

THE LEXINGTON GROUP OF TRANSPORTATION HISTORIANS

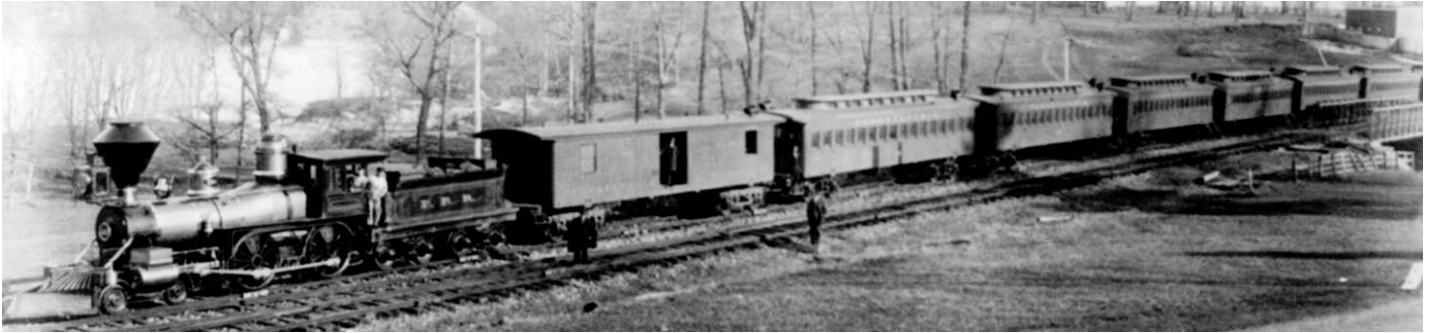


**Files of Articles, Images and Maps
To Accompany
The 2023 Annual Meeting
Hershey, Pennsylvania
September 26-30, 2023**

HERSHEY
PENNSYLVANIA

Pennsylvania's Transportation Heritage

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Pennsylvania Railroad, West Philadelphia. ca. 1874. (Library of Congress)



Cities mentioned in the article (except Philadelphia suburbs) are circled. Historic highways are highlighted: Cumberland Road (southwest): brown; Lincoln Highway: orange; Pennsylvania Turnpike: purple.

Pennsylvania has a rich history in transportation, as one of America's first colonies, as part of the technology-pioneering "Northeast Corridor," as one of America's premier industrial states of the "Rust Belt,"

and one of the principal "gateway" states connecting America's East to the "Midwest" and beyond. Here's a sampling of its notable transportation enterprises and achievements...

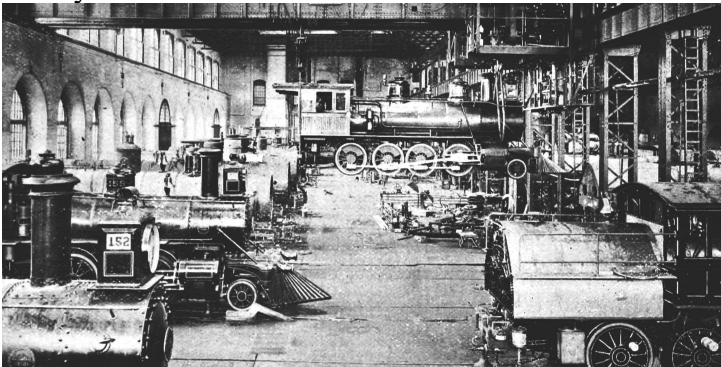
RAIL & ROADS – OF COURSE

RAIL

Pennsylvania's railroads, of course, are legendary, including key routes, facilities, assets, workers and leaders of the Pennsylvania Railroad, B&O, Penn Central, Conrail, CSX, Amtrak, etc.

In 1825, a Pennsylvania society sent engineer William Strickland to Europe to get information on inland navigation systems – mainly railroads, and to procure the best possible locomotive. He bought the Stourbridge Lion (shipped to America in 1828), wrote the nation's seminal text on railroads, and guided early railroads – suddenly accelerating early U.S. railroad development.

Baldwin Locomotive Works (1825-1951) in Philadelphia, later Eddystone, became the world's largest maker of steam locomotives. It also built other types – and over 70,000 in all. Other Pennsylvania manufacturers built rolling stock, too, and some Pennsylvania railroads also built their own.



Baldwin Erecting Floor, 1896 (Library of Congress)

George Westinghouse (Pittsburgh) developed the lifesaving railcar air-brake system (1873), and – with Nikola Tesla – largely pioneered the use of alternating current and AC motors, later pivotal in electric trains, streetcars and other vehicles, and in alternators to power vehicle electrical systems.

America's first railroad tunnel is in Pennsylvania, still viewable today. And over a dozen "heritage" railroads still preserve Pennsylvania's rail history.

This book offers much more on Pennsylvania's pivotal railroad legacy. But there's more to the "Keystone State's" transportation history...

ROADS

Pennsylvania's transportation notoriety began with stretches of trails, then primitive roads, then finished, even paved stretches, connecting New England and New York to the Mid-Atlantic states, Washington D.C. and The South.

Cumberland Road / National Road

The U.S. Government's first highway, begun in 1811 – one of the first "macadam" surface highways – was the Cumberland Road. It tied the upper reaches of the east-flowing Potomac River (at Cumberland, Maryland) with the west-flowing upper Ohio River (at Wheeling, West Virginia, then just part of Virginia) – mainly through southwest Pennsylvania (route of today's U.S. 40). The new route thereby connected the Atlantic coast to the Midwest, and (via the Ohio) to the Mississippi River, unifying the growing nation.



Cumberland road 1½ miles west of Brownsville, Pa , 1911
Packed-gravel macadam surface remnants visible a century after laid. (John Kennedy Lacock, Library of Congress)



Peterson Toll House
on the Cumberland
Road, in Addison
(built 1835, photo in
1933; Library of
Congress)

The Cumberland Road later expanded into the new "National Road" reaching nearly to St. Louis, and (with private funding) eastward to Baltimore – origins of today's U.S. Route 40, and I-70 beyond.

Lincoln Highway

America's first transcontinental highway, the Lincoln Highway (begun 1913) – from New York to San Francisco, one of the world's first highways designed for automobiles – made its first long stretch westward across Pennsylvania. It presaged today's U.S. Route 30, and I-80.



"Lincoln Highway approaching the Pennsylvania [Railroad?] Tunnel", 1922 (Library of Congress)



On the Lincoln Highway (US. 30), in East Pittsburgh, the George Westinghouse Bridge – world's longest concrete arch span in 1932 – arcs 240 feet above the Monongahela Valley, over Pennsylvania Railroad's tracks to Philadelphia. (Historic Amer. Engineering Record, Library of Congress)

Pennsylvania Turnpike

In 1940, the trend-setting Pennsylvania Turnpike – one of America's first long-distance limited-access highways – opened to the public, using seven tunnels of the defunct, unfinished South Pennsylvania Railroad ("Vanderbilt's Folly") to penetrate the state's Allegheny Mountains.

The turnpike became an icon of modern travel in the mid-20th Century, and influenced today's interstate highway system. It's still in use, today, as the trans-Pennsylvania turnpike route of I-76.



Laurel Hill Tunnel, Pennsylvania Turnpike, July 1942. Raised median divided traffic. (Library of Congress)

WHEELS for the ROAD

Like many industrial states of the northeast and Midwest, Pennsylvania was the birthplace of many transient early automakers. One of them, Holley Brothers, switched to producing carburetors for others' cars. It was acquired by Ford in 1905, who made Holley carburetors famous, especially for high-performance cars.



Pennsylvania has also hosted two famous names in heavy truck manufacturing. Mack Trucks, founded in Brooklyn, NY, in 1900, moved to Allentown, PA in

1905. There, for over a century, it built thousands of legendary big-rigs – before scattering its plants across the continent, by 2009, including in Lower Macungie, PA.

Diamond Reo, founded out-of-state in 1905, moved to Harrisburg in 1975, building big trucks until 2010.

WATERWAYS & WATERCRAFT

RIVERS & CANALS

Pennsylvania's inland waterways are among the most expansive in the nation. With rolling hills and mountains, and abundant regional rainfall, Pennsylvania has the most navigable rivers of any state, bearing industry and commerce well inland.



Steamboats at the Monongahela Wharves, near confluence with the Allegheny to form the Ohio River in Pittsburgh. ca.1902 (Detroit Publishing Co., Library of Congress)

Henry Miller Shreve, Pennsylvania riverboat captain, entrepreneur, and later federal bureaucrat, developed the first steamboat to make the 2,200-mile round-trip from Pittsburgh to New Orleans and back (1814), proving viability of steamboat travel on America's main inland waterways.

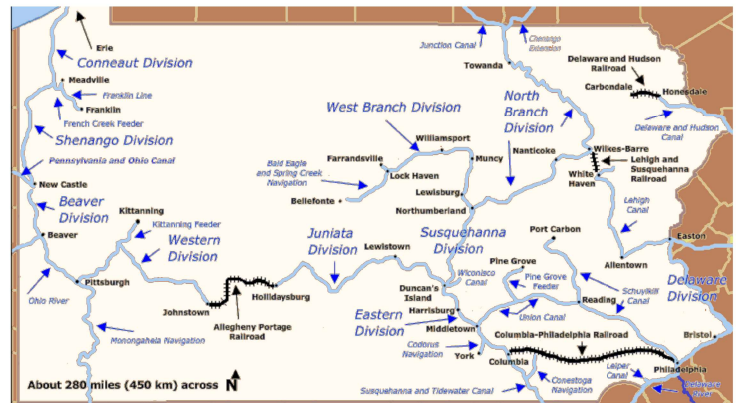
Through various technical innovations, waterway improvements and legal maneuvers, Shreve effectively opened the Mississippi River, and the Ohio, and other rivers, to extensive, practical steamboat commerce, all the way to the sea – a major boost to America's mobility and westward growth – and set a pivotal American legal precedent for the free movement of interstate commerce.

Pennsylvania Canal System

During the early 1800s, Pennsylvania was laced with roads, railroads and canals connecting the rivers, to provide practical travel and commerce throughout the state, even from Philadelphia in the southeast (on the Atlantic coast) through the Allegheny Mountains to Pittsburgh in the west, and on to Erie (on Lake Erie) in the northwest.

The river/canal/rail network (known as the Pennsylvania Canal system) – much like the competing Erie Canal in New York to the north – used

a complex system of dams, locks and towpaths to tie the state together, especially to tie Philadelphia industry to raw materials out West.



The vast Pennsylvania Canal system of the early 1800s. Some sections incorporated or paralleled rivers. Not all parts existed simultaneously, but it provided extensive viable transport of goods throughout the state, and also between the American East and new midwestern/western states and territories. (Finetooth, Ruhrfish, U.S. Census)

America's first two transportation tunnels were dug for these canals. The third, near Johnstown – America's first railroad tunnel – was for the finishing link of the Pennsylvania Main Line Canal: the Allegheny Portage Railroad, whose trains hauled disassembled canal boats, and their cargoes, over the mountains – 2,000 feet above sea level.



America's third transportation tunnel, its first railroad tunnel – the Staple Bend tunnel (1833) of the Allegheny Portage Railroad. Trains hauled halves of canal boats through this arch to join segments of the Pennsylvania Main Line Canal, linking Philadelphia and Pittsburgh. Later acquired by the Pennsylvania Railroad, now a restored National Historic Site. (National Park Service)

The system cut travel between Pittsburgh and Philadelphia to 3-5 days, until eclipsed by the extensive development of railroads in the late 1800s, when the canals were abandoned.

River Routes

However, Pennsylvania's broad and deep rivers remain key waterways, permitting shipping far inland. Forming the state's east border, the Delaware River takes ships 50 miles inland, to Trenton, N.J..

In the west, the Ohio River forms at Pittsburgh from the Allegheny River (navigable over 70 miles throughout the state's northwest) and the Monongahela River (navigable throughout its 130-mile length, across state's southwest). From Pittsburgh, the Ohio carries oil, ore, refined metal and industrial cargo to the Mississippi, and even down to the sea. Other Pennsylvania rivers fit shipping, too.



A huge riverboat heads down the Ohio River from its origin, downtown Pittsburgh, where the Allegheny (left) meets the Monongahela (right). Coal, ore and other barges line the shore, right. (U.S. Army Corps of Engineers, 2023)

And Pennsylvania's rivers are now tied together by many fast highways and railroads, also linking Pennsylvania ports on the Atlantic and Lake Erie.

Out to sea, Pennsylvania railroad engineer William Strickland revolutionized American harbor design, with America's first breakwater (the world's third)-- a man-made barrier to sea storms creating a safe harbor. His Delaware Breakwater (begun 1828), at the mouth of Delaware Bay, saved countless ships from Atlantic storms, setting a trend for safe harbors throughout the hemisphere.

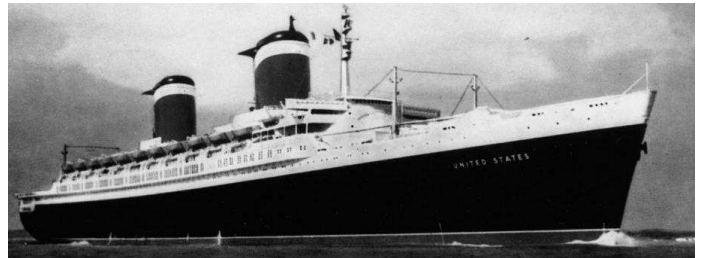
SHIP-SHAPING

As one of the principal original colonies on the Eastern Seaboard, Pennsylvania was strategically placed as a fairly central port on the east coast of the original 13 colonies. With its southeast corner, around Philadelphia – where the broad mouth of the Delaware river expands into the Delaware Bay – it was an excellent place to harbor ships, safe from Atlantic

storms. The well-protected inland waterway was an ideal place to build and launch new ships.

Pennsylvania became one of the nation's principal shipbuilding states.

Pennsylvania shipyards have, over the centuries, produced sailing ships, early steamships, battle-wagons and cruise ships. William Cramp & Sons, Philadelphia, were America's leading iron-ship builders of the 19th Century. The fastest passenger liner ever to ply the seas – the *S.S. United States* – emerged from Philadelphia.



S. S. United States (State Library of Queensland, Australia)

Bethlehem Steel (Bethlehem, PA) – besides its legendary role in Pennsylvania steel production – was one of the nation's premier ship-builders, through its various out-of-state shipyards. In World War II, its 180,000 ship-builders built over 1,000 military and merchant vessels, nationwide.

The Philadelphia Naval Shipyard (1955 Navy photo below) was the U.S. Navy's first shipyard, building ships from 1776 to 1970. In WWII, 40,000 workers built 53 ships there – even the massive battleships *U.S.S. New Jersey* and *U.S.S. Wisconsin* – while also repairing over 500. Today the Philly Shipyard, it builds huge commercial cargo ships.



The *U.S.S. New Jersey*, one of the few remaining gigantic Iowa-class battleships, is docked in Camden, New Jersey, across the river from its Philadelphia birthplace, as a tourist attraction, education center, and monument to the men who went to war at sea and to those who built their ships.



The author, at the *USS New Jersey*, Camden, NJ, 2008.

In the state's opposite corner, Erie, on the coast of Lake Erie, built ships for the Great Lakes, and beyond, from the early 1800s to 1980, including the legendary *U.S. Brig Niagara*, which led the victory over the British in the 1813 Battle of Lake Erie. Resurrected from a watery grave, and rebuilt, it sails from there, today, training students and tourists.



U.S. Brig Niagara, Lake Erie, today. (K. Stone / NPS.gov)

Pittsburgh electric-power pioneer Westinghouse developed the first naval nuclear reactor, which propelled the submarine *U.S.S. Nautilus*, in 1955, revolutionizing America's global naval advantage.

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An excellent starting point for research:
 "Pennsylvania's Ship Building History" at:
paancestors.com/pennsylvania-ship-building-history/

COMMERCIAL AVIATION

Pennsylvania drew early aviators, seeking to connect the East with the Midwest, over the Appalachians, by air. Much of America's earliest air mail crossed Pennsylvania's mountains, hills and woodlands, often at night, and in great danger.

The first non-stop flight between New York and Chicago (1919) overflew Pennsylvania – making Pennsylvania the nation's first big "flyover" state – opening doors to future airlines that would be the demise of Pennsylvania's popular passenger railroads.

A CAPITAL DEVELOPMENT

One airmail contractor, Pittsburgh's **Clifford Ball Airline**, grew into **Pennsylvania Airlines** (1930), then merged with **Central Airlines** (who'd hired America's first female airline pilot), becoming **Pennsylvania Central Airlines** (1936), expanding into 23 states. Renamed **Capital Airlines** (1948), it became America's 5th biggest airline before merging with United in 1961.



Pressurized turboprop Vickers Viscounts of Capital Airlines (1960, Jon Proctor / Wikimedia)

ALLEGHENY / USAIR / US AIRWAYS

Pittsburgh airmail carrier **All American Aviation**, evolved from 1937 into a commercial passenger airline --becoming **Allegheny Airlines** in 1953. In 1979, upon passage of the Airline Deregulation Act, Allegheny Airlines was renamed **USAir**.



U.S. Airways Boeing 737-400 (U.S. Army / ODIN)

In the late 1980s, acquiring Piedmont Airlines and Pacific Southwest Airlines (PSA), it was one of America's seven transcontinental legacy carriers – renamed **US Airways** in 1997.

From its Pittsburgh and Philadelphia hubs, US Airways flew a vast domestic and international network: 193 destinations in 24 countries in North and South America, Europe, and the Middle East. It merged with American Airlines in 2015, making American the world's largest airline.

By 2015, the FAA estimated that commercial aviation brought over \$7 billion to Pennsylvania. But, at first, commercial passenger aviation was not the principal aviation industry of the "Keystone State."

AIRCRAFT MANUFACTURING

KEYSTONE



Keystone B-3A Bomber, early 1930s (USAF)

In the 1920s, **Keystone Aircraft** (briefly **Huff-Daland**) of Bristol, PA (near Philadelphia), would pioneer the nation's first successful purpose-built cropdusters, then early bombers, seaplanes – and just a tiny sampling of passenger and luxury aircraft. But Keystone merged with Loening, faltered, then faded into the Curtiss-Wright conglomerate, becoming a mere parts-maker in the 1930s.

TAYLOR, then PIPER

In the late 1920s, following Charles Lindbergh's inspiring, trend-setting transatlantic solo, as America erupted in aviation mania, an upstart aviation venture from Rochester, NY – **Taylor Aircraft** – arrived in oil-rich rural Bradford, near the state's north-central border.

Principal founder C.Gordon Taylor crafted a tiny 2-seat plane that would be named the Cub – eventually selling out to his partner, local oilman-investor

William T. Piper, Sr. When fire destroyed the factory, **Piper Aircraft** moved to Lock Haven.



Piper J-3 Cub (author)

The cheap, little Cub's emergence in the Great Depression, when costly traditional planes died out, brought survival to 1930s aviation, and made the Piper Cub the most iconic light plane of all time – training and empowering generations of aviators worldwide, including most American pilots of World War II.



Piper Cub as Army "L-4" artillery spotter (U.S. Army)

At war, 1,000s of Cubs, as the "L-4 Grasshopper," pioneered Army Aviation, serving as spotter planes directing the powerful "King of Battle" (artillery), and as reconnaissance craft, aerial observation posts and "liaison" links (hence "L-4") for commanders, hasty ammunition airlift to the front, and early air ambulances for the wounded – pioneering roles for the helicopter.

After the war, the Cub evolved into a variety of bigger, more capable planes. Piper eventually spawned a huge



family of light aircraft, used worldwide – at one point the most prolific line of light aircraft in the world.



Piper PA-22 TriPacer lifts off, nosewheel first. (author)

Abandoning tricky-to-land tailwheel airplanes (except the SuperCub and a cropduster derivative), in 1951 Piper became one of the first lightplane makers to offer tricycle gear, with their steel-tube-framed, fabric-skinned, 4-seat TriPacer (an instant hit, selling over 7,500 planes by 1961).



Piper Cherokee 140 (PA-28-140) (author)

When rival Cessna caught up, years later (1956), with its all-metal Cessna 172/Skyhawk (eventually the best-selling airplane of all time), Piper finally (1962) replaced the TriPacer with a modern all-metal, cantilever-winged plane designed for mass production: the Piper Cherokee (above) – sold by the tens of thousands.



Piper Seminole light twin (NOAA.gov)

Cherokee production was begun in a new facility in Vero Beach, Florida, and derivatives proliferated,

including six-seaters, with and without retractable-gear, even twin-engine variants, like the Seminole. They still sell around the world today.

Meanwhile, back at Lock Haven, well into the 1970s, Piper continued developing aircraft. Piper expanded into faster, 6-seat, retractable-gear planes, bush planes, cropdusters, light twins, pressurized cabin twins, then mini-ailiners, and turboprop executive aircraft – most initially built in Lock Haven.



Army nurses prepare to board a Piper Navajo airliner of Star Marianas Air, in the Marianas Islands. (U.S. Army)

A 1972 flood drove the company to its Florida branch. But, over 85 years since the first Cub, Piper's still a global powerhouse in light planes.



Pressurized twin-turboprop Piper Cheyenne (author)

Cub-creator C.G. Taylor, himself, branched out to create the competing line of "**Taylorcraft**" which sold by the thousands in the 1930s and 1940s (many sold as military spotter planes). The enterprise moved around Pennsylvania, Ohio, and other states, going in and out of business, well into the 21st Century (now also based in Florida).



Taylorcraft BC-12D near its creator's first idea, Piper Cub. (author)

PIASECKI / VERTOL / BOEING-VERTOL

However, another dimension of flight found a firm footing in the Keystone State: Helicopters. In 1940, in Eddystone (near Philadelphia) the **Platt-LePage XR-1**, imitating a twin-rotor (side-by-side) German design, became the first helicopter purchased by the U.S. Army.

A crash and other troubles left delivery at one, as the Army preferred the rival Sikorsky R-4. Igor Sikorsky, in nearby Connecticut, had initially set the trend with his big-main-rotor/little-tail-rotor helicopter.

But a junior Platt-LePage engineer – Frank **Piasecki**, son of a Polish immigrant – envisioned that heavier loads could be lifted with two rotors of the same size as a single-main-rotor helicopter. His early Piasecki helicopters used various configurations, but – except for his first small Sikorsky-like craft-- all used a matched pair of "tandem" rotors at opposite ends of the aircraft.

Having a strong lifting rotor on each end of the aircraft not only lifted more weight, but made it far less critical to carefully balance loads, so greater flexibility in loading the helicopter became practical and (comparatively) safe.



A trio of Piasecki HRP-1s deliver two-dozen Marines in an exercise, ca.1948. (U.S. Marine Corps)

Piasecki's first real success, near Philadelphia, in Morton, was the PV-3 (HRP-1 Rescuer / HRP-2, above). In 1945 he proved it could lift a dozen men – not just the two or three of Sikorsky's early craft (and early competitors from Bell and Hiller).

Its fabric-skinned fuselage curved upwards towards the rear, to elevate the rear rotor above the front one, earning it the nickname "Flying Banana" for its odd

shape. Flawed, it was withheld from combat. Even the fabric skin occasionally ripped loose and fouled the rotors. At the time, it was the world's largest helicopter, but only 22 sold.

Following that, Piasecki's enterprise produced a similar, but *all-metal* helicopter that looked bent in the middle, the H-21 Work Horse / Shawnee. It could lift a dozen soldiers and crew, or over a half-ton of cargo, and found intense use in the Korean War by the Army, Navy and Marines.



Piasecki H-21 Work Horse (U.S. Army)

For his next design, Piasecki placed the rear rotor on a large streamlined pylon. The Navy bought many of these HUP-2 Retrievers as shipboard aircraft for anti-submarine warfare, transport-and-evacuation, ship-to-ship cargo transfers, and rescue. The Army used them as the H-25 "Mule."



Piasecki HUP-2 Retriever in action (U.S. Navy)

When investors ejected Frank Piasecki from his company, it became "**Vertol**" (as in "VERTical TakeOff and Landing") in 1956.

Vertol began embedding reliable, powerful, lightweight, twin turboshaft engines (jet engines turning a driveshaft) to power their next design: the stout, reliable CH-46 Sea Knight helicopter.

Vertol CH-46 Sea Knight (U.S. Navy)

By the early 1960s, the Sea Knight provided fast, flexible, heavy-lift capability for naval ships, carrying up to two-dozen servicemen or 5 tons of people, cargo and fuel, with an aft boarding ramp.

Able to float on water, the Sea Knight would serve on warships for generations, until finally eclipsed by the Sikorsky Blackhawk / Seahawk.



The Sea Knight evolved into an even bigger Vertol to serve the Army and Marines: the massive CH-47 Chinook – America's principal combat heavy-lift helicopter even today – capable of hoisting a 12-ton light tank, or carrying up to 45 troops, while growling through the air at (for helicopters) a swift 160 miles per hour or more.



Boeing-Vertol CH-47 Chinook (U.S. Army)

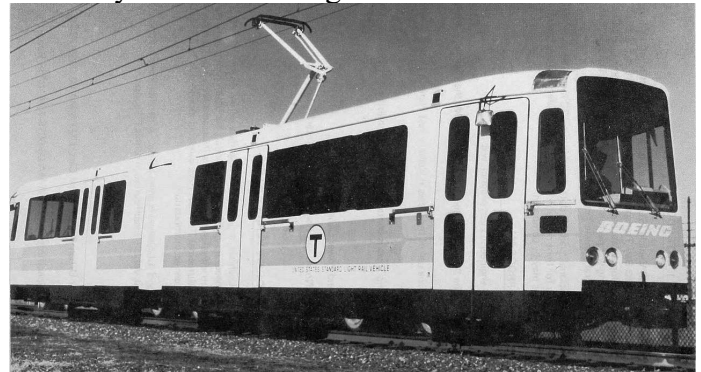
In 1960, **Boeing** acquired Vertol – its first major acquisition since the 1930s – yielding "**Boeing-Vertol**," or "**Boeing-Pennsylvania**."

Choppers to Choo-Choos

In the 1970s, with the U.S. withdrawal from the Vietnam War, demand for military helicopters plummeted. To keep riding the government gravy-train, Boeing-Vertol toyed with making railroad rolling stock.

In Ridley Park, Boeing-Vertol manufactured 2400-series Chicago 'L' cars for the Chicago Transit Authority, and the Morgantown Personal Rapid Transit system for West Virginia University.

Their last rail vehicle was the US Standard Light Rail Vehicle ("SLRV", branded "Boeing LRV"). It was an attempt – promoted by the federal Urban Mass Transportation Administration – to develop a nationally standardized light rail vehicle.



U.S. Standard Light Rail Vehicle (SLRV) (Boeing LRV) (1979, Urban Mass Transportation Admin., DoT)

But numerous problems led to Boeing-Vertol quitting the rail business. Boeing and their two LRV customers – Massachusetts Bay Transportation Authority and San Francisco Municipal Railway – lost millions, and prematurely retired the vehicles.

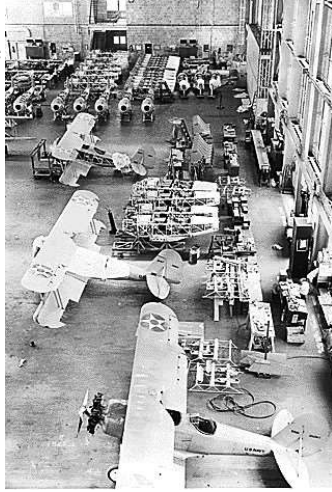
Though Vertol's subway cars performed better, Boeing quit the rail-car business, returning to helos when a post-Vietnam military build-up offered more lucrative military contracts.

Today, renamed Boeing Rotorcraft Systems, Vertol remains active in the Philadelphia area, churning out choppers, nearly 80 years after the premier Piasecki prototype.

OTHER AIRCRAFT COMPANIES

While too numerous to mention, many less-known aircraft manufacturers and designers have been part of Pennsylvania's heritage, including...

- The **Naval Aircraft Factory**, built by the U.S. Navy in 1918, in Philadelphia, near the Navy Yard to accommodate its need for small quantity and experimental aircraft. By end of World War II, it had built a thousand trainers (right, U.S. Navy) hundreds of observation aircraft, and early attack drones.



Pitcairn "Autogyro" (NASA)

- **Pitcairn Aircraft**, in Philadelphia's Willow Grove suburb earned notoriety for 1920s airmail biplanes and 1930s "autogyros" (below, a forerunner to the helicopter), famously flown around the U.S. by Amelia Earhart.

Capable of vertical landings, and near-vertical take-offs, it demonstrated the potential value of vertical-flight aircraft, stimulating the market for its ultimate replacement: the helicopter.
- Jack Gilberti's **Volaircraft** (Aliquippa, 1958), developed the Volaire light plane, marketed as the 3-4 seat Darter and Lark of Rockwell's Aero Commander line.



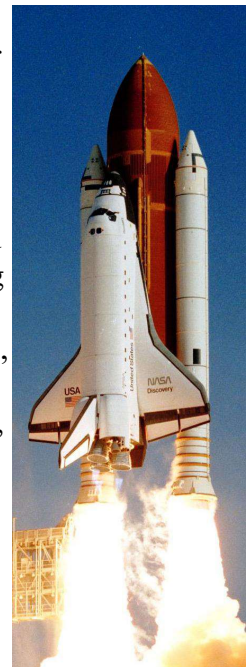
Volaire 1050 (Aero Commander 100-150/Darter)
(Robert Frola, via Wikimedia Commons)

- Homer **Kolb's** "Kolb Flyer" (Phoenixville, near Philadelphia, 1970) spawned one of the world's most popular lines of ultralight aircraft. Over 3,000 built in Phoenixville, 1980-1999, before company was sold and moved to Kentucky. Production continues.

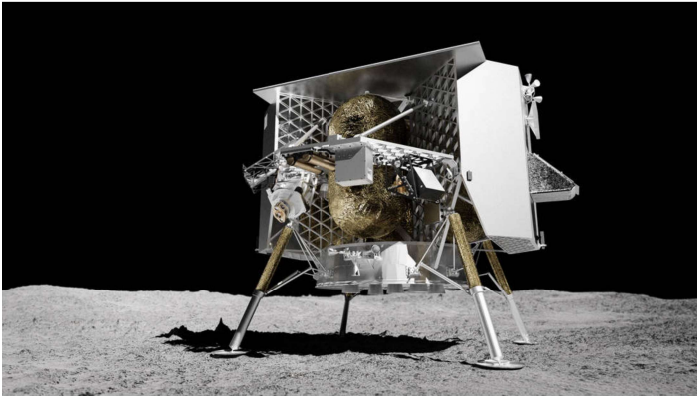


Kolb Firestar at Sun 'n Fun 2006 (Adam Hunt / Wikimedia)

- **Monocoupe** sport planes, 1930s-vintage, were revived in Grantville in 2016.
- Industrial conglomerate **North American Rockwell / Rockwell International** (under various names) – based in Pittsburgh from the 1950s to 1988 – developed key components for various vehicles; also produced Aero Commander lightplanes and executive twins at sites nationwide. Its North American Aviation division, California-based, pioneered advanced aircraft, including America's first supersonic fighter (F-100 Super Sabre), the supersonic B-1 Lancer bomber, and key spacecraft, including the crew capsule and second stage of Apollo moon rockets, and the revolutionary Space Shuttle.



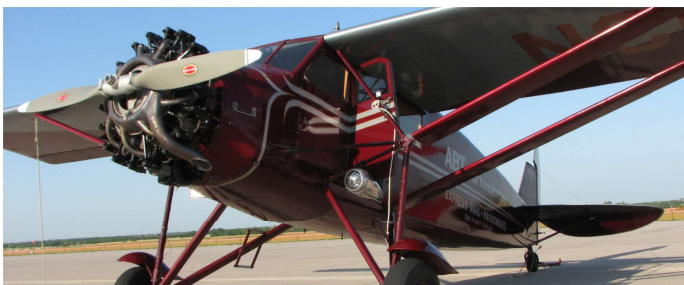
- **Astrobotics**, a Pittsburgh-based startup, won NASA's contract to build the first U.S. spacecraft to land on the moon since Apollo – Peregrine (below, Astrobotics via NASA), an unmanned lunar lander with tiny rover, meant to launch in 2023. It's developing other lunar craft as well for NASA and commercial use.



LYCOMING ENGINES

With all this aerospace activity, and mechanical know-how, it's little surprise that an aircraft engine manufacturer would emerge from Pennsylvania. In north-central Pennsylvania's Lycoming County, Williamsport birthed one of the nation's first (and quickly one of the America's leading) light-plane engine manufacturers, the county's namesake: **Lycoming Engines**.

Originally a maker of sewing machines, bicycles, typewriters and other gadgets, it switched to automobile engines for Errett Cord's 1920s/1930s Auburn, Dusenberg and Cord automobiles.



Lycoming R-680 on 1931 Stinson Junior-S, #NC10886, in the 2008 American Barnstormers Tour (author)

Lycoming began tinkering with airplane engines in 1929, under the guidance of lightplane engine pioneer Harold Morehouse. Cord's automakers went bust in

1937 – but, by then, Lycoming was well-established in aircraft engines.

Early Lycoming powerplants ranged from the 50-horsepower O-145 flat-four (powering many 2-seaters, including Piper Cubs built nearby), to big, 260-horse R-680 radials dragging Cord's line of big-cabin, Detroit-built Stinsons. So Cord gathered Lycoming into his **AVCO** conglomerate.



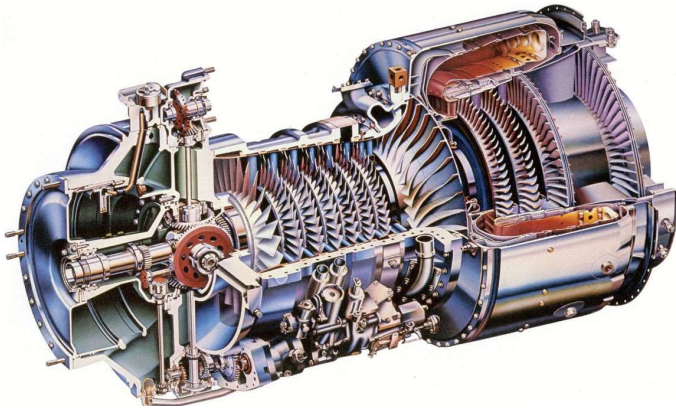
Flat-4 Lycoming O-360 replacing original Franklin engine in a Stinson 108-3 (author)

Today a division of **Textron** (maker of Bell helicopters and Cessna and Beech planes), more certified light aircraft are powered by Lycoming engines (from Williamsport) than any other brand. Lycoming went further, with piston/propeller engines for early airliners, modern light airliners, and pressurized, cabin-class, executive aircraft.



Bell UH-1F "Huey" (USAF)

Lycoming has built turbine helicopter engines, too, including the original 1400-horsepower T-53 turboshaft powering the legendary Bell UH-1 "Huey" helicopter, of Vietnam War fame, and the twin 4,000-horse T-55 turbines of the mighty Chinook (U.S. Army cutaway drawing).



Lycoming designs even power a few business jets (Bombardier Challenger) and small jetliners (BAe 146) – some surface vehicles as well. Even a few locomotives have been powered by Lycoming.



Lycoming powered British Aerospace (BAe) 146 airliner -- the Queen of England's usual ride, 2002 (Sgt. Jack Pritchard, DCC(RAF), Ministry of Defense, U.K.)

AND OTHERS...

Others provided plane power from Pennsylvania, including **Pratt & Whitney** (Middletown), and radial-engine maker **Jacobs** (Philadelphia and Pottstown).



Twin Jacobs radials powered the World War II Cessna Bobcat, which trained American, Canadian and British pilots to fly transports & bombers, including the B-17 Flying Fortress (background) (author)

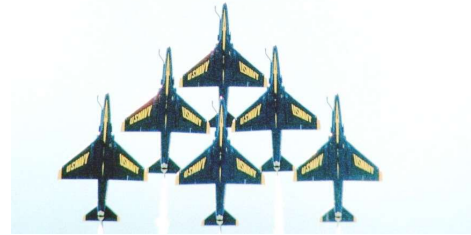
Prop-makers included **Standard Steel Propeller** (Pittsburgh) who propelled the *Spirit of St. Louis*, among others, and lightplane propmaker **Sensenich** (Lititz and Lancaster), famed since 1932 for its fine

wooden props (once standard equipment on most U.S. small light planes, and still popular), later adding metal props, and, lately, carbon-fiber-composite props – for light aircraft, unmanned drones, and airboats.

By 2015, the Federal Aviation Administration estimated that manufacturing aircraft, and aircraft parts, brought Pennsylvania over \$3 billion a year.

SHOW TIME

With all this aviation activity, it's hardly surprising that, during most years 1950 to 1981 (especially in the 1960s), America's biggest, longest, most spectacular yearly airshow was in Reading (pronounced "RED-ing," as in "Reading Railroad"), Pennsylvania.



Blue Angels in A-4 Skyhawks, 1980s (U.S. Navy)

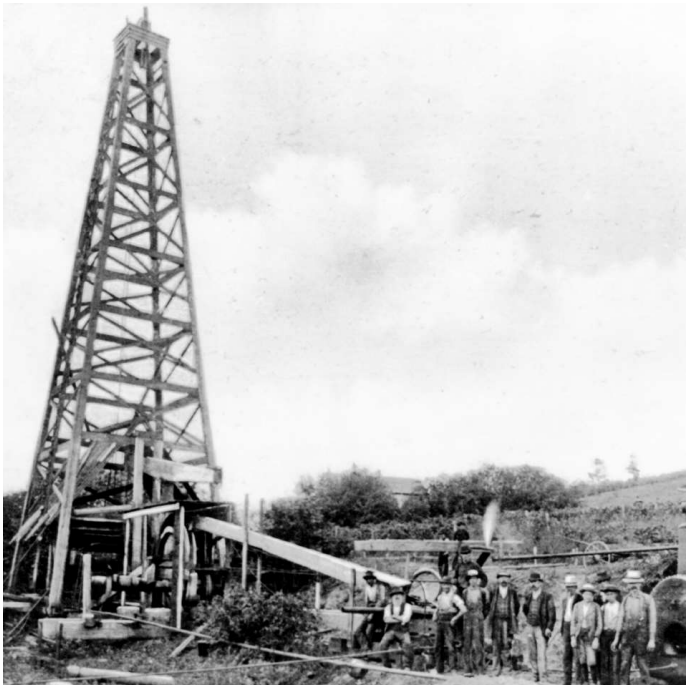
Aviators and aircraft from across the continent, and around the world, gathered annually for a week of aviation spectacles and industry-shaping exhibitions. (Today's biggest airshow and fly-in, EAA AirVenture in Oshkosh, Wisconsin, largely reproduces the Reading show.)

THE ELEMENTS OF TRANSPORT

BLACK GOLD

Pennsylvania is rich in fossil fuels. Its coal, from early colonial times, has powered many cook-stoves, furnaces, heating boilers, industrial machines, locomotives and steam ships, and eventually electric power plants (largely pioneered by Pittsburgh's Westinghouse).

With the demand for oil and its by-products to lubricate – then power – America's industrial and transportation machinery, oil-rich western Pennsylvania became America's first major source of petroleum, starting with the Drake well oil-strike near Titusville, in 1859 – the beginnings of America's modern petroleum industry.

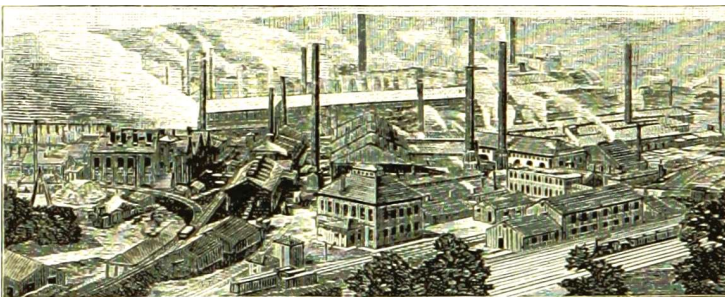


Oil Rig, Titusville, Penn., ca.1900 (Library of Congress)

With the advent of the automobile, demand for Pennsylvania petroleum – as fuel, lubricant, and paving material – grew explosively. Even today, some of the oldest and most trusted names in automotive oil reflect their Pennsylvania origins: Pennzoil and Quaker State.

METAL and METTLE

And industrial Pennsylvania, from its origins, has been a key maker of the solid ingredients of every kind of transportation.



Andrew Carnegie's first "Bessemer process" steel plant, the Edgar Thompson Steel Works (named for Carnegie business associate / former boss: Pennsylvania Railroad's president). It turned out over 32,000 tons of steel rail in its first year, 1875. Many tracks of the railroad surround the plant, bringing coal and iron ore, or shipping finished steel.

(1891, *King's Hand-book of the U.S.*, British Library)

Legendary steel mills and foundries of Pittsburgh Bethlehem, Scranton, Aliquippa and Allentown have,

for centuries, cooked up and pounded out the raw metal for all these grand machines. Other Pennsylvania communities have, too, or refined raw metal into finished parts for train-makers, auto-makers, ship-builders and aircraft factories.

Pennsylvania legends of the steel trade include Carnegie, Frick, Schwab, Jones & Laughlin, Bethlehem Steel, and world's first billion-dollar corporation: J. P. Morgan's U.S. Steel.

Pennsylvania is an aluminum powerhouse, too. Pittsburgh-based Alcoa, a leader in aluminum refining and processing, has been a key part of aircraft development and production since before World War II. Its aluminum – strong, but lighter-than-steel – also enabled efficient, lightweight rail cars, and light, fast ships (Alcoa built some), and America's first aluminum bridge, nearby. Its Pittsburgh research center is the size of a college.

Over a million pounds of Alcoa's aluminum (largely produced in its Massena, New York plant – world's longest continually operating aluminum processor) once shaped the world's most powerful vehicles: the Saturn V moon rockets. Today, they shape countless vehicles of every type worldwide.



Pennsylvania minds and muscles made America mobile. Without Pennsylvania, America's movement, from its beginnings, would not have come so far, so soon.

~R.Harris

Wichita historian Richard Harris (www.harris1.net), of the Editorial Board of the American Aviation Historical Society, (AAHS) is a veteran aerospace industry worker, and a licensed aeronautics instructor, and has flown some of the aircraft mentioned here. Formerly an automotive instructor and Wichita Traffic Commissioner, Wichita Area Technical College instructor and member of Wichita State University's Curriculum Committee, his historical research, publications and presentations have been supported and/or assisted by the AAHS, the Kansas Humanities Council,