

History of Rockets

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First Understanding of Rockets

- At 100 BC Greek philosopher Hero mounted a sphere on top of a water kettle. A fire below the kettle turned the water into steam, and the gas traveled through pipes to the sphere. Two L-shaped tubes on opposite sides of the sphere allowed the gas to escape, and in doing so gave a thrust to the sphere that caused it to rotate.



Hero Engine

Chinese Fire Arrows

- The date reporting the first use of true rockets was in 1232. At this time, the Chinese and the Mongols were at war with each other. During the battle of Kai-Keng, the Chinese repelled the Mongol invaders by a **barrage of "arrows of flying fire."** These fire-arrows were a simple form of a solid-propellant rocket. A tube, capped at one end, contained gunpowder. The other end was left open and the tube was attached to a long stick. When the powder was ignited, the rapid burning of the powder produced fire, smoke, and gas that escaped out the open end and produced a thrust. The stick acted as a simple guidance system that kept the rocket headed in one general direction as it flew through the air. It is not clear how effective these arrows of flying fire were as weapons of destruction, but their psychological effects on the Mongols must have been formidable.



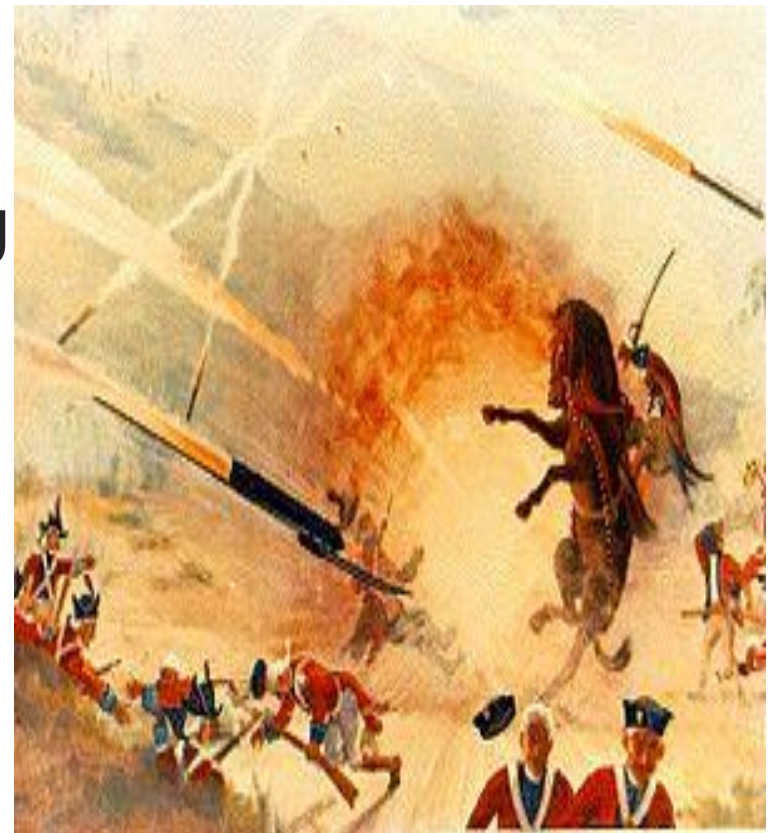
Chinese Fire-Arrows



Chinese soldier launches fire-arrow

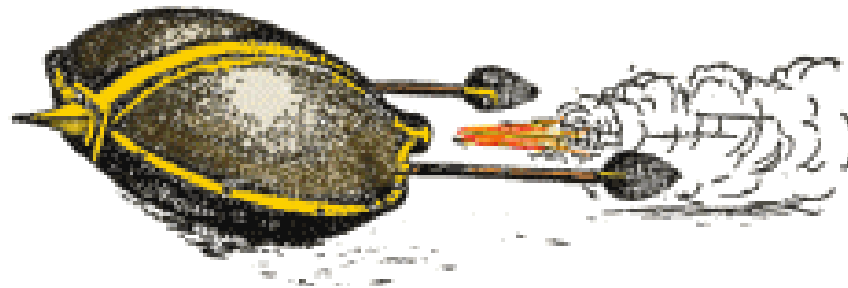
Tipu Sultan and Rockets

- The Mysore rockets of this period were much more advanced than what the British had seen, chiefly because of the use of iron tubes for holding the propellant; this enabled higher thrust and longer range for the missile (up to 2 km range). While these hammered soft iron rockets were crude, the bursting strength of the container of black powder was much higher than the earlier paper construction; thus a greater internal pressure was possible



Modern Rocket Science

- While there were many developments such as Isaac Newton's contribution to the Newton Laws and many rocket related inventions, the actual rocket science starts in the 20th century.

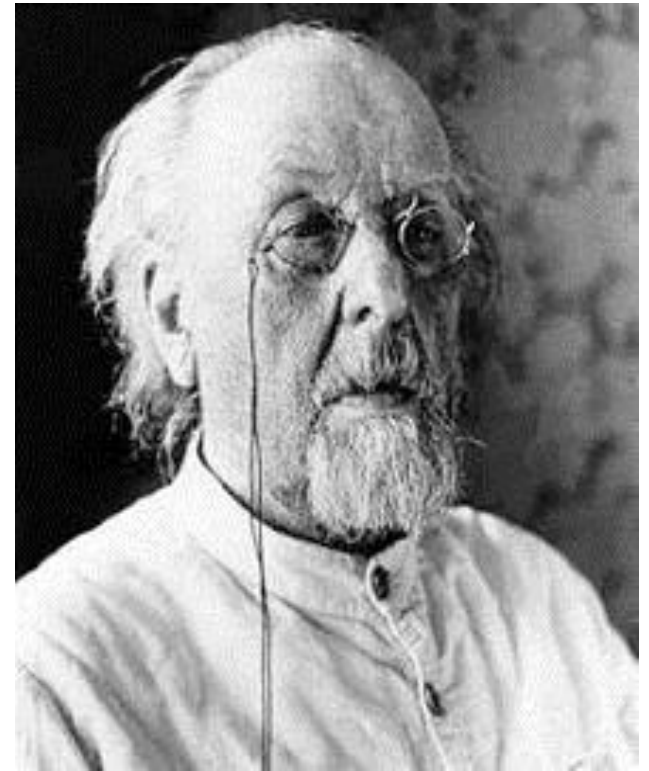


Surface-Running Torpedo

Father of Astronautics

Konstantin Tsiolkovsky (1857-1935)

- In 1898, a Russian schoolteacher, Konstantin Tsiolkovsky (1857-1935), proposed the idea of space exploration by rocket. In a report he published in 1903, Tsiolkovsky suggested the use of liquid propellants for rockets in order to achieve greater range. Tsiolkovsky stated that the speed and range of a rocket were limited only by the exhaust velocity of escaping gases. For his ideas, careful research, and great vision, Tsiolkovsky has been called the father of modern astronautics. His rocket equation for velocity change is still used today.



Robert H. Goddard

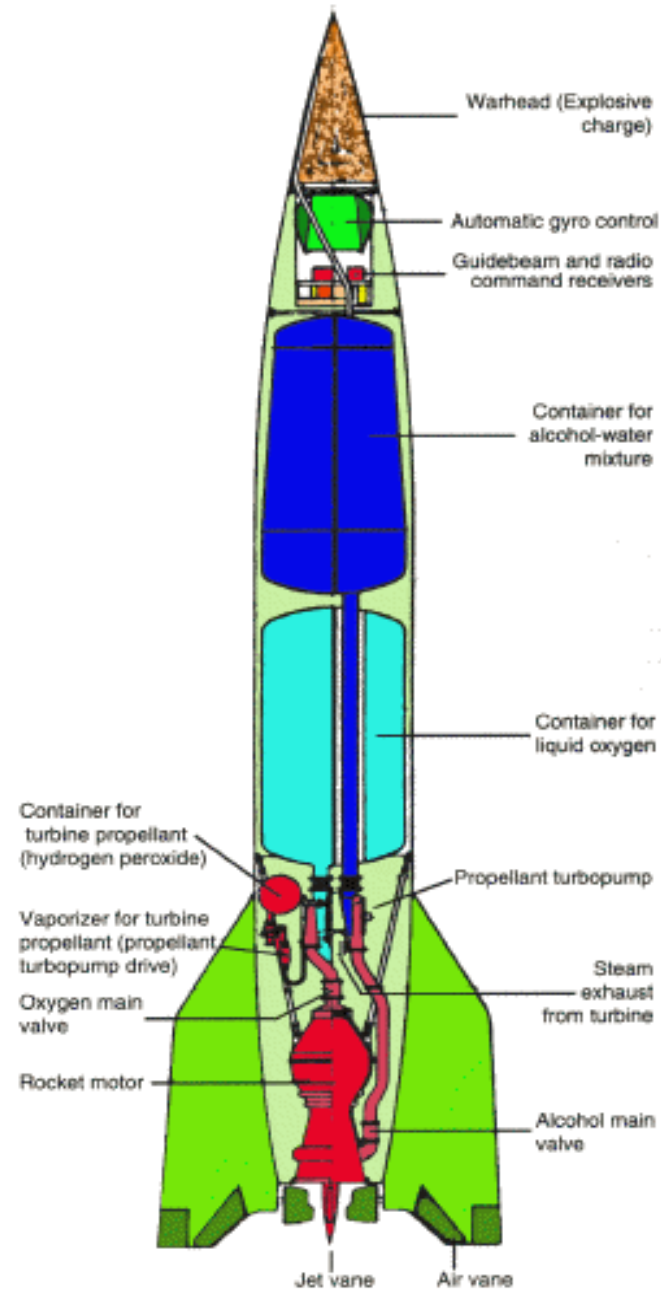
Father of Modern Rocketry

- Goddard achieved the first successful flight with a liquid-propellant rocket on March 16, 1926. Fueled by liquid oxygen and gasoline, the rocket flew for only two and a half seconds, climbed 12.5 meters, and landed 56 meters away in a cabbage patch. By today's standards, the flight was unimpressive, but like the first powered airplane flight by the Wright brothers in 1903, Goddard's gasoline rocket was the forerunner of a whole new era in rocket flight.



V2 Rockets

- In 1943, production of the **V-2 rocket** began. The V-2 had an operational range of 300 km (190 mi) and carried a 1,000 kg (2,200 lb) warhead, with an **amatol** explosive charge. Highest point of altitude of its flight trajectory was 90 km. It was designed by Wernher von Braun who then became the father of the American space program.



German V-2 (A-4) Missile

R7-First Russian Rocket to put a Satellite into Space

- The R-7 launched the first satellite- **Sputnik**, Laika and later Yuri Gagarin who was the first man into space, as well as the first lunar and planetary probes. This rocket is still in use today.



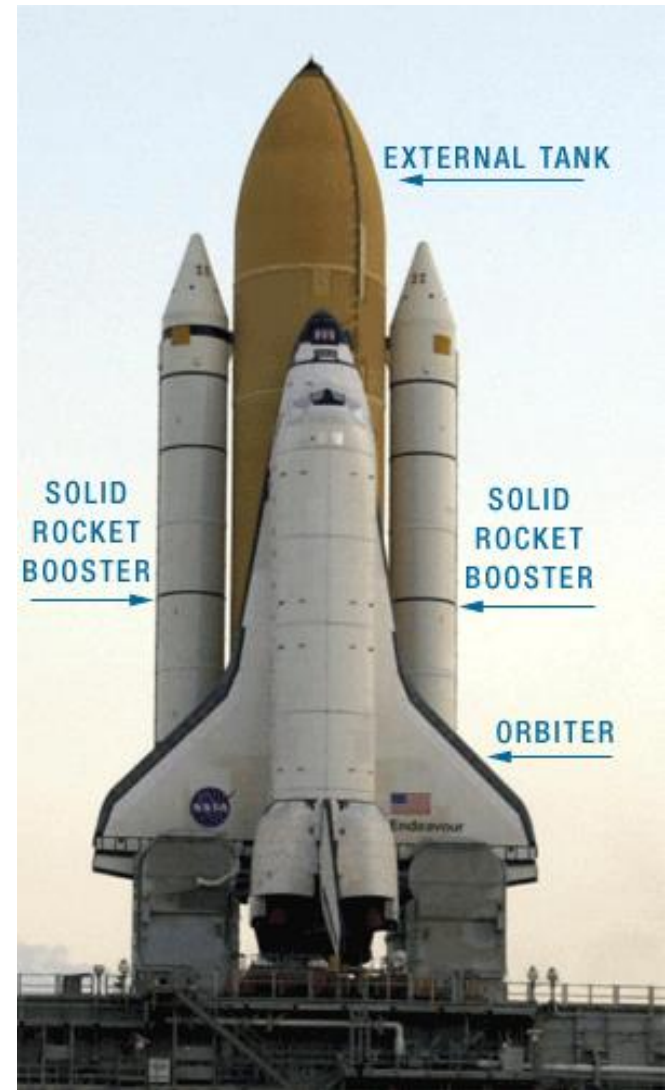
Saturn V – The Moon Rocket

- The Saturn V remains the only launch vehicle able to transport human beings beyond low Earth orbit. A total of 24 astronauts were launched to the Moon, three of them twice, in the four years spanning December 1968 through December 1972.
- The Saturn V remains the tallest, heaviest, and most powerful rocket ever built.



Shuttle Rocket Boosters

- Space Shuttle is powered by Liquid Rocket Boosters as well as Solid Rocket Boosters. The Liquid Rocket Boosters are designed to be integrated into the Shuttle itself, while the Solid Boosters are designed to be reusable which are dropped off during flight.



Missile vs Rockets

- A missile is basically a rocket which explodes on impact and it is designed to carry only destructive military payloads.
- ICBM is an Intercontinental Ballistic Missile and it is designed to have a long range (minimum 5500 km) and it carries a thermonuclear warhead.

