Essential Question: 24, 29 September 2020

How did aviation developments during the 19th century link to future developments?

Questions/Key Points	Notes

What does a balloon flight have to do with fixed-wing flight?	• First overnight balloon flight, Nov 7-8, 1836
	  ○ https://www.sciencephoto.com/media/363268/view/first-overnight-balloon-flight-1836
	  ○ Flies from London to Nassau, Germany for 18 hours. Sets a new record for distance flown in a balloon

What other potential breakthroughs were cut short by financial difficulties?	• William Samuel Henson
	  ○ https://aerosocietyheritage.com/biographies/william-samuel-henson
	  ■ (also a ref for above)
	  ○ The next after George Cayley to experiment with heavier-than-air flight
	  ○ Got a patent for an "Aerial Steam Carriage" - tried to put an engine on an airplane
	  ○ Worked on his project but had to stop due to financial issues

	• First Aerial Photographers
	  ○ https://www.newyorker.com/culture/photo-booth/origins-aerial-photography
	  ○ Used balloons to take pictures from above
	  ○ First was Gaspard-Félix ("Nadar") Tournachon in 1858
	  ○ First in US was James Wallace Black, in Boston, 1860

Were people aware of the dangers of Hydrogen lifting? (i.e. the Hindenburg)	• Dirigibles and airships
	  ○ Solomon Andrews
	  ■ https://rucore.libraries.rutgers.edu/rutgers-lib/43742/
	  ■ In 1864, flew a hydrogen lifted dirigible in New Jersey for 30 minutes
	  ○ Ernst Jagels
	  ■ https://ufdcimages.uflib.ufl.edu/UF/00/09/88/72/00001/roleoftechnology00brad.pdf
	  ■ First flight in a rigid metal airship
	  ■ Took off in Germany
	  ■ The ship was destroyed when it crash landed

How did limitations in engine technology limit the development of aviation?	• Matthew Piers Watt Boulton
	  ○ https://upload.wikimedia.org/wikipedia/commons/8/8f/On_A%C3%ABrial_Locomotion_Full_Text.pdf (his own publication, "On Aerial Locomotion"
	  ○ Explores how one might put an engine on a plane, ref. George Cayley's experiments
	  ■ "Sir G. Cayley made experiments to ascertain the capabilities of gunpowder as a source of motive power. But two great disadvantages attend the employment of this substance as a mover of engines"
	  ○ (did not actually invent the aileron)

	• 1870 - Siege of Paris
	  ○ https://www.bbc.com/news/world-australia-35583853
	  ○ https://www.uh.edu/engines/epi1132.htm
	  ○ https://www.historynet.com/bullets-and-balloons-escape-from-the-siege-of-paris-1870.htm
	  ○ During Franco-Prussian War

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What might the Parisians have done if they didn't have balloons? Would the outcome have been much different?	○ French used balloons and pigeons to move people and mail out of Paris; this was the only way possible ○ "As I climbed aboard my balloon, the cannons exploded once more at the city gates. I embraced my brothers and friends and thought of the soldiers fighting and dying only steps away. My soul filled with the cry of the country in need; my destiny now was to deliver what had been entrusted to me. This was my solemn moment, and no other thought could delay me" - Gaston Tissandier, translated from French ● Francis Herbert Wenham ○ https://invention.psychology.msstate.edu/library/Wenham/WenhamLocomotion.html (On Aerial Locomotion) ○ http://www.wright-brothers.org/History_Wing/History_of_the_Airplane/Doers_and_Dreamers/Doers_and_Dreamers_W.htm (brief bio) ○ First lecturer to the Royal Aeronautical Society, read his paper "On Aerial Locomotion and the Laws by which Heavy Bodies impelled through Air are Sustained" (1866) ■ Discusses air resistance and aerodynamics of birds
Were non-scientific people able to gain anything from Wenham's research in Aerodynamics?	■ "As noticed at the commencement of this paper, large birds may be observed to skim close above smooth water without ruffling the surface; showing that during rapid flight the air does not give way beneath them, but approximates towards a solid support" - observation of ground effect ○ Built the first wind tunnel with John Browning ■ Studied wing designs, camber and aspect ratios ○ Also designed gliders of his own but was not successful ○ Ideas about stacking wings led eventually to biplanes. ● The *Zenith*, Gaston Tissandier
Would people have learned of hypoxia in any other way?	○ https://www.loc.gov/pictures/collection/tisc/item/2002724811/ ○ Tissandier and two other frenchmen ascended in a balloon to nearly 28,000 feet ○ The two others died and Tissandier was left deaf due to hypoxia ● Enrico Forlanini (Helicopter) ○ https://www.museoscienza.org/en/collection/objects/enrico-forlanini-experimental-helicopter ○ Designed a helicopter that runs on an engine; flew in 1877 ○ First to fly using thrust from an engine
Even though some engineers only produced model airplanes, in what ways did their inventions lead to further ones?	● Victor Tatin ○ https://www.flyingmachines.org/tatin.html ○ http://www.ctie.monash.edu.au/hargrave/tatin.html ○ Built a model airplane that used compressed air to power two propellers (1879) ○ "It describes over the ground a curve similar to those described by small models gliding freely, and when it comes down after its orbit, the shock as so violent as to injure the running gear. This accident recurred upon each experiment carried out under the same conditions; the carriage was soon destroyed, and even the propellers were injured, although they could be repaired. l then tried another experiment, which I had already attempted several times without success, in consequence of inadequate preparation"

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Why didn't other inventors use control surfaces after Montgomery came up with them?	(tr. French) ○ 1890 - built a steam engine powered airplane with Charles Richet ● John Joseph Montgomery ○ https://www.jstor.org/stable/41170270 ○ https://www.nationalaviation.org/our-enshrinees/montgomery-john-joseph/ ○ https://www.wmof.com/1883.htm ○ https://patents.google.com/patent/US831173A/en ○ Also a glider builder ○ Was able to control his glider using movable flight surfaces ■ Represents the first "controlled" aircraft (1883) ○ Received congratulations from Octave Chanute and his results were published in Chanute's book ○ Received a patent for an "aeroplane" in September 1906 ○ Died in a gliding accident in 1911; his glider stalled
To what extent have inventors lied about themselves and their achievements? What effects did this have?	● Clement Ader ○ https://www.britannica.com/biography/Clement-Ader ○ https://invention.psychology.msstate.edu/inventors/i/Ader/Ader.html ○ https://www.flyingmachines.org/ader.html ○ http://www.ctie.monash.edu.au/hargrave/ader.html ○ Was able to place steam engines on his aircraft ○ His airplane designs were based on bats ■ They didn't have any control surfaces which was dangerous ○ His designs didn't work but he tried to claim that they did (1897) ■ Was probably annoyed that he spent so much effort trying to make it work ■ Created a controversy over his flights ○ Also interesting to see the different tones that people used when writing about him; some were more suggestive that his planes did fly while others were more absolute that it didn't fly
How much technology have we missed out on simply because a potential inventor was dismissed?	● Chuhachi Ninomiya ○ https://www.researchgate.net/publication/319053550_Chuhachi_Ninomiya_and_the_Failure_to_Transfer_his_Airplane_Technology_to_Japan ○ https://www.researchgate.net/publication/318952585_S2001-2-2_A_Miniature_Aircraft_Invented_By_Chuhachi_Ninomiya ○ http://www.ctie.monash.edu.au/hargrave/ninomiya.html ○ Was inspired by kites and watching crows fly ■ Wanted to build a flying machine ○ 1891 - built a rubber powered model airplane with a propeller and landing gear ○ Submitted blueprints for an airplane while in the army but was ignored ○ Worked on creating an airplane but gave up when he heard that the Wright Brothers were successful ● Otto Lilienthal ○ https://s3-eu-west-1.amazonaws.com/bga-sg-archive/Books/BIRDFLIGHT%20AS%20THE%20BASIS%20OF%20AVIATION.pdf ○ https://lemelson.mit.edu/resources/otto-lilienthal ○ https://www.britannica.com/biography/Otto-Lilienthal

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How did Otto Lilienthal's work directly and indirectly contribute to the work of the Wright Brothers?	○ German man, born in 1848 ○ Most significant work was *Birdflight as the Basis of Aviation* in which he describes his studies ■ Mainly deals with aerodynamics of birds and possible applications to human flight ■ "The bodies of flying creatures are not so materially lighter than those of other animals, as to justify us in considering this difference in weight an essential condition of flight" ● Was convinced that humans would be able to fly and that weight was not an issue ■ "Flying creatures, and especially birds, demonstrate that transit through the air is far more perfect than all other modes of locomotion to be found in the animal kingdom as well as any method of artificial locomotion devised by man" ○ Mainly worked with gliders; had pictures taken of him flying ○ Died in a glider crash ○ Made the most progress after Cayley and before the Wright Brothers ○ Legacy - his name is on the side of the building at Berlin-Tegel Airport ○ https://www.loc.gov/resource/mwright.05004537/?sp=6 ○ "Occasionally the sister asked me for a bit of help in translating difficult or obscure passages for her brothers in current German aeronautical publications, especially several by Lilienthal, whose spectacular death had so startled us" - Prof. William Wethner, after Wilbur's death ■ Wright brothers had looked closely at Lilienthal's work and aeronautical data
Hargrave created a seemingly obscure invention that directly helped people decades after he died.	● Lawrence Hargrave ○ https://adb.anu.edu.au/biography/hargrave-lawrence-6563 ○ https://www.flyingmachines.org/harg.html ○ http://www.thekitesociety.org.uk/PDF/Gibson%20Girl.PDF ○ Born in England but moved to Australia ○ Made rubber powered and compressed air powered model airplanes ○ Known best for inventing the box kite ■ This type of kite would later be used in WWII to lift antennas for emergency radios
Chanute can be described as a benevolent person. How would aviation be different if his personality wasn't as kind?	● Octave Chanute ○ https://invention.psychology.msstate.edu/inventors/i/Chanute/Chanute.html ○ https://www.nationalaviation.org/our-enshrinees/chanute-octave/ ○ https://memory.loc.gov/master/ipo/qcdata/qcdata/wrightold/wb005.html ○ https://www.uh.edu/engines/epi2702.htm ○ https://books.google.com/books?id=62oWkVM39yAC&printsec=frontcover&dq=Progress+in+Flying+Machines+Chanute&source=bl&ots=wyvpu5kDU6&sig=hf2aM2iB-EuF-X_HNtfn5AKymQs&hl=en&ei=CSksTcMQx7iEB8bO5PUI&sa=X&oi=book_result&ct=result&resnum=4&ved=0CDQQ6AEwAw#v=onepage&q&f=false ○ https://www.lib.niu.edu/2001/iht810114.html ○ Built a working biplane glider with a horizontal and vertical stabilizer ○ Published *Progress in Flying Machines*, a comprehensive review of

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Samuel Langley almost beat the Wright Brothers, but he is never mentioned. Is this an example of "winners writing history"? What if he continued his work despite being discouraged?	aviation so far ■ Summarizes and analyzes the work of other scientists ■ "This view seems to have prevailed with Mr. H. F. Philips, for he patented, in 1884, a whole series of curved shapes…" ○ Sought to make aviation well known and accessible to all people ■ Acted as a fact checker for aviation events ■ Donated money to engineers experimenting with flight ○ Established a close relationship with the Wright brothers after they read his book; exchanged letters and Chanute gave them advice ○ Chanute became annoyed at the Wright brothers after they entered their patent war. Their relationship was settled when Wilbur delivered his eulogy at Chanute's funeral ● Samuel Langley ○ https://www2.hao.ucar.edu/Education/FamousSolarPhysicists/samuel-p-langley ○ https://www.sil.si.edu/ondisplay/langley/intro.htm ○ https://invention.psychology.msstate.edu/inventors/i/Langley/Langley.html ○ https://www.historynet.com/samuel-langley-aviation-pioneer.htm ○ Almost beat the Wright Brothers in flying a powered airplane ○ Known for the Langley Aerodrome which was the name of his airplane ○ In 1896, his Aerodrome No. 5 flew semi-successfully as a steam-powered airplane. It was powered but the flight was not sustained. ○ Then received a $50,000 grant from the War Dept. to continue his research ○ Attempted manned flight 9 days before the Wright Brothers but failed. He then gave up. ○ The problem with his method was that he tried to launch his planes using catapults, which caused high stress on the structure, which caused it to fail.

Summary

The 19th century was full of successes and failures in the field of aviation. Lighter-than-air aircraft saw improvements in flight duration and distance, and a new type of aircraft was invented - the zeppelin. Building off the work of George Cayley, a plethora of scientists worked independently and sometimes collaboratively to build, test, and improve heavier than air gliders and model airplanes. Their achievements culminated in the beginning of the 20th century with the success of the Wright Brothers, whose work was both directly and indirectly influenced by the engineers discussed.