "functional" boundary following a natural division of the continental shelf along the Northeast Channel and treating the Georges Bank fishery as a single, indivisible ecological unit. The decision handed down in 1984 struck a balance between equidistance and these "special circumstances." As the map indicates, the court's boundary recognizes a need for both compromise and simplicity.

Like the International Court's two-segment solution to the Gulf of Maine dispute, maritime boundaries filed with the United Nations are surprisingly simple. Despite heavy use of maps, navigation charts, and tidal records during negotiations, an international accord between maritime neighbors represents the negotiated boundary as a straightforward list of points, described by their latitude and longitude. *Loxodromes*, or lines of constant geographic direction, connect successive points so that each boundary segment has a constant bearing. As with the deed to a farm or building lot, the boundary's legal

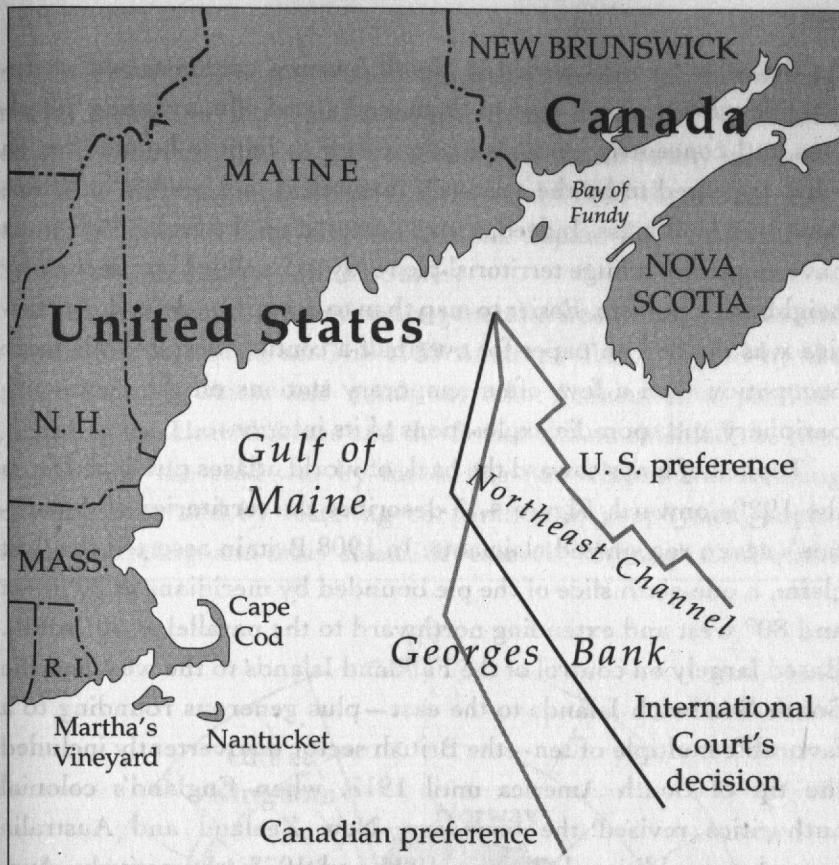


Fig. 4.12. Disputed boundaries in the Gulf of Maine.

description is more important than its map. When Britain and France used a mere six points to divide the English Channel, their agreement included a map but noted quite pointedly, "The boundary line defined [by the list of coordinates] has been drawn solely by way of illustration on the chart annexed to this Agreement." As centuries of international boundary disputes demonstrate, a map on equal footing with the list of coordinates only encourages future conflict.

Older maps of Antarctica reflect perhaps the most flagrant use of maps and the equidistance principle to grab vast overseas territories.

As the early colonial period in North America demonstrated, cartographic white space is easy to claim, and a grid of converging meridians and concentric parallels made it easy to impose boundaries on what appeared to be the relatively featureless, not readily habitable Antarctic land mass. Indeed, a map centered on the South Pole must have suggested a huge territorial pie ready to be sliced into sectors by neighboring powers. Easier to map than to occupy or defend, Antarctica was divided on paper for over half a century despite little more occupation than a few, often temporary stations on the continent's periphery and sporadic explorations of its interior.

Typical of maps toward the back of world atlases published from the 1920s onward, Figure 4.13 describes the territories of Antarctica's seven recognized claimants. In 1908 Britain asserted the first claim, a one-sixth slice of the pie bounded by meridians at 20° west and 80° west and extending northward to the parallel at 50° south. Based largely on control of the Falkland Islands to the west and the South Sandwich Islands to the east—plus generous rounding to a favorable multiple of ten—the British sector inadvertently included the tip of South America until 1917, when England's colonial authorities revised the boundary. New Zealand and Australia carved out additional slices in 1923 and 1933, respectively. Australia's enormous sector, reflecting the broad longitudinal range of its mainland and island territories in the southern Indian Ocean, overlapped France's Adélie Land, near the magnetic South Pole, which Dumont d'Urville had explored in the late 1830s. Leisurely diplomatic correspondence between 1911 and 1938 eventually fixed the French claim as a thin wedge, from 136° east to 142° east, which divided the Australian zone into two parts. In the late 1930s, Norway claimed the coast between the Australian and British territories. Lacking territory directly north, the Norwegians based their claim on exploration but acknowledged the sector boundaries of their Antarctic neighbors. In the early 1940s, Argentina and Chile proclaimed sectors that overlapped each other's claims as well as the "British Antarctic Territory." The former's broad sector reflected

not only the Argentinean mainland but its historical, often frustrated claims to the Falklands and South Georgia. No nation claimed the remainder of the continent, well south of any inhabited territory, but research stations were established there and elsewhere in Antarctica by Germany, India, Japan, South Africa, the Soviet Union, and the United States.

Current maps of Antarctica are generally free of boundaries and seem likely to remain so. The 1959 Antarctic Treaty signed by the seven claimant states and numerous other "consultative parties," including the United States and the Soviet Union, shielded the continent from the cold war by forbidding new claims and freezing existing ones and by fostering cooperation in geophysical exploration, mapping, and other scientific research. Although none of the

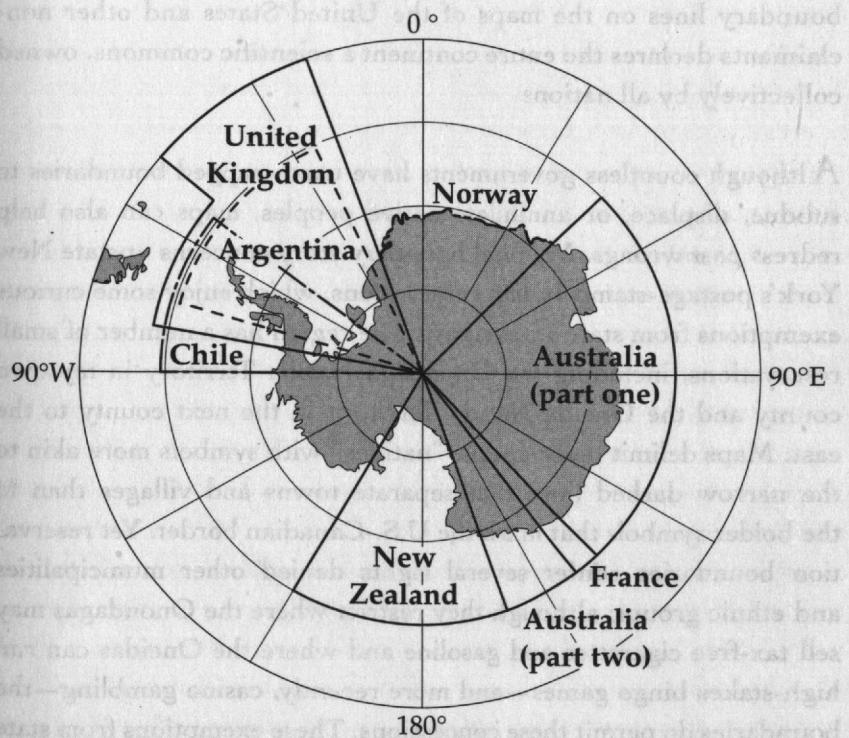


Fig. 4.13. Territories of the seven Antarctic claimants.

original seven claimants has yet renounced its claims, three decades of scientific study by others have considerably weakened their stature. In his book *Antarctica: Private Property or Public Heritage?* Keith Suter observes, "Ironically, in terms of establishing a 'presence' the US and the USSR each 'occupies' Antarctica more effectively than any of the seven claimant nations." In 1987 a *National Geographic* map supplement on Antarctica honored the national claims only on a small, marginal inset map—little more than an anecdotal fragment of geographic trivia; and in 1993, the completely new *Hammond Atlas of the World* left no hint of territorial boundaries on its one-page treatment of Antarctica. In contrast Argentinean, Chilean, and even British world atlases show several different political geographies. While these maps make individual Antarctic territories a reality for the claimant states, a conspicuous absence of boundary lines on the maps of the United States and other non-claimants declares the entire continent a scientific commons, owned collectively by all nations.

Although countless governments have used mapped boundaries to subdue, displace, or annihilate native peoples, maps can also help redress past wrongs. My final boundary story concerns upstate New York's postage-stamp Indian reservations, which enjoy some curious exemptions from state sovereignty. The region has a number of small reservations, including the Onondaga Nation Territory in my own county and the Oneida Nation Territory in the next county to the east. Maps delimit these unique "nations" with symbols more akin to the narrow dashed lines that separate towns and villages than to the bolder symbols that mark the U.S.-Canadian border. Yet reservation boundaries confer several rights denied other municipalities and ethnic groups: although they restrict where the Onondagas may sell tax-free cigarettes and gasoline and where the Oneidas can run high-stakes bingo games—and more recently, casino gambling—the boundaries do permit these concessions. These exemptions from state

power apply to specific territories, which could not exist within contemporary America without maps and boundaries. As with territories defined by zoning maps, maps of EEZs, and other cartopolitical instruments, the Onondaga and the Oneida nations have a status and legitimacy that maps represent, reinforce, and defend. In the eyes of the state, maps make them real.

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4. BOUNDARY LITIGATION AND THE MAP AS EVIDENCE

GENERAL SOURCES

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5. CONTINENTAL DRIFT AND GEOPOLITICS: IDEAS AND EVIDENCE

GENERAL SOURCES

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