The History of Inflatable Boats and How They Saved Rivers
by Herm Hoops ~ 2009 {Revised 2017}

Rubber has been part of human history for ages but the industrialization of rubber was an important part of the evolution of river craft. Without rubber it is unlikely that we would have our modern inflatable boats to use in running rivers and it is likely many of our rivers would have been silenced behind dams. A combination of events led to the development of rubber inflatables that river runner's use today.

There is only one kind of natural rubber. The rubber plant only thrives in hot, humid regions near the equator in Central America, Southeast Asia and Africa. World War II cut the United States off from rubber supplies and the production of synthetic rubber from oil was increased for the war effort.

Today most rubber is a synthetic product made from crude oil. There are about 20 grades of synthetic rubber and the intended use determines the process and chemicals involved in production. In general, to make synthetic rubber, byproducts of petroleum refining called butadiene and styrene are combined in a reactor containing soap suds. The latex is coagulated from the liquid and results in rubber "crumbs" that are melted into the final product.

Ancient images of animal skins filled with air used as floats to cross rivers are the first records of inflatable boats. In 880 BC Assyrian King Ashurnaspril II ordered his troops to cross rivers on greased animal skins which they inflated.

The Mayan people of South America made and used rubber latex to make rubber balls, figurines, bindings and in other applications as early as 1600 BC. Latex is the sap of the Hevea or rubber tree, and when exposed to air it hardens into a springy mass. The Mayans learned to mix the rubber sap with morning glory vines to make it more durable and elastic.(34)

By1736 rubber had made its way to Europe, and in 1791 Englishman Samuel Peal discovered that by mixing rubber with turpentine he could produce a waterproof cloth. Soon after, inventor Joseph Priestly found that rubber could be used to erase pencil marks on paper. But rubber was subject to weather conditions. If the weather was hot and sticky, so was the rubber and in cold weather it became brittle and hard.

In 1837 rubber had its first practical application in the industrial world when American Charles Goodyear accidentally dropped rubber, lead and sulfur on a hot stove top, causing it to char like leather yet remaining plastic and elastic. The resulting substance wasn't affected by weather, and would snap back to its original shape if stretched. The process was refined and uses for rubber materials blossomed. This new rubber (not patented until 6/15/1844) was resistant to water and chemical interactions and it did not conduct electricity, so it was suited for a variety of products.

{letters (#a.) refer to Significant Notes at end of document added after 2013}

In 1839 vulcanization, a refined version of this process where the rubber is heated under pressure, transformed the white sap from the bark of the Hevea tree into an essential product of the industrial age.(#k.)

Around 1837 John MacIntosh used Goodyear's technology to develop a small rubber boat with leggings in its bottom for amphibious-like use (U.S. Patent #462).(#l.) In his patent application he claimed that, "this life-boat may be used for the saving of persons and property, for the conveyance of troops across rivers." In 1840 Englishman Samuel White created a rubber hat that doubled as a life preserver.

In the mid 1800's, naval and army personnel from both England and the US started to create inflatable flotation devices to cross rivers. In 1839 the Arthur Wellesley, the 1st Duke of Wellington, tested inflatable pontoons to bridge rivers in Europe.(#f., #h.)

In the 1830s lieutenant, John Foote Lane was supervising the Army occupation of former tribal lands in the South and transporting tribes to the West. He spent 1835 in Washington in the quartermaster corps where he won honors for his invention using India rubber pontoons for military bridges over the Delaware River. Lane attempted to use some of the pontoons in the Florida Seminole wars with little success. In 1840 the patented pontoon boats were lashed together for bridge building during the Second Seminole War.(18)

In 1840 Englishman Thomas Hancock, designed an inflatable craft he described in "*The Origin and Progress of India Rubber Manufacture in England.*" In 1844 - 1845, British naval officer Lieutenant Peter Halkett developed two types of inflatable boats. A Halkett boat is a round shaped, lightweight, inflatable boat. Halkett had long been interested in the problems of designing boats light enough to be carried over arduous terrain, but robust enough to be intended for use by Arctic explorers. Halkett's boats were made of rubber-impregnated "Mackintosh," a waterproof raincoat, first sold in 1824. The "boat cloak" served as a waterproof poncho until inflated, when it became a one-man boat. A pocket held a bellows, and a blade to turn a walking stick into a paddle. A special umbrella doubled as a sail. Halkett also developed a two-man boat that was carried in a knapsack, and could serve as a waterproof groundsheet.

Halkett's designs had a limited market, and he was unable to persuade the Royal Navy that they would serve any useful purpose, and efforts to market them as platforms for fishing and duck shooting failed. Only a single Halkett boat, that of explorer John Rae who surveyed parts of the Northwest Passage and discovered the fate of the Franklin Expedition is known to survive today.(9) The French had their own version of an inflatable boat designed by Clement Ader.

In 1842 John Charles Fremont purchased a rubber raft from Horace H. Day for $150 and used it for the Platte River survey. Fremont's survey began at the confluence of the Sweetwater and North Platte Rivers. The inflatable was loaded with seven men, twelve days of provisions, and the equipment and dunnage for the trip. The inflatable was described as being twenty feet long and five feet wide in a rectangular shape.(5) The boat, laden with a cart and equipment, and paddled by three men made six successful crossings of the Kansas River near Topeka. It was loaded with two carts on the seventh trip and promptly flipped.(6)

On the flat water of the Platte, Fremont reported the boat handled 'light as a duck on the water."(6) As the survey continued, they encountered rough water and flipped the raft, under what is now Pathfinder Reservoir, scattering their gear down the river. He wrote: "had our boat been made of wood, in passing the narrows she would have been staved; but her elasticity preserved her from every shock."(6)

In August of 1844 Fremont, trapper and guide Kit Carson, map maker Charles Preuss and seven others planned to paddle an inflatable boat made of India gum rubber from the mouth of the Weber River to an island in the Great Salt Lake. The $300 boat was eighteen feet long and pointed on both ends. On unpacking his boat Fremont discovered that instead of being strongly sewn like the one used a year earlier in exploring the canyons of the Upper Platte River, this boat's air cylinders had been poorly pasted together by a manufacturer rushed for time. At sunrise the rubber raft was inflated. When two of the cylinders leaked and threatened to sink the boat, one man constantly had to work the bellows while the others rowed. Midway to their destination as the wind grew stronger the air cylinders started to collapse. At last, the boat made it to the island beach. For the men boarding the "miserable rubber boat" returning to the Weber River was a challenge. Carson's recollection was understated: "*We had not gone more than a league, when a storm came up." "The boat was leaking wind*." (1)

In January 1846, Horace Day received patent #4,356 for the craft. Day's patent papers described it as *"forming the boat of a sheet of India rubber for the bottom extending around and attached to hollow cylinders of India rubber cloth connected together by their ends to form the outer frame."*(5) The patent showed a four-sided rectangular craft, but it noted a sharper bow could be made by using additional cylinders. In Day's design "The ends of the cylinders are closed to avoid the necessity of uniting the ends of the several cylinders with water tight joints."(5) The floor was wrapped up and over the outside of the tubes, a practice that was not used on commercially produced boats until the military assault inflatables of the 1940's. On Day's craft, boards could be placed on the floor to keep the floor from sagging down from weight.

Prior to the Mexican War there were no organized temporary bridge "trains" in the U.S. Army. General George W. Cullum designed a bridge that rested on inflatable pontoons to cross rivers in 1848. Two "trains" of India Rubber pontoons were used by the army in the Mexican War. In 1847 the Roxbury Company had produced a number of rubber bridge pontoons that were constructed with two layers of canvas with an inner, middle and outer coating of rubber (also called caoutchouc at the time). General Cullum describes the process:

"...In preparing the caoutchouc gum for coating the duck, it is first cut up into small pieces and carefully washed, to rid it of all dirt and impurities, and is then passed between two grinders - in cylinders revolving with different velocities and heated by steam to about 150 degrees Fahrenheit - and then mixed with white-lead and sulphur; in the proportion of 25 lbs. of gum to 10 lbs. Of white-lead and 3 lbs. of sulphur.

When the rubber becomes plastic, and is well mixed with the sulphur and the white-lead, it is laid aside, and after a few days is passed through a second series of revolving cylinders, more nearly in contact and heated like the first; and after it is made perfectly homogeneous, and about as soft a putty by this second grinding, it is passed through a third set of heated revolving cylinders - longer than the width of the duck to be coated. Upon one of these cylinders a thin sheet of rubber is formed, which is brought nearly into contact with another cylinder , over which the duck is passed from a drum around which it is wound. By the compressing of these cylinders, the rubber is so forced between the meshes of the duck and firmly united with the surface..." (27)

After the Mexican War the pontoons were sent to West Point to instruct cadets and engineers. By 1858 they were unserviceable because the vulcanized rubber had deteriorated. After several years inflatable pontoons were abandoned in favor of the French wooden and Russian canvas-covered pontoons.(20)

By 1851 Charles Goodyear had won numerous awards for his designs of inflatable boats, self-inflating boats (sprung open with whale baleen), pontoons with multiple chambers and other designs. In 1851 Goodyear Rubber displayed the first pontoon made of India-rubber in London.

In 1853 artist H.B. Molhausen sketched an inflatable raft used by Lieutenant Amiel Whipple of the U.S. Army Corps of Topographical Engineers crossing the Colorado River near Fort Mojave. In 1855 the Thomas Hancock Company in Britain developed a series of modern-looking inflatables.

During the European Wars and American Civil War of the 1860's destruction of bridges was a defensive tactic in a country veined with numerous streams and rivers. Temporary bridges were built from wooden boat-like pontoons decked with timber. It took some thirty-four pontoon wagons, twenty-two wagons hauling planks and timbers, four tool wagons, two traveling forges and a supply train of more than twenty wagons of a cumbersome "train" that stretched for miles. As the war went on, collapsible, canvas-covered pontoons were deployed, increasing the capacity of bridging trains, but the lengthy pontoon column still caused havoc. The delay of pontoon trains for crossing the Rappahannock River at Fredericksburg, Virginia lost Union General Burnside the initiative and thousands of lives.

Although the Army had been experimenting with George W. Cullum's design of inflatable pontoon bridges as early as 1846 they had not yet gained acceptance. In 1861 Col. Barton Alezander began looking into the Army's use of the India rubber pontoon bridge. Since1851 the Goodyear Rubber Company had produced an operational India rubber inflatable bridge pontoon and the U.S. Army began showing interest in the Goodyear pontoon design.(19,30) (#e.)

Some of the inflatables were made of double thick India cloth coated with rubber, glued together and baked in an oven to vulcanize fabric, coating and adhesive. The ends were tapered and the tubes were twenty feet long and twenty inches in diameter. Each section of the bridge rested on three pontoons secured by a forty-five-pound anchor. Each section of pontoon could support 7,000 pounds. If damaged it was easily repaired with a rubber patch. This type of inflatable pontoon was used by General F.P. Blair in the Vicksburg, Mississippi Campaign. It was also used to cross, and retreat across the Saline River in the Arkansas Red River Campaign.(8, 29)(#a.)

By 1863 the U.S. Navy began using inflatable life rafts on its ironclad warships because they could be deflated and stored below deck out of harm's way. Prior to that time wooden lifeboats were towed behind the ironclads and left with another vessel during combat.(27) In his memoirs Alvah F Hunter wrote about an inflatable lifeboat on board a Passaic class monitor USS Nahant:

"He stood at the gangway overseeing the stowing of the men in the 2nd cutter and on board a life raft which was pressed into service for the occasion. This life raft... was familiarly called 'The Catamaron'. It consisted of four huge tubes of stout rubber secured to the underside of a light framework of wood on which were four oarlocks. When the rubber tubes were inflated, they were about eighteen inches in diameter and very buoyant. The raft was eight feet long by six feet wide, and even with eight or ten men on board it bobbed like a cork." (27)

In 1866 four men crossed the Atlantic Ocean on an inflatable raft named Nonpareli.(7) The *London Star* reported:

"The American life-raft Nonpareil, forty-three days from New York, arrived at Southampton on Thursday, 25th July." "She is only 24ft long and 12ft broad. The raft, which has two masts, consists of three cylinders, pointed at each end, united together by canvas connections" "There is a smaller raft on board for use as a boat. The raft has kept perfectly water-tight all the way, not a leak of any sort having occurred. She is fitted with an apparatus for filling the tubes with air."(21)

After the Civil War use of inflatable craft continued, but did not come into its own until the 20th century when compressed air systems were developed that could produce rapid inflation. But rubber inflatable items were still developed and experimented on.(#c.) In 1888 John Boyd Dunlop invented the pneumatic rubber tire.(10) By 1892, there were many rubber manufacturing companies in Connecticut. Nine companies consolidated their operations in Naugatuck to become the United States Rubber Company.(11) Dunlop and U.S. Rubber went on to be major producers of inflatable life rafts and bridge pontoons for military use in WWII and the Korean Conflict.

Around 1900 advances in rubber manufacturing made it possible to build more durable rubber inflatable boats. But these crude craft had inherent defects and tended to split at the seams and folds due to less than optimal manufacturing of the rubber. German Albert Meyer developed a new and better inflatable boat design in 1913. His company, Bau Pneum. Boote, marketed it as a "pneumatic boat" and by 1920 nine of Meyer's assault boats were in use by the German Army.
In 1900 to 1910 the development of rubber manufacturing enabled attempts at producing circular rubber inflatable boats similar to modern coracles. These were only usable as rafts and could be propelled only by paddling, and they tended to crack at seams and folds due to imperfect manufacture of the rubber. Although Goodyear had found a way to join rubber to other materials and discovered a better way to manufacture inflatable life rafts their use had not been implemented.

The loss of lives on the Titanic in 1912 and the World War I loss of ships to torpedoes created a demand for more lifeboat capacity on oceangoing ships. Passenger ships had a difficult task to carry additional lifeboats and they had to stack lifeboats one on top of each other to save the limited deck space. His inflatable life rafts (actually developed by employee Ward Van Orman) were square-shaped inflated rubber cylinders with a rigid floor.

In 1919 Reginald Foster Dagnall tested inflatables on a lake in England and that year British Zodiac claimed patents for the first modern inflatable boat, the ancestor of the one-man life raft. In 1919, Firestone Tire and Rubber Company of Canada was incorporated in Hamilton, Ontario. At one point, the company had a rubber plantation in Liberia that covered more than one million acres. During World War II the company was called on by the U.S. Government to make rubberized inflatable military products.(10)

Amos Burg used a small inflatable boat to float the Alaskan Bell and Porcupine Rivers in 1929. Burg wrote that his craft, six feet long and weighing twelve pounds, made by the Sevylor Company-handled better than expected. At the time (circa 1929) the Sevylor company made small light rafts for modest recreational use.

“The flimsy materials and construction of the boat concerned him. The rubber floor of the raft was thin and subject to rips and tears if he ran upon a snag or gravel bar. After a few hours of rowing, he noticed that his port oarlock (made of vulcanized rubber) was wearing thin.”(23)

In 1934 Pierre Debroutelle, and engineer for the French company Zodiac, designed an inflatable kayak. In 1937 he designed the now traditional U-Shaped inflatable for a company that would later become Zodiac. It was the first boat of its kind to gain certification from the French Navy. Later in 1943 a wooden transom was patented (patent August 10, 1943) to accommodate a motor on the Debroutelle style boats built by Zodiac.

In 1938 Amos Burg used a small one-person raft to float the Middle Fork of the Salmon. In 1938 Buzz Holmstrom and Amos Burg duplicated Buzz's 1937 solo trip down the Green and Colorado Rivers to make movies of his previous famed adventure. Burg’s inflatable raft, named “Charlie,” was the first known use of an inflatable raft on the Colorado River System. In early May 1938 Burg’s benefactor, Charlie Wheeler, had arranged a meeting with a Mr. Asfall the executive vice president and of B.F. Goodrich in Akron, Ohio. The Goodrich engineers were skeptical as no one had really developed an inflatable for whitewater use and they were unsure of how to fabricate such a boat.

Goodrich agreed to provide the vulcanized rubber for the raft and directed Burg to Air Cruisers, Inc. of Bayonne, New Jersey for the boat’s construction. At the time Air Cruisers manufactured life rafts and floatation devices for the United States military. At Air Cruisers Burg was met with more skepticism. They were reluctant to take on production of a small one-time project. In addition Burg had no specifications or designs of his proposed inflatable boat.

After Burg convinced the company to take on the project, he spent another week explaining the details of what he wanted. The 1958 fall issue of *American Whitewater* magazine estimated the cost of Burg’s boat at $1,500. The raft was approximately 16' long and 5' wide and weighed 83 pounds. “Twenty-six air tight compartments, inflated with two-and-a-half pounds of air, would allow Charlie to “float on a dew drop,” boasted Burg.” According to the Goodrich Company the boat could carry five thousand pounds of gear.(23)

On July 22 Air Cruisers began production of Burg’s yellow boat with a promised delivery to Oregon in early August. Air Cruisers estimated the assembly and manufacture would take a week, but they immediately ran into problems from the summer heat and humidity at the factory. Burg had named his yet unseen boat the “Charlie” in honor of Charlie Weaver who had donated $200 to the expedition. It was not until mid-August that Burg’s crated boat arrived in Green River, Wyoming. After nearly a month’s delay of the expedition Burg launched his untried boat, along with Buzz Holstrum’s wooden boat the “Julias” at Green River Lake on the morning of August 26 to begin their journey down the Green and Colorado Rivers. In 1982 Amos Burg donated “Charlie,” the first inflatable raft to be rowed through the Grand Canyon to the Utah Historical Society.

An airman named Patten died in 1934 when his plane crashed into the ocean during maneuvers. The pilot had no life raft and died because he was unable to survive the sea until a rescue arrived. In 1939 his brother, Fred F. Patten, joined the navy and pioneered the development of one-man life rafts to save pilots. Soon after Pearl Harbor the Navy and Army Air Force adopted Patten’s prototype life raft that was produced by the U.S. Rubber Company in Rhode Island.(#j.)

In 1942 Patten, who worked for U.S. Rubber, was approached by the Army to produce life size inflatable decoys of B-26 bombers. Before the Normandy invasion thousands of inflatable decoy tanks, trucks, artillery, planes and one-hundred-ten-foot-long landing crafts were deployed near Dover, England to lead the Germans to expect the Allied invasion of Europe at Calais, France. In the 1950's Special Forces adopted a Patten design of an inflatable drop stitched floor. Patten was likely the first to incorporate this feature in inflatable boats.

Between the World Wars a joint venture by Polish immigrant Stanley Switlik and George Putman (Amelia Earhart's husband) started the Switlik Parachute Company. The company continued development of new products including the "Mark II" life vest for the Navy in 1947. In 1949 inflatable one-man life rafts were developed and sold to the Navy. In 1951 Switlik manufactured a large quantity of 20-man life rafts for the Air Force.

By World War II the Russians and Germans developed new synthetic materials that revolutionized inflatable boats.(#i.) With its supply of rubber cut off the United States embarked on a campaign to develop synthetic rubber. The refinement of neoprene, a synthetic with excellent air holding capabilities, combined with a manufacturing process that impregnated a cotton inner fabric with neoprene allowed boat tubes to have more rigid and various shapes. The rubber and manufacturing process was significantly better than the prior 35 years, the inflatable returned, but this time it was boat-shaped.

On entry into World War II the United States recognized the importance of pontoons to cross Europe's rivers and small infantry craft to infiltrate and assault the enemy's coast. Army engineers, faced with transporting large wooden pontoons and boats across the Atlantic and Pacific began to look at inflatable rubber as a solution. Designs were made for pontoons and small 7-man boat-shaped assault rafts capable of using a motor or being paddled. In WWII inflatable, collapsible military pontoon bridges (described in detail in US242383 patent 1947) were in common use. The air compartment is a supporting element in the construction (described in patent CA886879). To develop portable bridges the U.S. Army Corps of Engineers opened the Yuma Test Branch below Laguna Dam on the Colorado River in late 1942. The Yuma, Arizona location, 15 miles northeast of Yuma and just below Imperial Dam, was considered the most desirable spot in the country for the testing of portable combat bridges because there was an abundance of swift flowing water that engineers could control.(28)(#j.)

The military challenge of crossing a river under fire is one that was often faced by the armies that fought in NW Europe, Italy, and on the Russian Front. An advancing army could expect to encounter a 200-yard-wide river at least every 100 miles. The Panzers that crossed the Meuse at Sedan in May 1940 cut the French Army in two. The Wehrmacht's ability to cross the great rivers of the western USSR was vital to the lightning advances of Operation Barbarossa in 1941, and in 1943-45 the Red Army had to drive the Germans back from a succession of river lines during their advance to the Reich, culminating in the Vistula and Oder lines. With World War II armies dependent on heavy mechanized equipment, the function which rivers played became essential for soldiers in all sides of the war. World War II River Assault Tactics details the methods, means and analysis of specific successes and failures. But no matter how rich an army might be in gear and know-how, for the first wave of infantry in their flimsy assault boats it was always a deadly risk.

Submarine warfare in the Battle of the Atlantic led to casualties on warships and merchant ships. US warships began using rubber life rafts and they were used on submarines where space was limited. Inflatable boats allowed troops to make landings in shallow water, and their compact size made overland transport possible. In August 1942 the submarines USS *Argonaut* and USS *Nautilus* carried elements of the 2nd Marine Raider Battalion (Carlson's Raiders) in a Makin Island raid using inflatable boats.

On reaching their insertion point at 3:00 a.m., the submarines surfaced, and the Raiders were transferred to rubber rafts. Heavy swells created problems for the Marines as they transitioned from the subs to the rafts. Fifteen of the eighteen rafts hit the beach along with Carlson, while two others landed approximately a mile north.

Invasions of the Battle of Arawe by the 112th Cavalry Regiment and parts of the Battle of Tarawa involved amphibious landings in inflatable boats against heavy enemy resistance. Inflatable life rafts were also used to save crews of aircraft that ditched in the sea. The PBY Catalina was the first airplane to have an inflatable rescue life boat aboard.(16)

There was another advantage of using inflatable boats in the war. The craft were inflated to a low pressure of 2-4 pounds per square inch. They would deflate slowly if struck by an enemy bullet and multiple chambers allowed the boat or pontoon to continue to float while repairs were made. In the 1930s and 1940s much of America was still rural. Many town and farm boys had become familiar with patching leaking tire tubes and the repair of rubber was relatively easy to teach. A GI or Engineer didn't have to be a wood craftsman to repair a rubber boat. In addition inflatable repair kits included wooden and rubber plugs and metal clams that would seal bullet holes very quickly.

In the 1950s, French Navy officer and biologist Alain Bombard was the first to combine the outboard engine, a rigid floor and a boat shaped inflatable. The former airplane manufacturer Zodiac built the boat and a friend of Bombard, diver Jacques-Yves Cousteau, began to use it after Bombard sailed his inflatable across the Atlantic Ocean in 1952. Cousteau liked the shallow draft and performance of the Zodiac and he used it as tenders on his expeditions. The inflatable boat was so successful that Zodiac lacked the manufacturing capacity to satisfy demand. In the early 1960s, Zodiac licensed production to a dozen companies in other countries. In the 1960s, the British company Humber began mass production of Zodiac brand inflatable boats.

The Zodiac inflatable boat, grew to be popular with the military and contributed significantly to the rise of the civilian inflatable boat industry, both in Europe and in the United States. In the United States U.S. Rubber, Goodyear, Uniroyal, B.F. Goodrich and Dunlop produced significant quantities of inflatable boats and pontoons. Many of these companies eventually subcontracted their inflatable products to Rubber Fabricators, Inc. of West Virginia after 1954.(12)

The Korean Conflict further highlighted the use of inflatable boats. Raids by British Commandos and US Special Operations Group in the 1950's became common. A towrope attaching the black rubber raft to a landing craft (LCPR) was used to haul the rafts and men toward a landing site. A British writer who accompanied one mission wrote:

"*Cut loose they paddled towards land. The silence grows half-perceptibly into sound, the rhythmical swish of surf. ... For a second or two we are caught violently in a chaos of foam. We hit something solid: "Out, quick, get out Come on, for Christ's sake!" It is an urgent but not quick task to drag the boat up to [the beach]; no tug-o'war team ever heaved so desperately.... A new, temporary bridgehead is established in North Korea..*"(2)

After World War II, and the Korean Conflict thousands of rubber boats and pontoons became available to the public through military surplus sales. In 1948 Don Hatch convinced his dad, Bus to look into the military surplus sales in Salt Lake City. Among the many surplus items were inflatable bridge pontoons, 7-man and 10-man inflatable rafts.

"Bus and Don realized that here was a replacement for the wooden river boat. The inflatable rafts were cheap - only $25 each for the 10 man, less for a seven man - and they were virtually maintenance free. With an inflatable raft, you could carry twice as many passengers, and do it in comfort. If you hit a rock, it usually bounced off. They required no varnishing or repairs beyond a patch or two now and then, and when the river season was over you could just roll them up and store them away. And they were so cheap that a man could afford to have a fleet of them."(3,33)

Albert Quist of famed Moki Mac River Expeditions in Green River, Utah was another early fan of the inflatable boats. He, John Cross and Malcom Ellington began taking Boy Scouts through Glen Canyon shortly after World War II. About that time, Roy DeSpain also began using the inflatables on the Upper Green and Yampa Rivers. In an article about the inflatables Don Hatch wrote:

"They handle extremely fast. They pivot, slide slip, and perform many other antics not usually possible with other boats. An empty ten-man raft with a good set of oars can be made to almost leap out of the water with one good hard stroke. They turn and dodge like little water bugs. This is possible because they draw less than three inches of water - loaded! They bounce off rocks like a billiard ball striking a cushion. When they pound through big waves and holes, their low center of gravity helps tremendously to keep them upright." (4)

The surplus inflatable assault boats and bridge pontoons were cheap and plentiful and river outfitters began experimenting with their possibilities. Improvements to neoprene and Hypalon fabrics by 1953 made inflatables more reliable. B.F. Goodrich had discovered that adding carbon black, a coloring pigment, to neoprene in the manufacturing process improved neoprene's resistance to abrasion.(#g.) Ripstop nylon, invented in World War II, was far superior to cotton as an inner base fabric and soon replaced cotton.(#b.)

For a few years there were still many of the early "war surplus" inflatables available, and the cotton fabric boats continued their appearance as river craft.(15) At a time when river running was considered a mere stunt, enterprising outfitters began experimenting with the surplus inflatable assault craft and bridge pontoons and advertising commercial river trips.

By 1962 Ron Smith and a few others had discovered the surplus bridge pontoons. A Ceiba Adventures article indicates:

"Ron Smith, founder of Grand Canyon Expeditions was perhaps the most prolific player in the evolution of Grand Canyon motorboats. He ripped out the floors of the doughnuts making them self-bailing, dropped in two-piece aluminum frames to allow for flexing and, brought the motor and boatman into the doughnut. The resulting "S-Rig," S for Smith, became a model for what has become the most widely used motorboat design in Grand Canyon today."

The S-Rig is a combination of a donut pontoon and two snout tubes strapped to the side. The frame sat about a foot above the water and much of the gear is loaded below the top level of the boat giving the boat operator a much better view than on the J-Rig. There were various sizes and ways outfitters rigged the side tubes on the S-rigs.

Paul T. (Pablo) Thevenin remembers those World War II bridge building pontoons that became the 28-foot and 33-foot boats:

"I remember picking them up (surplus) for $10 to $20 a piece, some in mint shape. These were the old "rotten cotton" ones that blew out on a hot day." "The big change came when we started getting the short snouts from Korean War. I think Jack Curry was the first to buy those, and we had to figure out what to do with them, thus began the J-Rig and other snout rigs which I was involved.

With the old WW2 and Korean War pontoons we always carried at least a gallon of glue and yards of patching material. It was not unusual to see a boat explode while parked on a beach at lunch time, any major scrape on a rock indicated a need for repair. One of the side issues, besides the quality of the rubber in the first pontoons was the valve issue where valves would easily cross thread and leak air like mad."(13) (#b.)

Jack Curry (Western River Expeditions) thought he had made a real deal when he purchased two railroad boxcars full of surplus bridge pontoons in 1965. Jack thought he was getting the oblong 33-foot bridge pontoons similar to those used in WWII, but instead what he had purchased were 22-foot-long, 36" diameter straight tubes (Snouts). Paul Thevenin was dispatched to unload the rubber in Salt Lake City. He kept digging through the pile looking for the round 33' pontoons, but there were not any there. Paul began experimented by gluing the tubes together end to end, and side by side. Jake Luck built a frame that spanned the longer tubes Paul made. Thus Paul and Jake made the first "J" Rig, which came to be named for Jack Curry.(14)

Jack Curry didn't know what to do with all the excess tubes so he put them up for sale. In 1969 Dick McCallum (Grand Canyon Youth Expeditions) experimented by spreading the big tubes apart and spanning them with a frame that had two oar stations and a sweep oar at the stern for steering. One boat carried eight people and gear for a 22 day Grand Canyon trip.(14)

Dick's creation inspired Allan Wilson (ARTA) to build a one oar station craft. Wilson rowed his design through the Grand Canyon and soon ARTA had a fleet of Snout Rigs. Jack Kloepfer (Jack's Plastics) saw a Snout Rig named Moms Apple Turnover on his first Grand Canyon trip in 1972.(14) Western River Expeditions took the idea of the J Rig and miniaturized it into a rowing platform that was 28' long and 12' wide on four 36" diameter tubes side by side.(14) Other Grand Canyon outfitters experimented with the surplus bridge pontoons, including Georgie White's "G" rig and the Hatch "Tail Dragger."

It was not until the mid-1960's that outfitters like Ron Smith (Grand Canyon Expeditions), B.A. Hanten (Rogue Inflatables) and Dick Barker and Frank Ewing (Barker Ewing Float trips) began designing inflatable boats specifically for running rivers with Rubber Fabricators of West Virginia.(22) By 1971 the British company Avon was producing small inflatables like the Redstart and Redshank. but they were expensive. But these boats were small, expensive and did not carry the number of passengers or load for outfitting multi-day river trips. The Craighead Brothers, in Jackson, Wyoming began using the Avon rafts and the company recognized the potential in manufacturing river rafts. In 1971 Avon introduced the larger Adventurer (13' long x 6'6" wide with 17" tubes - cost $875.) and the River Professional MKII (15' long x 6'8" wide with 18" tubes- cost $1200).

Soon a number of different manufacturers began producing river inflatables, primarily for non-commercial use as people's interests in doing their own river trips increased. Newco, a manufacturer of military rafts, began sales of an expensive line of nylon boats. At the other end of the spectrum, Udisco manufactured a very light, inexpensive raft that many people began their river experience with.

The inflatable boats & pontoons made the marginal commercial river outfitting business more profitable because they allowed outfitters to carry more customers and gear in each boat than the older wooden river boats.

As the controversy to build a dam at Echo Park, within Dinosaur National Monument spilled into the national press headlines, the National Geographic Society, Wilderness Society and Sierra Club began sponsoring trips down the Yampa and Green Rivers. In 1953 more than 200 Sierra Club members took six-day raft trips down the Yampa and Green Rivers in Dinosaur National Monument and the Club produced "Wilderness River Trail" to promote saving Dinosaur's spectacular river canyons. The magazine and newspaper articles the trips generated showed that river running was a legitimate sport, and with a seasoned guide could be enjoyed by anyone. The articles showed Americans the magnificent vistas, sublime beauty and challenging rapids of the canyons.

Within a few years the inflatable boats used in commercial river running brought thousands of people to the rivers and canyons. The river tourists and the organizations to which they belonged wrote letters of protest and united against the desecration of magnificent rivers and inspiring scenery through which they passed. In a sense it was the inflatable raft that saved places like Echo Park, the Yampa River and Grand Canyon for our enjoyment today.

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SIGNIFICANT NOTES:

(#a.) Fields of Honor by Edwin C. Bearss, page 491; Grant's campaigns to capture Vicksburg May 1863:

"Grant wants McClernand to pin the Rebels in position behind their breastworks east of the [Big Black] river; Sherman, who left Jackson [Mississippi] on the 16th marching via roads parrallel to and north of the railroad, will reach the Big Black at Bridgeport, north of the river's big bend, and cross the river there. With Sherman is the army's pontoon train. It is novel: instead of wooden boats or canvas-covered collapsible craft, Sherman's pontoons consist of large, circular rubber tubes that, when inflated by a large traveling bellows, are anchorded athwart the river to support the sleepers and planks that form the bridge. McPherson plans to cross the river midway between Bridgeport and the Big Black Briddge."

"Henry Atchley of this county visited our office and presented us with a piece of General Steele's pontoon bridge which was destroyed by the Federals after crossing the Saline River at Jenkins' Ferry. Our souvenir is a brass air nozzle, still with part of the rubber cloth attached.

The bridge, a type developed by George W. Cullum, Corps of Engineers, U.S. Army, was first used in the Mexican War. The pontoons are mode of double India-rubber cloth and consist each of three tangent cylinders, peaked at both extremities like the ends of a canoe, which are firmly united together by two strong India-rubber ligaments along their lines of contact, and widening into a connecting web towards the ends. The whole thus forms a single boat 20 feet long and 5 feet-broad, of great bouyancy and stability. Each cylinder is 20 feet long, 20 inches in diameter, and is divided into three air-tight compartments, each of which has its own inflating nozzle. The middle compartment occupies the entire width of the roadway of the bridge, but the ends of it are placed sufficiently within the ends of the cross boards to be secure from injury except in rare cases. The end compartments are exposed, but if pierced can be quickly repaired by means of rubber patches. Inflating bellows are used for inflation. The bridge, which can support 7,000 pounds, was moored by a light 45-pound anchor.

The bridge used at Jenkins' Ferry was determined to be over two years old and much the worse for wear. The 34 wagons used to transport the bridge would also slow the movement of the train, according to Captian Wheeler, Chief Engineer. The bridge was then pulled to the bank where the pontoons were punctured with bayonets and thrown back into the river. The 34 wagons were also destroyed. Two companies of the 24th Missouri, detailed as pontoniers, rejoined the column."(29)

(#b.) 1950s development of nylon:

The process of building inflatable boats was refined to adhere the air holding neoprene on the inside of the cotton inner fabric and the more durable hypalon to the outside. Unfortunately, when the cotton inner fabric was exposed to water from cuts or tears, it began to deteriorate - causing a defect known as dry rot and the craft became unserviceable. As long as the fabric remained intact, and repaired quickly the material remained durable.

Today fabrics have nylon or polyester as a base that overcomes the problems created by cotton. Neoprene and Hypalon still command a significant portion of the river boats produced because of their durability. Other fabrics like PVC, thermoplastic urethane, unsupported bladders and other materials have also found a place in the river boat market. Each has its advantages.

Ripstop nylon is a light-weight nylon fabric with interwoven ripstop reinforcement threads in a crosshatch pattern. It is woven with coarse, strong warp and filling yarns at intervals so that tears will not spread. It was developed in World War II as a replacement for silk in the production of parachutes.

(#c.) Inflatables and great loss of life by ships at sea:
In the late 1800s a number of serious ship accidents and sinkings (Notably the *Mississippi* burned at sea and the *Atlantic* and *Huron* sank with great losses of life.) created a national outcry for ships to carry enough lifeboats to save passengers and crew. The problem was that there was not enough room aboard the ships to accommodate wooden life boats. In 1973 Mark Twain wrote to the *Tribune*: "The Atlantic had eight boats... Not one of the boats saved a human life. The great cumbersome things were shivered to atoms by the seas that swept over the stranded vessel... But a life-raft is a different thing. All the people you can put on it cannot swamp it... The sort of life-raft I have in my mind is an American invention, consisting of three inflated horizontal rubber tubes, with a platform lashed on top. These rafts are of all sizes, from a little affair the size of your back door, to a raft 22 feet long & six or eight feet wide."

"As you remember, no doubt, two men crossed the Atlantic from New-York to London, some years ago, on one of these rafts of the latter size. That raft would carry 120 men. Nine such rafts would have saved the Atlantic's 1,000 souls, & these rafts (fully inflated & ready for use) would not have occupied as much room on her deck as four of her lubberly boats; hardly more than the room of three of her boats, indeed."

(#d.) Abraham Lincoln's Inflatable Patent:
Lincoln, a multifaceted man who had a fascination about how things worked and solving problems, invented a floatation system for lifting river boats stuck on sandbars (Patent #6469 - May 22, 1849). His idea was to equip the boats with an inflatable collar of India rubber cloth that would be inflated by a bellows to make the boats more buoyant and float them rather than the time-consuming practice of unloading and freeing the boats by winching them to an anchor.

(#e.) U.S. Army Pontoon Bridges 1840s - 1860s:
"The pontoon bridge is really a very basic, easy to build structure consisting of multiple floating waterborne "pontoons" linked semi-tightly together. No nails were used, but the parts were lashed together to make it flexible. It was designed to move (slightly) with the current so it would resist being broken.

In the previous articles I wrote about the wooden pontoons. The other two successful types of pontoons used were rubber and canvas. A very early pontoon was made of India-rubber. The Goodyear Rubber Company invented the process of vulcanizing rubber ten years before the Civil War. However, the U.S. army actually began experimenting with rubber pontoons as early as 1846. This technology found many uses during the war, including rubber blankets, ponchos, buoys, boats and lots of other items. Originally, the rubber pontoons and equipment like gum blankets were coated with rubber, glued together and baked in an oven to vulcanize both fabric, coating and adhesive. The same process is used today. These rubber pontoons were made of double thick India rubber cloth.

The single pontoon cylinder was tapered at the ends like the end of a canoe or modern torpedo. Each cylinder was twenty feet long and twenty inches in diameter. Three of these cylinders made one pontoon. The assembly formed a single "boat" twenty feet long and five feet wide.

The bridge deck was laid and secured on top of the rubber floats. The cylinder in the center supported the entire width of the roadway. Each cylinder had a brass air nozzle. Large bellows that fit over the inflating nozzle were used to inflate. When inflated and assembled, and touching each other, two rubber straps were used to bind them together. Then to make them more secure they were laced together, resembling a spider web, from side to side.

Each section of pontoons could support approximately 7,000 pounds but could be held in place with a light 45-pound anchor. These pontoons fit neatly under the bridge and were protected for the most part by the ends of the chess boards. If the pontoons were damaged it was easy enough to repair with a rubber patch. This type of pontoon bridge was lighter and easier to move than the wood or canvas type pontoon. The rubber pontoons requiring only 34 wagons to transport the entire bridge and its components. (The wooden pontoons required 62 wagons.)

The rubber pontoon bridge was regularly used in the Western army by General F.P. Blair's division in the Vicksburg Campaign of 1863. He had one built across the Saline River at Jenkins Ferry to be used as an escape route towards Little Rock, Arkansas. They were able to escape by cutting the bridge loose, but the Southwest region remained in Confederate hands to the end of the war."(30)

(#f.) Benjamin Sullivan 1827 Letter Maitland Times
Maitland, Mercury - Australia - December 27, 1848

To the Editor of the Maitland Mercury.
SIR-In the fourth page of your paper of the 6th instant, under the head of intelligence from the Cape of Good Hope, extracted from the South Australian Register of the 11th Nov., it is stated-
"...at a place called Boem Plaats, about three days march beyond the Orange River, which, being full, the Governor and his forces crossed by means of rafts and a pontoon of American invention, elsewhere described, which, with a soldier's forethought, Sir Harry brought with him from England. The pontoon referred to consists of cylindrical India rubber tubes, about five feet in circumference and twenty feet in length. There are three of these on each side, placed parallel to each other aud joined together, each tube having an aperture at one end, with a brass nut or mouthpiece, into which a strong bellows, also covered with caoutchouc cloth, is screwed and with which the tubes are inflated, exactly on the same principle as the India-rubber life preservers, used for swimming. The centre space between the cylinders is occupied by a wooden platform, resting upon the cylinders. A rope is fastened 'on either bank, by which the pontoon is easily warped or drawn across a rapid stream."

From that account it would appear that an American was the inventor of air-bags for the passage of troops »cross rivers; but as I feel it to be an act of justice to myself to dispute it, may I be permitted to solicit that the accompanying official correspondence may be inserted in your paper, when I think it will be clearly seen that an American was not the inventor of air-bags for pontoons, but that it was-Your humble servant,

BENJAMIN SULLIVAN. Wollombi, 16th December, 1848.
6, Regent-street,

10th April, 1827. MY LORD-Your Lordship having kindly permitted me to submit to you a plan for a portable floating bridge, not requiring pontoons, and for a float that could be used in embarking and disembarking troops, horses, ordnance, and all sorts of stores, I have the honor of presenting to you, herewith, models of both, which I hope will clearly show their nature and construction, and prove their utility for military and naval purposes.

The air bags are cylindrical, and are each ten feet in length, and two in diameter, made air tight and waterproof, and capable of supporting 16 cwt. They should have in the centre of their upper surface a small valve, with a stop-cock made to fit a small air pump, and should have rings on either side for fixing the lashings to. These were found impracticable to place on the model bags, from the very reduced scale on which they are made. Should it be found inconvenient to have rings, then the bags must be placed in nettings made for them.

The bridge is sixty feet by twelve, supported on twenty cylindrical bags of air, capable of sustaining about twenty tons, including its own weight. The float is fifty-four feet by sixteen, supported on thirty bags of air, capable of sustaining about 28 tons, including its own weight, and can be "worked either with two lug sails or with twenty-four sweeps, and steered with an oar in the place of a rudder, for the purpose of enabling it, without inconvenience,' to 'enter into shallow water. The frame works of the bridge and of the float are made to take to pieces, that the former might be easily packed on a truck, or in a wagon; and that the latter might be stowed away between the masts of à vessel, without lumbering its decks; when required they could be put together in a very short time.

Although the frame-work of a bridge to be formed on bags of air would he as heavy us one to be formed on pontoons, yet, from the air bags being light, and not being so unweildy as pontoons, nor occupying so much space in a carriage, and... not requiring so many anchors and cables as a pontoon, it would be found to be more eligible tor military operations, particularly in being able to frustrate any attempt on the part of an enemy to destroy it, by being able to swing bodily round upon a single anchor.

The float, from the impossibility of upsetting it, and from its drawing very little water, might be used for the landing of troops, horses, ordnance, etc., on any coast, and even under the fire of an enemy, without the danger and confusion attending a boat when struck by a round shot, as no more than one bag could be hit at a time, which, without the least inconvenience or confusion, could be easily replaced by another.

For the surveying of coasts, and for rendering effectual assistance to the crews and vessels m distress, stranded, or wrecked, it would be found to be of very great use. It would also be found to be) equally useful for the merchant service, particularly in the case of a vessel being abandoned at sea, when the whole of the lives of the crews might he saved; and by erecting a temporary galley they might regularly cook their meals.

Should your Lordship, after examining the models, conceive that they may be applied to the aforesaid purposes, I trust that your Lord-ship will do me the honor to lay them before the Commander-in-Chief in the hope they may recommend me to his Grace's protection for such invention. I have the honor to be your Lordship's most obedient and humble servant, '
(Signed) BENJAMIN SULLIVAN, Major half-pay.

The Right Hon. General Lord Viscount Beresford, Master-General of Ordnance, &c, &c.
Lord Eitzrov Someiset presents his compliments to Major Sullivan, and begs to inform him that his inventions have been referred to a select committee at Woolwich for their consideration and report. Ordnance Office, April 14, 1827.

(#g.) Carbon Black:
Carbon black pigments were used extensively in painting since prehistoric times. Rembrandt, Vermeer, Van Dyck, Picasso and Manet used it in their paintings. Carbon black produced by the incomplete combustion of heavy petroleum products such as FCC tar, coal tar, and ethylene cracking tar. For a long time carbon black was the best neoprene fabric strengthening material, and thus most of the early boats were black or dark gray in color.

Carbon black (Color Index International, PBK-7) was traditionally produced from charring organic materials such as wood or bone. It appears black because it reflects very little light in the visible part of the spectrum. It is known by a variety of names, each of which reflects a traditional method for producing carbon black: Ivory black, Vine black, and Lamp black. Newer methods of producing carbon black have superseded these traditional sources, although some materials are still produced using traditional methods.

(#h.) Duke of Wellington Pontoons:
In 1839 the Duke of Wellington tested and described his inflatable pontoons:
"Among the useful things which formed a portion of our equipage, was an India-rubber boat, 18 feet long, made somewhat in the form of a bark canoe of the northern lakes. The sides were formed by two airtight cylinders, eighteen inches in diameter, connected with others forming the bow and stern. To lessen the danger of accidents to the boat, these were divided into four different compartments, and the interior was sufficiently large to contain five or six persons, and a considerable weight of baggage."

(#i.) German Large Pneumatic Boat" from *Tactical and Technical Trends*:
The following intelligence report on a pneumatic boat used by the German military during WWII was published in *Tactical and Technical Trends*, No. 14, Dec. 17, 1942.

"This German pneumatic boat is 31 1/2 feet long. It is similar to their 18-foot type, except that both ends are prow-shaped, and have a rake. The weight is approximately 800 pounds. When deflated the boat rolls up into a cylinder 8 feet 6 inches long, and 2 feet 9 inches in diameter. The floor boards fold into a square bundle 2 1/2 by 2 by 3 1/2 feet. The boat contained the following equipment: a number of plugs for temporary repair; 4 paddles, each 5 feet 3 inches long; two bellows-type foot pumps for inflating; and wooden gratings for stiffening the floor.

The method of inflation is by using foot pumps attached to the two inflation valves, one of which is located at each end of the boat. It is possible, however, to inflate the boat by using only one of the valves. The boat has eight compartments, each of which is fitted with a valve to permit passage of air from the adjacent compartment. During inflation all valves are open, but upon completion of inflation these valves are closed, thereby separating the boat into compartments. Should one compartment become damaged, the hole can be repaired, and a balanced pressure obtained by opening all valves.

As a result of trials, the boat was found to have a capacity of 26 men. Estimated capacity for men with full pack was 24. Using 10 paddles, the boat made 2 knots in calm water, with 24 men aboard. An additional paddle was used for steering. The boat was towed with 24 men aboard, one operating a steering paddle, at various speeds up to 9 knots. Above that speed, the boat had a pronounced tendency to buckle and was no longer safe. The design of the boat, with tapered prow and rake, does not lend itself to the attachment of an outboard motor as easily as does the flat-bottomed 18-foot German boat. The rake undoubtedly helps in rough water.

The skids under the bottom seem to provide a definite advantage in beaching, under conditions when the boat is used either in assault crossings or landing operations. These skids are made of ordinary garden hose, seated in a rubber base so that they will fit flush against the bottom of the boat. The base and hose, after attachment to the bottom of the boat, are covered with a strip of fabric about 6 inches wide, which effectively seals the skid to the bottom of the boat.

It was not possible to determine if the material from which the boat was made was rubber or synthetic rubber. It was repaired, however, with ordinary rubber patches. There were no cementing troubles. The boat is not vulcanized."

(#j.) WWII Military Inflatables:
Initially the Navy (Marines) and Army worked together on the development of inflatable boats for reconnaissance, special operations and demolition, rescue, assault, carrying cargo and for other purposes. Kayaks and canvas folding boats were also tested but were rejected. The determining criteria for boat selection was that reconnaissance boats needed to fit through the small hatches of fleet submarines while carrying weapons and equipment and be capable of handling related loads. In 1939 Fred Patten had designed and produced small life rafts to be used in planes. Later that year Army Lt. Lloyd Peddicord of the Observer Group designed an inflatable boat for Naval Combat Demolition Teams and brought his plans to the Goodyear Tire and Rubber Company who produced the Landing Craft Rubber-Small craft.

The LCRS (Also identified as IBS - Inflatable Boat Small) was an inflatable boat, that could transport seven men, used by the U. S. Navy and Marines from 1938 to 1945. During World War II 8,150 LCRSs were made. LCRS were 7-man inflatable rubber boats with a displacement of 210 lb. light, (277.4 lb with motor). length: 12'5"-14', beam: 5'11", draft: 0' and speed: 4.5 knots with 6 ½ HP outboard motor. This boat was the prototype for the Selway Whitewater model designed by Ron Smith and initially manufactured by Rubber Fabricators, Inc. In its Richwood, WV plant.

The LCRL (Landing Craft Rubber Large or LCRI - Landing Craft Rubber Infantry) was an inflatable boat which could carry ten men that was used by the USMC and US Army from 1938 to 1945. Originally called the Landing Craft Rubber (Large), this inflatable rubber boat became known by the more common term - IBS. The IBS had a pointed bow that, over time, became blunter. Over the decades the IBS was in use, its overall length of 16'-20', 8' beam, nil draft, and 396-pound weight (or 474 pounds with a 9-1/2 HP outboard) remained fairly constant. Speed was roughly 4.5 knots with the outboard and 55 yards per minute with eight experienced men paddling. 10,125 LCRLs were made during World War II. The IBS was the workhorse of NCDU/UDT/SEAL units until it was replaced by the Zodiac series of inflatable boats.

(#k.) Vulcanization:
On 21 November 1843, Hancock took out a patent for the vulcanization of rubber using Sulphur, eight weeks before Charles Goodyear in the U.S. (30 January 1844). He mentioned in his "Personal Narrative" that his friend William Brockedon invented the word vulcanization from the god Vulcan of Roman mythology. Hancock did not credit himself with discovering the reaction of Sulphur with rubber; he instead said that in 1842 Brockendon had showed him some American rubber samples which had been treated with Sulphur.

Brockendon later said in an affidavit that he never heard or knew of Hancock analyzing the Goodyear samples, a claim Hancock verifies in his "Personal Narrative", where he claimed he had been experimenting with sulphur for many years himself. A number of chemists also swore that even if he had analyzed Goodyear's material, this would not have given him enough information to duplicate the process. Alexander Parkes, inventor of the "cold cure" process (vulcanization of fabrics using sulphur chloride in a carbon disulphide solution), claimed that both Hancock and Brockendon admitted to him that their experiments on the Goodyear samples had enabled them to understand what he had done. The firm had large display stands at the Great Exhibition of 1851 in London and at the 1855 Exposition Universelle in Paris. In 1857 Hancock published the story of his life's work as "The Origin and Progress of the Caoutchouc or India-Rubber Industry in England".

(#l.) Goodyear v. Hancock & MacIntosh:
Thomas Hancock experimented with rubber solutions and in 1825 patented a process of making artificial leather using rubber solution and a variety of fibers. His choice of solvents, coal oil and turpentine, was probably influenced by Charles Macintosh's 1823 patent. In the same year he began working with Macintosh to manufacture his "double textured" fabric. By 1830 it was obvious to everyone that Hancock's leather solution was better than Macintosh's. The two inventors merged their companies and began more fully co-operating.

In 1852 Goodyear went to Europe and saw Thomas Hancock, then in the employ of Charles Macintosh & Company. Hancock claimed to have invented vulcanization independently, and received a British patent, initiated in 1843 and finalized in 1844. In 1855, in the last of three patent disputes with fellow British rubber pioneer, Stephen Moulton, Hancock's patent was challenged with the claim that Hancock had copied Goodyear. Goodyear attended the trial. If Hancock lost, Goodyear stood to have his own British patent application granted, allowing him to claim royalties from both Hancock and Moulton. Both had examined Goodyear's vulcanized rubber in 1842, but despite several chemists testifying it would not be possible to determine how it was made by studying it. Hancock prevailed.

Despite his misfortune with patents, Goodyear wrote, “In reflecting upon the past, as relates to these branches of industry, the writer is not disposed to repine, and say that he has planted, and others have gathered the fruits. The advantages of a career in life should not be estimated exclusively by the standard of dollars and cents, as is too often done. Man has just cause for regret when he sows and no one reaps.”

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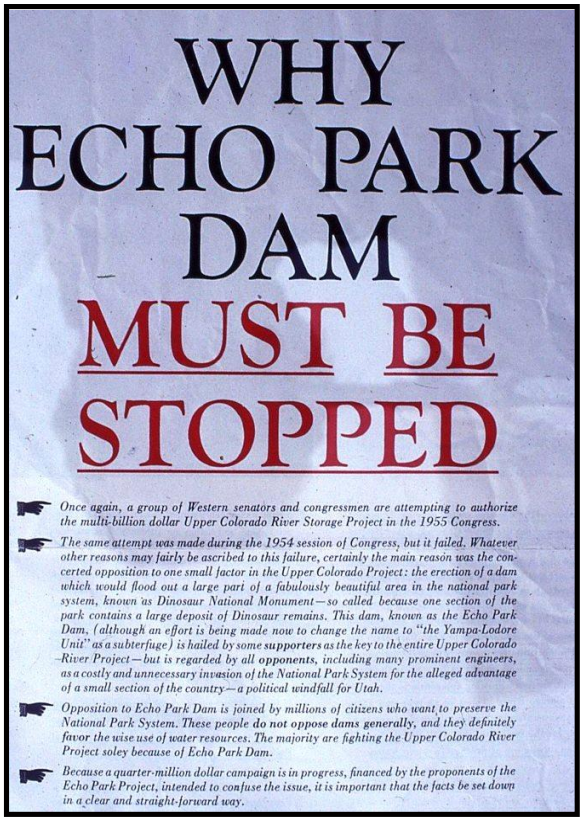


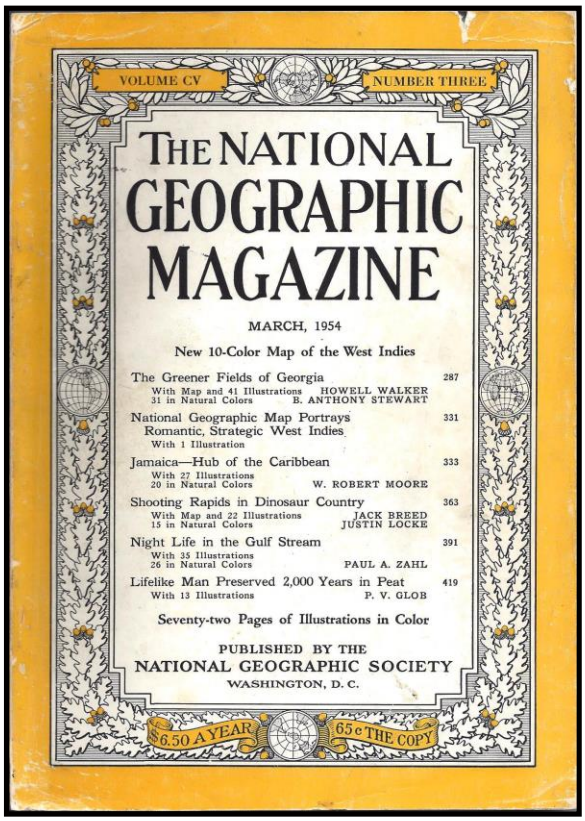
WHY ECHO PARK DAM MUST BE STOPPED

Once again, a group of Western senators and congressmen are attempting to authorize the multi-billion dollar Upper Colorado River Storage Project in the 1955 Congress.

The same attempt was made during the 1954 session of Congress, but it failed. Whatever other reasons may fairly be ascribed to this failure, certainly the main reason was the concerted opposition to one small factor in the Upper Colorado Project: the erection of a dam which would flood out a large part of a fabulously beautiful area in the national park system, known as Dinosaur National Monument—so called because one section of the park contains a large deposit of Dinosaur remains. This dam, known as the Echo Park Dam, (although an effort is being made now to change the name to "the Yampa-Lodore Unit" as a subterfuge) is hailed by some **supporters** *as the key to the entire Upper Colorado River Project—but is regarded by all* **opponents**, *including many prominent engineers, as a costly and unnecessary invasion of the National Park System for the alleged advantage of a small section of the country—a political windfall for Utah.*

Opposition to Echo Park Dam is joined by millions of citizens who want to preserve the National Park System. These people **do not oppose dams generally**, *and they definitely favor the wise use of water resources. The majority are fighting the Upper Colorado River Project soley because of Echo Park Dam.*

Because a quarter-million dollar campaign is in progress, financed by the proponents of the Echo Park Project, intended to confuse the issue, it is important that the facts be set down in a clear and straight-forward way.



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