

Research Report

Synopsis of
Historic Watercraft
Operating In Southwestern States and
The Salt River, Arizona.

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Abstract

The following paper discusses the types of historic vessels available in the Colonies and later States for the commercial transportation of raw products, finished goods and passengers along navigable rivers. Specific attention is paid to those vessels available for use in Southwestern States in general, and whether or not they were used on the Salt River, Arizona, in particular. The paper examines the recorded instances of attempted historic vessel use on the Salt River with respect to how such use indicates the viability of the river as a reliable route for commerce and transportation. There is, in fact, a preponderance of evidence to the contrary. It is concluded that the minimal use of trade vessels that did occur shows a history of failed experiments. Also, that there is no correlation between the uses of specialized craft for exploration, and of later craft for recreation, to the use of the Salt River as a viable route for the commercial transportation of products and people at any time in its history.

Introduction

This paper results from a consulting request by the firm of Salmon, Lewis and Weldon P.L.C., on behalf of the Salt River Project Agricultural Improvement And Power District and The Salt River Water Users' Association (Salt River Project). The Salt River Project has for some time been engaged in the process of presenting information to the Arizona Navigable Stream Adjudication Commission (ANSAC) relative to the navigability of the Salt River running through the state from the Black and the White rivers in the White Mountains to the Gila River west of Phoenix. The author was asked to address several specific questions:

What types of watercraft were used, or were available for use, for the transportation of goods or people in the southwestern United States at and before the date of Arizona statehood on February 14, 1912? Is there any evidence that such watercraft were used on the Salt River in its ordinary and natural condition?

Are the types of watercraft currently used on some reaches of the Salt River, AZ, meaningfully similar to watercraft used or available for use in 1912 and earlier, for purposes of transporting goods or people on water?

Is the draft/draw of a boat necessarily the same as the amount of depth in the river that is required in order to be able to transport goods or people in that boat on the river?

Historical Background

The various cultures of Europe had thousands of years to develop small craft capable of operating in the diverse riverine environments of the continent. As the British colonies on the east coast of North America began to be established, it was natural for these proven technologies to be transferred to the riverine systems that fed from mountainous upland regions, across midland and lowland plains toward the east coast. It was through this transference mechanism, for example, that the Stockholm tar boats and the Douro River wine boats became the Durham boats of the northeast and the Petersburg cotton boats of the south. The development of north-south road systems drove the need for ferry craft and again European solutions were adapted to meet this need. When, in the

eighteenth and nineteenth centuries, the importation of enslaved Africans increased significantly, another cultural influence was added to the small craft traditions of the colonies and later states. These various cultural influences were applied to the adaptation of European and African small craft design. The resulting subtle changes in appearance and construction were regional in nature and did not affect the basic form and function of the craft.

A second major factor driving vessel form and function was the nature of the containers needed for the products these small craft were required to transport to market towns and coastal ports. The canoe form, for example, was ideal for the transportation of small bundles of beaver pelts. The transportation of tobacco barrels or cotton bales, often from inland and upland plantations, needed a very different solution and required much larger and heavier vessel forms.

A third factor influencing form and function was the geomorphology of the riverine systems in which these craft operated. Narrow, shallow and fast running upland region rivers required a very different vessel form from coastal plain rivers which tend to be deep, wide and slow running. Upland rivers general tend to be narrow, shallow, fast moving with winding channels over rocky strata. This forces vessel design in the direction of shallow draft hull forms with a reduced beam. They also need highly responsive steering coupled with reinforced bows. Lowland rivers typical of the East Coast, for example, are generally slow moving, usually traverse flat plains or agricultural areas, and have wide channels with clay or mud bottoms and considerable depth. This allows for deep draft, wide beamed vessels with large cargo capacities. The terrain also allows for use of wind power to overcome slow or tidally influenced estuaries.

Temporal context and economics are the final factors influencing the function and design of riverine craft in the American colonies and emerging states. Riverine trade in the early seventeenth century east coast Colonies would have included a significant number of lone trappers earning subsistence income from small loads of beaver pelts carried in birch canoes or dugouts. Business enterprises and plantations using large capacity vessels moving huge quantities of raw and finished goods up and down rivers dominated riverine trade by the end of the nineteenth century. These temporal changes reflect the growth of both mature and frontier centers of population and the change over

time in demand for goods. Early communities needed survival and subsistence materials from axes to ammunition. Later, mature communities demanded more manufactured goods to support increasingly sophisticated lifestyles such as porcelain, carriages and silverware. By the same token, the nature of products shipped from these communities also changed over time. Mature centers of population were seeking to export bulk goods from cotton and tobacco to wheat and lumber. The economics of transportation also demanded larger vessels and larger cargoes in order to generate significant profits.

Development of the Southwest

As the States pushed the frontier westward, these five factors passed through the same cycle. The types of small craft used for subsistence and exploration on rivers in eastern States in the eighteenth century were employed for the same purposes in the rivers of new territories in the nineteenth century. Exceptions to this general rule would have been California and Texas, both states accessible via large ocean coastlines (ocean going vessels are beyond the scope of this paper and have been excluded from discussion). These states achieved statehood in 1850 and 1846. Exploration of southwestern states without access to major sea routes progressed from the eastern states and both California and Texas. Thus Nevada in 1864, Colorado in 1876, Utah in 1896, New Mexico and Arizona in 1912.

All of these states have river systems and the presence or absence of complex modes of riverine trade and transportation can, among other factors, be linked to the navigability of these rivers. The decline of riverine based trade and transportation began with the introduction of an expanding rail network during the nineteenth century and, to a lesser extent, the development of road and highway networks in the early twentieth century.

Vessels in use for Trade and Transportation

The following discussion provides a general overview of the types of vessels built by aboriginal cultures and by Europeans in the Colonies and later states and which were available in the southwest for riverine trade and transportation for the period 1846 to 1912. The general area considered for this discussion ranges from the Texas-Louisiana border to California. Some more northerly states are mentioned where appropriate.

Early dugout craft are most often associated with aboriginal American cultures, the ‘burn and scrape’ method of production being documented by some of the first European explorers. These craft were typically made of softwoods such as cypress and pine. Carefully controlled fires were set on the top of a log to carbonize the surface wood. This was then scraped away with shell or stone tools. The process was repeated until the log was hollowed. The ends of the log were typically wedge shaped. Sizes ranged from one to two man craft. Much larger sizes could have been produced when first growth timber was available. Both Africans and Europeans continued to make dugout craft throughout the historic period, producing refined versions with advanced tools or by incorporating a dugout log as the keel of a larger vessel, known as a pirogue. The small dugout (Fig. 1) was primarily used for subsistence activity, hunting and fishing, and for local travel. The earlier versions could hardly be described as useful for the conveyance of cargoes of any kind. Even those dugouts produced in southern states in the early twentieth century were acknowledged as precariously balanced craft fit only for personal use. There is no evidence that dugouts were used on the Salt River during the pre-historic period.

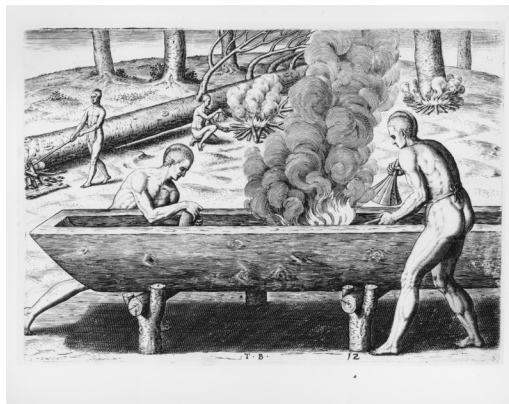


Figure 1: Early Illustration by De Bry of the dugout scrape and burn process.

In 1874, a logging expedition led by C.T. Hayden is reported to have built a pine dugout in the Sierra Anchas. According to later reports, boulders on the Salt River destroyed the dugout and the project was deemed a failure (Fireman in *The Smoke Signal*, 1968).

The canoe, in addition to the dugout, was in wide use among Native American Indians well prior to the arrival of Europeans. These were lightly framed craft with an exterior skin or hull of birch or pine bark (Fig. 2) sewn with sinews or root fiber. The native population used the craft for subsistence activities and local transportation. The craft was quickly adopted by Europeans and used for the same purposes. Trappers were among the first to also use canoes for the transportation of small amounts of trade and finished goods. The lightweight and small cargo made the craft suitable for frequent portages around falls and rapids on rivers that were not navigable, such as the Salt.

Both canoes and dugouts continued to be used throughout the states as they expanded westward. Skillfully carved cypress dugouts were still being carved in southern rural communities from Louisiana to Georgia well into the middle of the twentieth century. The form faded from use with the advent of cheaply produced plastic canoes and kayaks, the modern version of the historic canoe now in wide use for recreational purposes. There is no historical or archaeological evidence to date that canoes were regularly used for trade and transportation on the Salt River.



Figure 2: 18th Century bark canoe (courtesy Coburn House State Historic Site, Pittson, Maine).

The pirogue as used in North America was a craft that combined the cultural influences of aboriginals, Africans and Europeans. It appears to have developed either from Native American or African dugout canoe forms and perhaps early Louisiana French Cajun traditions (though the Cajun cypress dugout more than likely had an enslaved African origin). The craft was originally nothing more than a dugout canoe with planks added to the gunwale to increase its load bearing and passenger capacity. Over time this concept evolved into a complex construction in which the dugout canoe became a 'v' shaped central log forming the keel of a large soft-chined hull. Between the two forms were a variety of shapes from large canoe-like boats propelled by oars and paddles to sailing vessels that plied estuarine and coastal waters. Pirogues were used during the early exploration of the Red River and its tributaries (Bagur 82, 2001). The pirogue was doubtless used on other southwestern rivers, especially those connected to the Red and Colorado River systems. There is no indication that pirogues were ever in use on the Salt River.

Agriculture and industry began to be established in population centers as Europeans moved westward. One result was the wider availability of lumber processing machinery. Finished lumber played into the economic demand factor for larger, sturdier vessels capable of carrying bulkier cargoes. This also had an impact on much smaller craft, making it easier to produce them with planked lumber. In most cases, these craft were not being built by experienced boat builders, instead plantation and farm carpenters often made small, planked vessels along with barns, carts, carriages and vernacular furniture.

The most common planked up craft produced under these circumstances was the skiff. This craft is essentially a flat-bottomed, shallow draft form constructed of bottom planks and one or two side planks, edge joined with a flat or slightly rising sheer (Fig. 3). The internal frames to which the planks are pegged or nailed are usually square-cut floor and side timbers.



Figure 3: Small skiff built with planks supported by a small inner frame (Currier & Ives).

The skiff and its variations are most commonly used for recreational, subsistence and local transportation. They are not a useful craft for carrying heavy loads or many passengers. The design is not suitable for fast running currents as the shallow draft resulted in a high center of gravity and a lack of stability. A skiff does appear to have been used as a small utility craft in the Salt River on a calm stretch of water in the Salt River Canyon (Fig. 4).



Figure 4: Three men in a small skiff (compare with figure three) in the Salt River Canyon. Note the calm river conditions, (courtesy Arizona State Library, Archives & Public Records).

Traditionally built small craft such as rowboats would also have been widely available in the southwest, either as a result of importation or construction by skilled boat builders where there was sufficient demand for the work. These vessels were typically of curved hull, carvel or clinker planked hull construction with sophisticated internal framing using floor timbers and futtocks. Like skiffs, rowboats and craft of similar design were used primarily for local transportation, recreational and subsistence activities.

The 'bateau' was a term applied to a wide range of similarly designed vessels that began to meet the demand for raw and finished cargo transportation on American rivers by the mid eighteenth century. Developed for the bulk fur trade, the design may well have been inspired by the canoe. They were for the most part flat bottomed, double ended and relatively light construction and narrow beam:

"The boats...are from 48 to 54 feet long, but very narrow in proportion to their length..." (Weld 1969:210).

"...These (bateaus) are very light boats about 60 feet long and 4 or 5 feet wide..." (Carter 1977:92).

The flat bottom was usually built without a keel, unless large "king and queen" planks were used along the center of the hull. Steering and propulsion was by means of a large stern sweep and oars, poles and wind power. As with the Petersburg type boats discussed below, the bateau was designed to carry heavy loads in fast running upland rivers. As such they needed considerable operating depths beneath the keel. There is no evidence that bateaus were ever used on the Salt River.

The keelboat (Fig. 5), largely introduced in the late eighteenth, early nineteenth century overcame the limitations of the lighter, narrower bateau. They quickly developed into the 'freight truck' of the period and differed from the bateau in several major features. The keelboat used a heavy central keel on a flat bottom, a much wider beam, and the bow and stern were reinforced to withstand the hazards of shallow river navigation. They were designed to carry large and bulky loads of both raw and finished goods up and down navigable rivers. Massive amounts of commercial cargo were transported over American rivers by these craft, half a million tons in one twenty year

period in the Ohio River valley system for example (Baldwin, 1941). Use of the craft spread westwards with the opening up of the interior and they were being used on the upper reaches of the Missouri River by the mid-nineteenth century. There is no archaeological or historical evidence that keelboats were able to ply the Salt River.

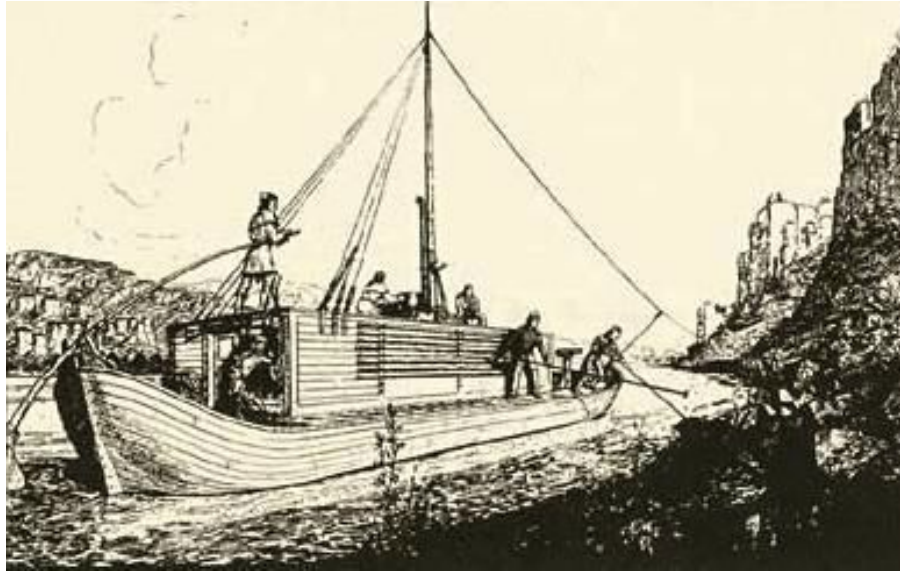


Figure 5: Keelboat on the Ohio River (author files).

Many of the rivers of the States originate in mountainous areas where navigation encounters fast running and shallow rivers and streams, usually with considerable changes in elevation over short distances. As with other vessel environments, this problem already existed in European rivers and the same design solution was used. The ‘mountain boat’ appeared on eastern state rivers as products such as short staple cotton and tobacco began to be produced on the piedmont or upstate regions of the east coast after 1800 (Fig. 6). They were often regionally named, referred to as Durham iron ore boats in the northeast and Petersburg cotton boats in the south.

the only means of transportation out of a major cotton growing area around the town of Petersburg, Ga. Petersburg or cotton boats as they were locally called, would gather at the confluence of the Broad and Savannah Rivers and await major winter rains. The boats would be loaded with ten to thirty tons of cotton bales, depending upon their length. Rainstorms would raise the trickle of water in the Savannah to a raging torrent. The boatmen would launch into this current and make the journey to Augusta in three days – at one point in the journey travelling through a rocky pass only twelve inches wider than the seven foot beam of the boats. Wrecks and deaths were not uncommon.



Figure 7: A Petersburg Boat in the Augusta Canal (Courtesy City of Augusta Archives).

As if the downstream journey was not remarkable enough, the boat crews routinely loaded these craft with finished goods and then dragged them back upstream against the current. The iron-tipped poles used to fend the boat off of rocks on the downward passage were used to wedge against the current when going upstream. The men prided themselves in arriving back at Petersburg with bleeding chests and armpits from the pole tips. There is no evidence of such activity or that these boats were ever used on the Salt River.

A similar craft called a ‘mackinaw’ operated on the upper Missouri River. It, along with keelboats, carried raw goods downriver from Fort Benton. According to B. B. Barbour the mackinaws would often make “100 miles in a day” a figure that implies fast currents indeed (Barbour, 2001). The mackinaws differed from the eastern mountain boat only in that they also used sail power. Not surprisingly, the mackinaws most often made

one-way journeys and were broken up for lumber at their destination. Again, there is no evidence that these one-way vessels were used on the Salt River.

‘Flat,’ ‘barge’ and ‘scow’ are generally taken to refer to the same type of craft. They may differ only in that barges were often very large and often had shaped sterns and bows as opposed to the double flat ends of the common river flat (Fig. 8).



Figure 8: A flat boat in Louisiana (author's files).

It is known that “flat bottomed pull boats” were in use in the Colonies as early as 1638 (Bunker 1979:6). As mentioned above, as colonists expanded west and north from the east coast late in the seventeenth century, they utilized craft based on European designs. The barge or flat would logically have come into use as demand increased for a type of craft to move bulk raw materials and finished goods to and from the developing centers of population on the frontier. The design also is the logical progression of the practice of splitting a log canoe and inserting planks to achieve a wider beam. Another earlier derivation is supposed to have been the lumber rafts fashioned by colonists to steer lumber to coastal ports (Alford, Michael, personal communication 1991). These wide beamed, flat bottomed, wedge ended craft would have been a logical design response to environments that called for heavy load bearing vessels operating in relatively calm waters with reasonable depth where constant on and off loading had to be achieved with ease and efficiency (Newell, 42:1995).

By the close of the seventeenth century, the plantation system had become well established in South Carolina, primarily as a result of the success of upland rice cultivation (Doar, 1936:51-53). There are indications that tidally irrigated rice fields were being introduced into South Carolina by 1720 (Carpenter 1973:15). By the 1730s widespread interest was developing in the lowlands cultivation of rice (Smith, H.A.M. 1988:59) with plantations irrigated and fertilized by tidally influenced river water flowing through an intricate canal system. It was in this environment that the basic barge design was especially suitable, amply demonstrated by the large number of these craft still to be found submerged in the State's plantation canal systems (Newell 1986:2). There is little doubt, therefore, that southern rice plantations were one of the driving forces behind the adoption of the barge or flat design.

As with other craft, the usefulness of the form ensured its long-term survival and use on the westward moving frontier. Barge forms were in use well into the twentieth century and the present day on large construction projects and for moving heavy loads where harbors and river depths permit their use. In a significant change in traditional design, these larger barges were built with a vertical stern that was strengthened to withstand pushing forces from a tugboat. Smaller versions also were built to this same design. We see no frequent evidence of their use on the Salt River or associated irrigation canals.

The steamboat (Fig. 9) made its appearance on eastern rivers early in the nineteenth century. By the time southwestern states were being populated these craft had developed into massive shallow water river craft capable of carrying large bulk cargoes and many passengers. As early as 1821, attempts were being made to use steamboats to overcome land transportation problems in Texas – an issue not solved until the advent of rail by the 1860s (Francaviglia 22:1998). The Missouri river route, more than 3,000 miles of waterways stretching into Montana, spread the steamboat throughout the mid and southwest. By 1852 the first steamboat appeared on the Colorado River. A 65-foot side-wheeler named the *Uncle Sam* carried 32 tons of freight for Fort Yuma. By 1854 the 104-foot *General Jesup* was carrying 50 tons of freight up and down the Colorado to and from Fort Yuma and drew only thirty inches of water (Muther, 15:2004).



Figure 9: A steamboat loaded with cotton on the Mississippi. Typical of the bulk transportation needed in the late 19th century (author's files).

The demand for steamboat transportation was so strong during the mid nineteenth century that vessels were ferried around Cape Horn to the west coast. Earlier, smaller steamboats were taken apart at west coast ports and shipped by larger craft to southwestern states to be reassembled.

Ferry craft (Fig. 10) are included in this paper, as they are commonly believed to be 'river craft.' By very definition, these flat or barge hull derived craft are part of a road transportation system. Their very existence, especially in large numbers within a given geographic area, is often an indication that the river they cross is not being used as a major route for trade and transportation. Ferry craft differed from flats and barges only in minor details – and the significant feature of usually being a tethered craft attached by cables from one bank of a river to the other. Ferries normally have heavily built flush decks and end ramps to facilitate loading and unloading of vehicles and passengers. Other than this, the construction was little more than that of a reinforced barge. Motive power was by hand and later by powered winches.

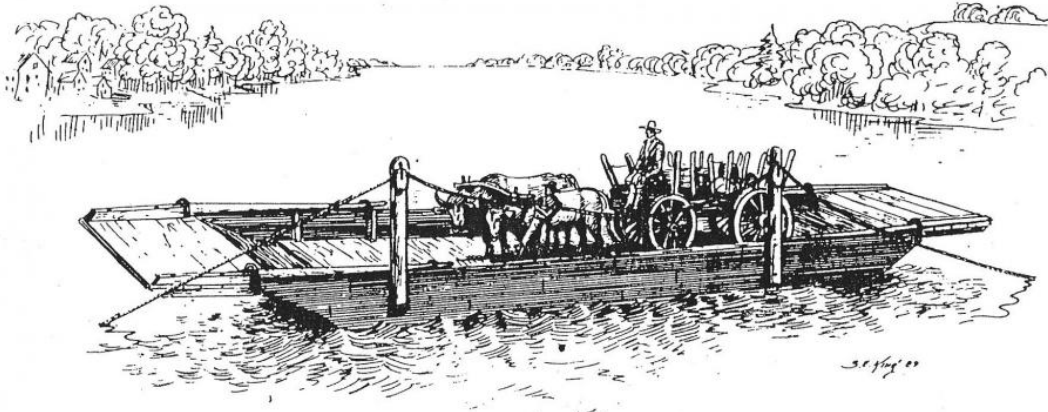


Figure 10: A rope ferry flat at Brown's Ferry on the Black River, South Carolina. The author documented this craft underwater in the 1980s (courtesy of the South Carolina Institute of Archaeology & Anthropology).

Arizona: The Salt River.

The geographic, hydrological features of the Salt River and the area's general history, cultural, and economic background have been amply discussed in specialized reports submitted to the Salt River Project. As a result, this paper will focus discussion on those elements directly related to a small craft activities on the Salt River.

The Phoenix Basin has been utilized for agricultural production from its earliest dates of occupation. The Hohokam culture was the first to divert the waters of the Salt River on a large scale for agricultural purposes (Gladwin et al 1975). They did so on a massive scale. These abandoned canal systems were used and expanded upon by European settlers when they came to the area after 1860 and for greatly expanded agricultural production by the 1880s (Montero, Stubing, 6:2004). While canoes and dugouts have been documented as in use by Native American Indians in other regions, there is no evidence that the Hohokam, or later cultures such as those of the Pima, Maricopa and Apache tribes used them. Even if such craft were in use, they were not a suitable craft for anything more than local travel and subsistence activity.

There is no evidence that there was any regular use of the canals for flat or barge traffic once European settlers expanded and modified the pre-historic canal system. Available illustrations indicate that canals were not constructed with vessel use in mind (Fig. 11 below).

One of the greatest challenges facing European settlers of the Salt River Valley was both the availability of water for irrigation through extended periods of drought, and control of floods on the river. Efforts to control the river on the part of private citizens and local government frequently failed. By the early years of the twentieth century the Federal Government created the Reclamation Service and one of its first projects was the construction of a dam on the Salt River to provide a source of irrigation water in times of drought.

Construction of the Roosevelt Dam began in 1903 at the confluence of the Salt and Tonto Creek. Its specific purpose was to provide a source of reliable irrigation for the massive agricultural acreage of the valley. Even at that, major floods during 1905 destroyed much of the construction work and delayed completion until 1911.

The dam project and its timing is a significant comment on the nature of the Salt River. Industrialization of agricultural production was beginning to produce bulk harvests of wheat and other produce. There was a rapid growth of western population and growing demand from burgeoning eastern states, both creating promising markets for the farmers of the Salt River Valley. The one critical factor necessary to connect supply with demand is reliable transportation. Had the Salt River ever been a reliable route for trade and transportation it would have been well established by the time the Roosevelt and later dams were built. Such major obstructions to the route west through the Gila and Colorado rivers would not have been installed on such a trade route. Instead, the historical record shows us that from as far back as the Hohokam culture, the river was used only for irrigation of farmlands.

Clearly the river was dangerous, given the nature of its short, shallow, braided channels and a propensity for flooding. In such an environment local Native Indian populations were not likely to have used dugouts or canoes to carry small amounts of subsistence goods or to cross the river and navigate irrigation canals. This is confirmed by a complete absence of boat use on the Salt by the Hohokam in the archaeological record.

Early European settlers were certainly engaged in the fur trade in the Salt River area, but there is no evidence that bark or skin canoes were used to transport bulk beaver pelts and other furs on a continual basis. The canoe form was small, narrow and light

draft. They could carry, depending upon length, anywhere from five hundred to a thousand pounds. While they were highly maneuverable, they were also fragile and not suitable for white water conditions in fast moving, shallow and rocky channels.

Later Europeans would have readily adopted the skiff for local travel and subsistence activities. It would have been a particularly dangerous craft for regular use on a river like the Salt. The skiff is a heavier craft than the canoe, but it is flat-bottomed and highly unstable in anything but calm conditions. They were not a craft customarily used for trade and transportation along the length of a river. The image above (Fig. 4) shows three men (or possibly a woman in the bow) on what appears to be a pleasure trip on the placid waters of the Salt River Canyon (John Fuller places this scene on the Roosevelt Reservoir rather than the Salt River Canyon). This is most likely the only use to which these craft were put.

A flat or barge appears to have been used on the Salt on one occasion. There is a report of one instance of a flat being used to transport a bulk cargo on the Salt in May of 1873. Two men, Vandermark and Kilgore, transported five tons of wheat from Hayden Ferry to the mouth of the Swilling canal, a distance of less than four miles. There is no evidence that the trip was ever repeated.

Hayden also appears in the historical record as the owner of a small boat that was stolen and used on the Salt. The fact that the incident is in the record at all indicates that it was a rare and therefore remarkable occurrence. The mere fact that a small craft could float on small sections of the river would have no bearing on the value of those sections as useful for the purposes of regular trade and transportation.

It might be expected that industrial versions of the barge form would have been used for construction projects in localized reaches such as the Roosevelt Dam. These are heavily built craft with drafts of twelve to fourteen inches and more depending upon size. When used to transport bulk cargos, these craft need long reaches of stable water. They are most successfully used in coastal riverine environments and canals. Flats and barges are solidly built craft and can withstand rough treatment and pressure on the sides and ends from tug boats.

Small steam craft have been used on inland and upland rivers. The craft are usually small enough to be broken up and shipped into areas by rail and then reassembled

for local use. Again, these craft need from eight to fourteen inches of draft and relatively calm waters. Typical examples of use were for recreational purposes and local travel. There is no evidence of any such commercial steamboat traffic on the Salt prior to Statehood.

Ferry craft are not components of trade and transportation on a river (up and downstream use). Instead, they are part of the local road system. There is evidence that ferries operated on the Salt River and that there was at least one ‘boat builder’, wagon maker and stable owner George Luhrs, in Phoenix who made a large ‘skiff’ for a local stagecoach company to enable passengers and mail to cross the Salt, (Phoenix Herald, August 3rd, 1891). As mentioned above, the ferry craft is often a tethered flat with a draft of twelve to fourteen inches, sometimes more depending upon total length. The depth of water to operate in was needed only in the cross-river area in which the ferry operated. Evidence suggests that many ferries of the Salt were useable only on a seasonal basis. Seasonal changes in water depth – from flood stage to drought – evidently impacted the value of ferry crossings.

A variety of other smaller craft have been used on the Salt for purposes other than trade and transportation. Some of these were purpose built for exploration, the majority for recreational use. Historic recreational activity is difficult to separate from subsistence activity, such as fishing for example. In all cases, the craft involved do not appear to have been used to demonstrate the viability of the river for use as a reliable route for trade and transportation.

The canoe and variants such as imported canvas canoes were valuable for their portability, an important factor where travellers on rivers had to negotiate falls and rapids. Portage usually allowed for only small, light cargoes, a limitation that precluded commercial trade and transportation based on the needs of the later nineteenth century. While there is evidence that conventional canoes and canvass canoes were used on the Salt for recreational purposes, they do not appear to have had any other function.

A few accounts of log rafts and commercial logging attempts have also appeared in the Salt River historical record, mostly in the context of failed attempts to determine if the river could be used to float logs for industrial use. A raft, of course, is not a vessel and would not be a viable vehicle in any swift current or white water. They could be used on

deep, slow moving rivers such as the Mississippi, for example. Logs float at varying depths depending upon whether or not they are hardwood, softwood or waterlogged. Successful commercial logging requires the floating of vast quantities of lumber. There is no evidence in the historical record that this was ever done on the Salt. Logging expeditions again appear to have been failed attempts to investigate the possibility of using the Salt as a transportation route (such as the Hayden Sierra Anchas attempt) and were not repeated on a regular basis.

Modern day recreational craft have little bearing on the ability of the historic Salt River community to use the river for the transportation of raw and finished goods and passengers. Plastic kayaks and canoes are more durable than their historic counterparts, are able to float in less water and have no role in commercial trade and transportation as it was understood in the past. The same case can be made for rubber rafts. The rubber raft is a completely new type of craft in historic terms. When used for recreational transportation over white water areas of a river they are certainly engaged in modern commercial activity. However, this fails to indicate that the same stretch of river could have been used to transport cargoes of finished goods, raw materials or passengers in the past.

Vessel Draft and Channel Depth.

Previous discussion concerning the use of vessels on the Salt River has focused on the draft of craft ranging from canoes to flats and how this relates to the depth of channel required on the river for safe transportation of goods and passengers. There is a significant difference between a vessel's draft and its operating depth.

The draft of a vessel is the distance between the surface of the water to the bottom of the hull (Turpin 1980). It will vary depending upon the load of the vessel. All formal definitions of draft are based on the impact of load on the waterline in **calm or stable water**. This is because variations in draft depend entirely upon the state of the water through which the vessel travels. Calm waters allow reasonable decisions to be made as to a draft's safe operating depth, but the moment any energy is imparted to the water the safe operating depth becomes totally unpredictable. This means that in high-energy water environments channel depth needs to be significantly greater than vessel draft.

Assume, for example that a canoe with a load of 800lbs has a draft of six inches in calm water. The canoe could easily travel across a still pond with a depth of nine inches. Change this environment to a fast running, high-energy river channel strewn with rocks and rock ledges and displacement depth alters dramatically. The bottom configuration produces rises and falls in the surface of the water. This energy is imparted to the hull of the canoe. When the water surface lifts the 800 pound load, it responds by falling after the rise – and the load ‘drives’ the hull much deeper into the water. The displacement depth is much deeper than the draft. If the channel depth is shallow, the vessel strikes the bottom.

This effect becomes critical when the vessel involved may be 50 feet long and carries 15 tons of cargo. Cotton boats of these sizes and with these loads operated on the upper Savannah River in Georgia. Floating in static water these fully loaded craft had a draft of 12” to 20.” When travelling on rapids, they needed a channel depth of at least 30” to 40.” The author personally observed this effect during the testing of a replica cotton boat built as a research project in 1993. The 57’ cotton boat was loaded with approximately 3,000lbs of cargo and ballast. With this small load the craft had a draft of four to five inches – but even when travelling over small drops in the river, the bow would plunge to a depth of 14” as a result of the energy imparted by the load. Clearly a greater operating depth would be needed with a 15-ton load.

This becomes an important factor when trying to compare modern recreational craft such as rubber rafts and kayaks, with load carrying vessels engaged in trade and transportation. It can be readily seen that recreational craft have no significant bearing on the nature of historic river use.

Conclusion.

American rivers, especially those used since colonial times for trade and transportation, have distinct signatures in the historical and cultural record. Maps of the river route will be found to contain name references to trade and transportation activities on the river. These will include names given to landings, fueling stations, railheads. Towns along the route will show dedicated commercial riverfront facilities from warehouses to brokerage houses, shipping firm offices, factors offices etc. Newspapers

over the historic period will show advertisements for shipping schedules, vessel arrival and departure times, factoring services, warehousing services, cartage and stevedoring. The news sections of the press will also show stories related to the commercial activity of the river. These typically range from arrival and departure of prominent individuals, arrivals of new machinery, new supplies, military and Native Indian activity, new vessel arrivals, vessel disasters, accidents etc. There is an almost complete absence of these trade and transportation indicators in the cartographic and archival records of the Salt River and the city of Phoenix.

Every community seeking to establish itself in the southwest over time actively promoted itself as a center of good living, commerce, trade and industry. This is the function of the modern chamber of commerce in every city in the US today. During the nineteenth century popular and common 'promotion' techniques were 'aerial maps' of cities. The maps were drawn by local artists, and featured a street layout and, significantly, vignettes of features considered vital to the promotion of the city. In 1885, artist C. J. Dyer produced such a map (Fig. 11) of Phoenix. It shows various commercial enterprises in the city, wagon trains and parts of the canal system. None of the canal views show locks through which vessels could travel. None of the vignettes promote the Salt River as a trade and transportation route. The text on the map also makes no mention of such routes.



Figure 11: C.J. Dyer aerial promoting Phoenix in 1885.

The historical record shows that there were attempts to travel on sections of the river, and sometimes the entire river. These attempts utilized small craft built specifically for the purpose of white water travel. The transport of the Vandermark and Kilgore wheat cargo is one instance of an attempt to use a flat for the commercial transportation of a bulk cargo – albeit for a distance of less than four miles. Hayden experimented with floating logs down the Salt and even made a “canoe” from a Ponderosa pine log - it was destroyed by boulders in the river (Fireman 1968). The logs could not be floated on the river and Hayden abandoned the effort as impractical.

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