India Discovery Center

Study of the British Period (1800AD-1947AD)

Science and Technology

Bijoy Misra

References:

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General editor – D. P. Chattopadhyay , Vol XV, Part 4,

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Editor – Uma Dasgupta, Pearson/Longman, Delhi, 2011.

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Miscellaneous internet resources.

Summary

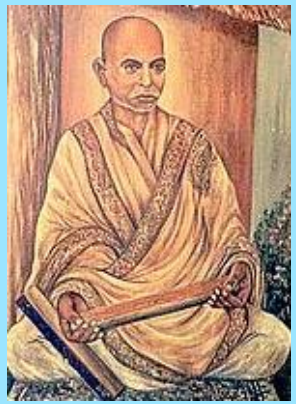
- Economy and social conditions caused a stagnation to analytic work. Most scholars were engaged in translating texts for export or creating interpretations of the texts.
- East India Company instituted massive surveys of land, vegetation, animals and minerals in India. Work began through the Asiatic Society of Bengal in the late 18th century. Indians were recruited as Assistants.
- Independent research work began with the privately funded Indian Association for the Cultivation of Science in 1876 AD.
- Other privately funded research institutions were founded.
- C V Raman pursued scientific research only in the evenings as a hobby and won the Nobel Prize in Physics in 1930 AD.
- Good analytic work followed with vigor and creativity.

Scientific research spanned the following fields:

- Astronomy
- Astrophysics
- Physics
- Chemistry
- Botany
- Mathematics
- Cartography and Land Survey
- Meteorology
- Geology
- Plant, Animal, Land, Metal Surveys

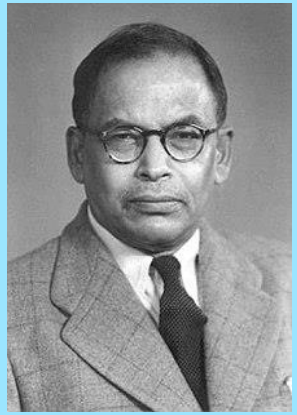
Astronomy and Astrophysics

- Astronomical observations continued at various Observatories in India with the goal of determining the accurate timing of the sky events as viewed from the earth.



  - Location dependence of measuring time was explored with the production of detailed almanacs for different regions.
  - Samanta Chandrasekhara (1835-1904) in Puri produced his new treatise Siddhanta Darpana. He observed through his own designed bamboo telescope and other instruments. He was successful in estimating the orbital corrections for the planets in their revolution around the sun.

- Meghnad Saha (1893-1956) worked on the thermionic emissions and star identification through temperature. Saha was born in modern-day Bangladesh and was educated in Kolkata and in England. Saha Equation is used as a standard tool in modern Astrophysics to calculate the degree of ionization of the gases in the star to be in thermal equilibrium.
  It is used for the spectral classification of the stars.
  Meghnad Saha was a champion of science education and eventually joined the Indian Parliament to help create India's Planning Commission.



Physics

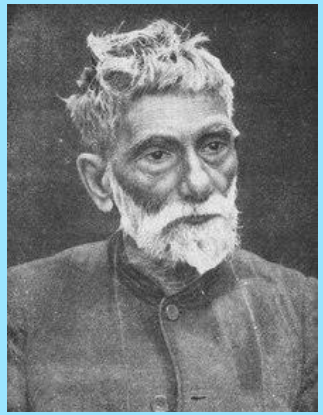
- Early Physics in India was based on natural philosophy, mostly study of sound, music and speculative cosmology.
- Basic training in modern sciences began in 1857 with the establishment of universities at Kolkata, Mumbai and Chennai.

- Chandrasekhar Venkataraman (1888-1970) had his science education in Chennai and joined the accounting service of the British administration. He moved to Kolkata and got connected with the Indian Association of Cultivation of Science, where he did experiments on light scattering. He discovered Raman Effect, shift of light frequency through scattering. He was awarded the Nobel Prize in Physics in 1930. Raman Effect is widely used in detecting the purity of chemicals. C V Raman built his own institute called Raman Institute of Science.

- Satyendra Nath Bose (1894-1974) was educated in Kolkata and was interested in theoretical physics. Bose studied general relativity and eventually developed statistics to define the quantum states of identical particles like photons. Albert Einstein did translate the paper in German and facilitated its publication. The statistics defined new states of matter in extreme low temperatures when quantum effects take control the state configuration. The work is popularly known as Bose-Einstein statistics in Physics.

Chemistry and Botany

- Traditional chemistry in India was involved in drug synthesis and alchemy.
- Inorganic products like mineral powders were used as dyes.



- Prafulla Chandra Roy (1861-1944) is considered the "Father of India's Modern Chemistry". He was educated in Kolkata and England and took interest in inorganic chemistry of nitrates, that had wide application in agriculture and in pharmaceutical industry.
- Inorganic dyes made out of chemical applications had widespread use in the British Empire.

- Jagadish Chandra Bose (1858-1937) was a physicist. He is credited with the discovery of the millimeter-scale radio waves and constructed the detecting apparatus for the radio waves. The radio as a communication device was discovered in parallel by Guglielmo Marconi in Italy.
- He made fundamental contribution in detecting the electrical response in plant physiology like in the humans.
- Noted scientists like Satyendra Nath Bose, Meghnad Saha and Paresh Chandra Mahalanobis were among his students.

Mathematics and Statistics

- Indian minds have been always active in numbers, numerology, algebraic manipulations and geometry.
- During the medieval period, the research was the calculus of the differentials and infinite series.

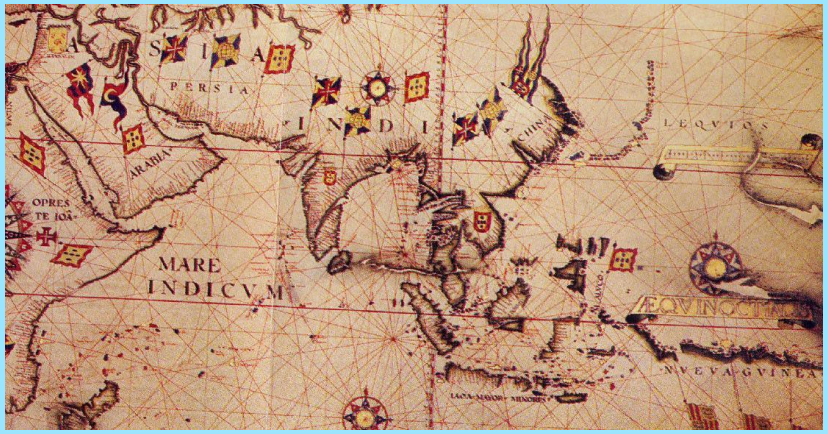
- Srinivasa Ramanujan (1887-1920) was a "boy wonder" in mathematics. It is said that mathematical results came to his vision and he simply wrote them down without proofs or analysis. Subjected to work as an Accounting Clerk, he could only pursue his passion of Mathematics after work. He contacted the famous British Mathematician Thomas Hardy who invited him to spend time in Cambridge University. Ramanujan spent five years in Cambridge and was able to publish his work and gain recognition. He fell seriously sick and returned to his home in Chennai in 1919. He passed away the next year. His theorems on infinite series are still being studied for completeness and elegance.

- Paresh Chandra Mahalanobis (1893-1972) is known as the father of the modern Statistics. Raised in a reformist Bengali family, he was educated in Kolkata and in Cambridge. While abroad, he developed interest in sampling methods and multi-variate analysis to gain information from widely divergent data. His method of creating a non-dimensional metric to quantify the scatter in data is a standard tool in Statistics. Known as Mahalanobis Distance, it was first applied to study the conjugal relationship of the Englishmen among Indian people.

  Mahalanobis helped establish the Indian Planning Commission and was instrumental in bringing digital computers to India.

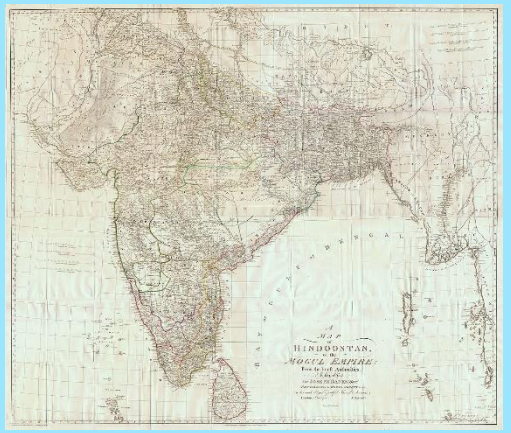
Cartography and Land Survey

- **Cartographic maps of India**



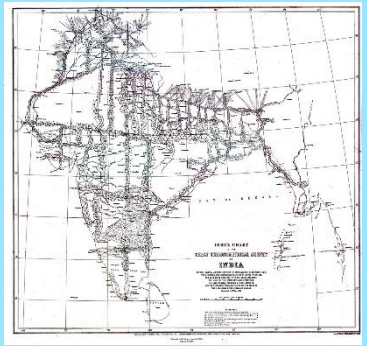
Portuguese map 1550

Dutch map 1596



James Rennell, 1788

- The British initiated massive survey programs as a part of their colonial consolidation. The Great Trigonometric Survey (1802-1852) was the largest geodesic survey ever undertaken.



- William Lambton (~1751-1823), an East India Company soldier turned surveyor, is credited to have engineered the task of accurately measuring the land and topography in India. The Observatory in Madras and the astronomical work in India were instrumental in completing the project. The work involved meridional measurement of distances with scientific accuracy from celestial observations and the ellipsoidal nature of the Figure of the Earth. The survey results helped the Company to consolidate their occupation by gaining advantage over other colonial forces in battles. The Himalayan peaks and the Mount Everest were eventually calculated by an Indian mathematician Radhanath Sikdar in 1852.

Meteorology and Geology

Meteorology:

- The British disrupted the food distribution in India by extracting away large amount in order to export out to the colonies.
- Cyclone in 1864 and subsequent droughts caused massive loss of lives and triggered research in Meteorology.
- Henry Blanford was the first Reporter on the Monsoons in India (1875).
- John Eliot studies tropical disturbances and cyclones (1889).

Geology:

- There was coordinated effort to determine the mining potential in India.
- Coal fields were discovered and massive amount of coal was exported to assist in the production of steam power in England.
- Thomas Oldham(1816-1878) organized the Geological Survey of India for prospecting and surveying.
- Iron smelting was already popular, but large iron fields were discovered. The ores were exported to England to be reimported as steel.
- Mica, Bauxite, Manganese were mined and exported.

Research Institutions

- Asiatic Society of Bengal, founded in 1784 in Calcutta (Kolkata) by William James, the Judge. *"Man and Nature, whatever is performed by one or produced by the other within the geographic limits of Asia."*
- Aligarh Muslim University, founded in 1875 in Aligarh as Muhammadan Anglo-Oriental College by Syed Ahmed Khan, the Islamic Reformist. Goal: *"to establish a modern education system for the Indian Muslim populace."*
- Indian Association for Cultivation of Science, founded at 1876 in Calcutta (Kolkata) by Dr. Mahendralal Sircar, a physician. From the concept document 1869: *"the desirability of cultivation of sciences by the Natives of India."*
- Indian Institute of Science, founded in 1908 in Bangalore (Bangaluru), from a Trust initiated by J. N. Tata, the industrialist. Goal document 1904: *"to foster research in a (nationalistic) empowering environment."*
- Banaras Hindu University, founded in 1916 in Banaras (Varanasi) by Pandit Madan Mohan Malviya, the Nationalist. From his plan document of 1911: *"The millions mired in poverty here can only get rid (of it) when science is used in their interest. Such maximum application of science is only possible when scientific knowledge is available to Indians in their own country."*
- Bose Institute, founded in 1917 in Calcutta (Kolkata), by Acharya Jagadish Chandra Bose, the multi-discipline scientist. From the Inaugural address: *"I call upon those very few, who, realizing some inner call, will devote their whole life with strengthened character and determined purpose to take part in that infinite struggle to win knowledge for its own sake and see truth face to face."*

Scientific Surveys

- Flora Indica and Plante Coromandel – An illustrated compilation of 2600 plants from South India, created under the guidance of William Roxburgh (1751-1815), a Scottish surgeon in British East India Company.
- Plantae Asiaticae Rariores (in three volumes) – A catalogue of 20,000 specimen plants from Indian subcontinent collected by Nathaniel Wolf Wallich (1786-1854). He was a Danish surgeon and botanist and worked as an Assistant to William Roxburgh.
- The Fauna of British India, including Ceylon and Burma – A series of books on the mammals and birds of the subcontinent, prepared by W. T. Blanford (1832-1905) and Associates. Blanford was a Geologist.
- The Ancient Geography of India – A reference book to locate places and events from the historical records, by Alexander Cunningham (1814-1893). Cunningham was an Army Engineer.
- The Geological Map of India – A series of fragmentary papers produced by Henry Wesley Voysey (1791-1824) while working as a surgeon in the team of the Great Trigonometric Survey of India.

Technological Progress spanned the following fields:

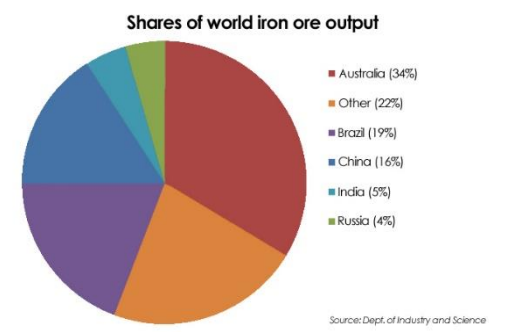
- Steel Industry
- Railways
- Textile Industry
- Jute Industry
- Chemical Technology
- Pharmaceuticals
- Civil Engineering
- Infrastructure Engineering
- Automotive Engineering
- Food Production

Steel Industry, Railways

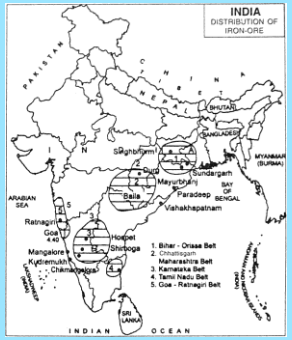
British Period

Steel Industry:

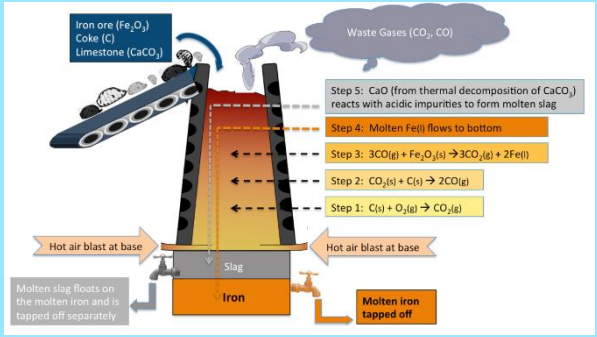
Iron ores were exported to England and steel was imported to India in 19th century. Dorabji Tata established Tata Steel Plant in Jamshedpur in 1908.



World Share of Iron Ore



Iron ore in India

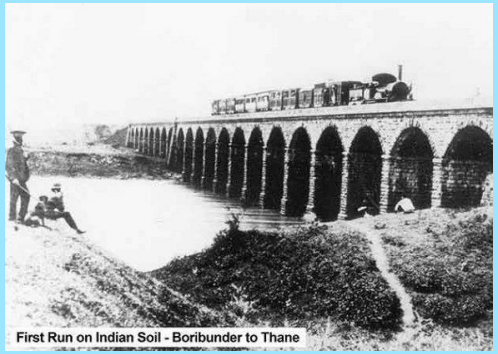


Blast Furnace Chemistry

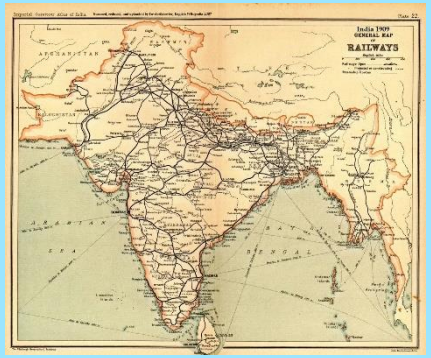
Tata Steel Plant, Jamshedpur

Railways:

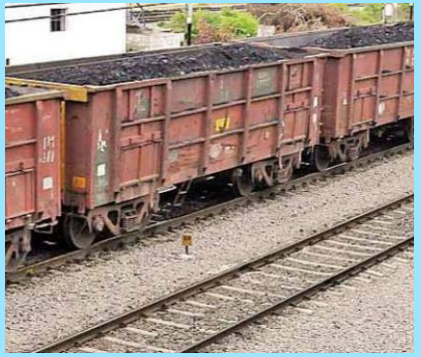
Early train, 1851



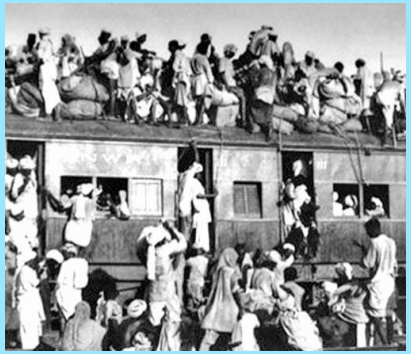
Bombay to Thane, 1853



Train routes in India, 1909



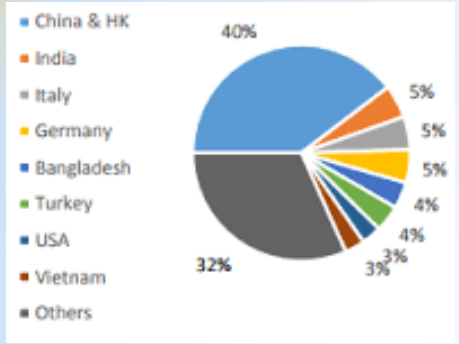
Iron ore carriage



Partition India, 1947

Textile Industry, Jute Industry

Textile Industry:

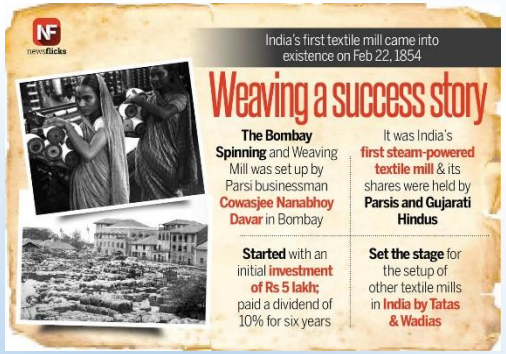


Production Share

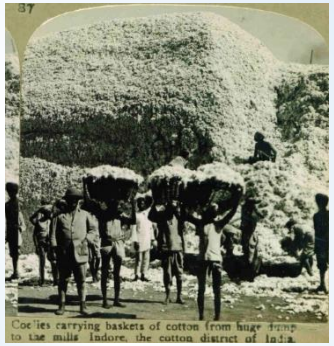
Clothing limit (Textile & garment exports, $ bn)

	World	India	Share in global exports (%)
2004	453	13.5	2.97
2005	479	16.1	3.36
2006	530	19.5	3.68
2007	588	19.7	3.35
2008	618	22	3.54
2009	527	20.6	3.9
2010	602	23.9	3.96
2011	712	30	4.21
2012	707	29.1	4.11
2013	766	35.7	4.66

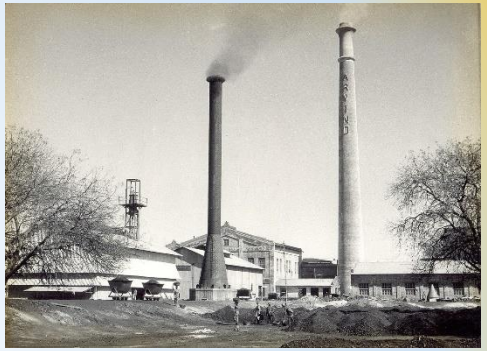
Export Share



Newsflash



Coolie and cotton



Arvind Mills, Ahmedabad

Jute Industry:

Jute plant

Hand made rope

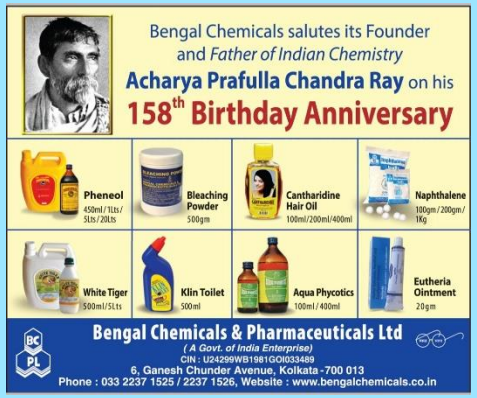
Jute factory

Gunny bags

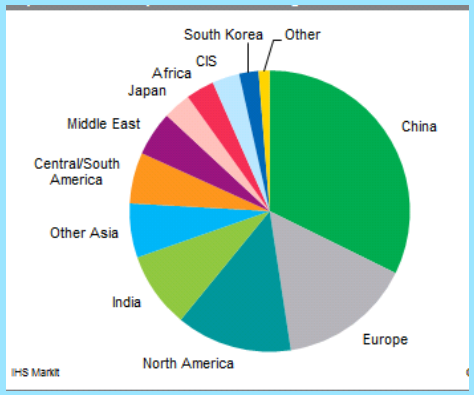
Chemical Technology, Pharmaceuticals

Chemical Technology:

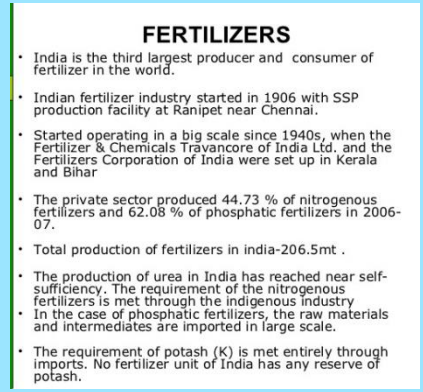
Bengal Chemicals and Pharmaceuticals



BCP 2019



World Share of Paints and Coatings, 2018



Fertilizers in India

Pharmaceuticals:

Ayurvedic medicine factory

Unani medicine store

Opium production (British engineered)

Hindustan Antibiotics, Pimpri

Civil Engineering, Infrastructure

Civil Engineering:

Victoria Memorial, Calcutta, 1921

Gateway of India,Bombay 1924

Viceroy House, Delhi 1931

Birla Mandir, Delhi, 1939

Infrastructure:

Chennai Port, 1881

Victoria Terminus, 1887

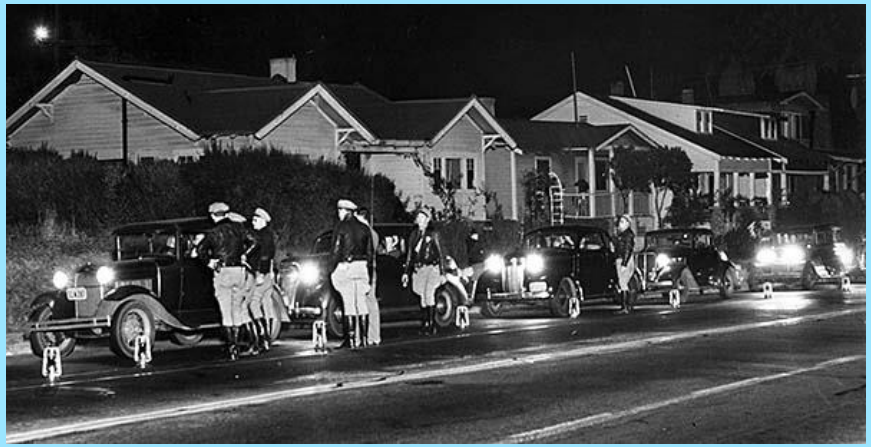
Howrah Bridge, 1943

Automotive Industry, Food Product Mills

British Period

Automotive Industry:

Car Showroom in Secunderabad, 1940



Vehicle Inspection in Bombay, 1944

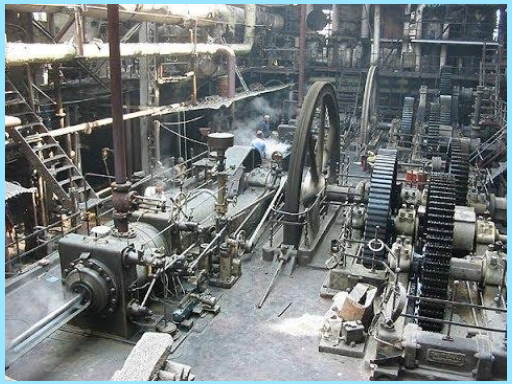
Calcutta Traffic, 1945

Mills:

Oil Mill

Rice Mill

Flour Mill



Sugar Mill

Thank you!