



# Scientific Method and its Role in Management Research

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# Three Anecdotes

## Galileo Galilei: A Physicist

- Born on February 15, 1564 at Pisa in Italy,

- Died on January 18, 1642 at Arcetri, Italy

## Christian Friedrich Schonbein: A Chemist

- Born on October 18, 1799 at Metzingen, Switzerland

- Died on August 29, 1868 at Baden Baden, Germany

## Gabriel Nahas: An anaesthologist

- Born on March 4, 1920 at Alexandria, Egypt

- Died June 28, 2012 at Columbia, USA.

# Galileo Galilei

Statue at Natural History Museum, Oxford



The early Pendulum Clock



# Pendulum Story

- Galileo Galilei was a staunch Catholic. He used to attend service in the church every Sunday. One day in 1582 a strange thing happened in the church.
- As the regular priest was not available a new priest gave a sermon that day. Since the presentation was not good, Galileo got bored and started looking around.
- His attention was caught by a chandelier that swung due to the wind from the open window. He noticed that the time taken for a swing remained almost the same.

## Pendulum Story....

- Galileo went to his laboratory and conducted experiment to test his hypothesis.
- He recreated the situation of the chandelier in the cathedral by hanging a ball to a thread.
- He then went on controlling a parameter and change another parameter.
- First he varied the weight of a ball and found that it does not affect the time period.
- Then he changed the length of a pendulum and found that the time period varies with the square root of the length.

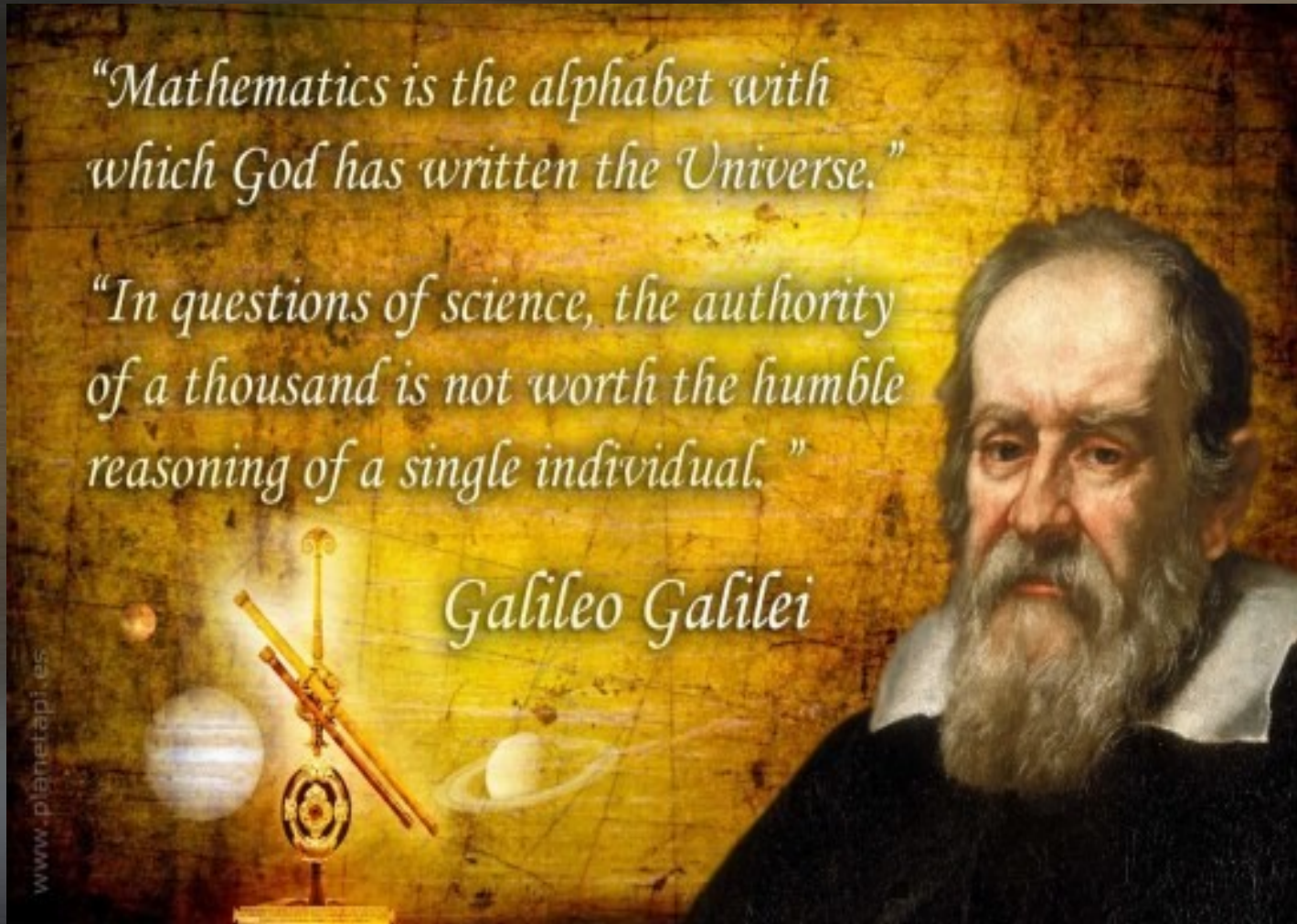


# Galileo's Belief

*"Mathematics is the alphabet with which God has written the Universe."*

*"In questions of science, the authority of a thousand is not worth the humble reasoning of a single individual."*

*Galileo Galilei*



## Pendulum Story....

- His work led to the formulation where the time period of oscillation of the pendulum is expressed in terms of its length and gravitational pull at that place.
- He derived the formula as  $T = 2\pi \sqrt{l/g}$ , where  $l$  is the length of a pendulum and  $g$  is the a gravitational pullatthat place.
- The work on pendulum enabledmaking of clocks. Thesependulum clocks remained the device of time keepingfrom1641 to1930 until atomicclocks were discovered.

# Steps involved

- Minute observation of a natural phenomenon.
- Made a guess about the time period based on the observations.
- Conducted experiment in a contrived situation to test the hypothesis.
- The work finally resulted into the formulation of a physical phenomenon called simple harmonic motion.
- He suggested possible implications of the work resulting into the making of clocks.

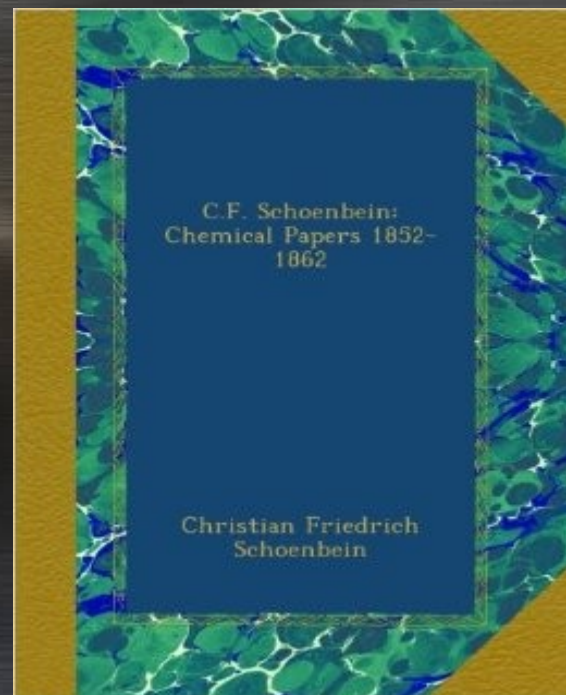


# Christian Friedrich Schoenbein

## The Person



## The book



# Story of Gun Cotton

- Christian Schoenben was a chemist by profession. He had the habit of conducting chemical experiments in the kitchen.
- Like many of us he was afraid of his wife and would not dare to enter into kitchen while she was around.
- In 1845 when his wife was away he started working with the mixture of Nitric Acid and Sulphuric acid in the kitchen.
- The mixture spilled on the kitchen platform. In a hurry he took a cloth and wiped the mixture.

## Guncotton ....

- He soon realised that the cloth that he has grabbed was actually the gown of his wife and wanted to dry it as soon as possible.
- He started a stove and tried to hold the piece over the flame for faster drying.
- To his surprise he found that the gown caught fire and burned like an explosive. This experience haunted him.
- He doubted that the accident resulted into an explosive material and decided to perform an experiment in a contrived situation to test it.



## Guncotton .....

- He soaked the piece of a cotton cloth in the mixture of Nitric acid and Sulphuric acid, allowed the piece to dry and then burned.
- He was right. His experiment resulted into an explosive that was badly needed in those days. Only explosive known at that time was Gunpowder, a dry mixture of carbon, sulphur and Chilly saltpetre.
- Gunpowder was inconvenient to use as it created smoke and in many cases led to fire when used in coal mines. Nitrocellulose (popularly known as guncotton), made by Schöenbein, proved to be a convenient explosive.



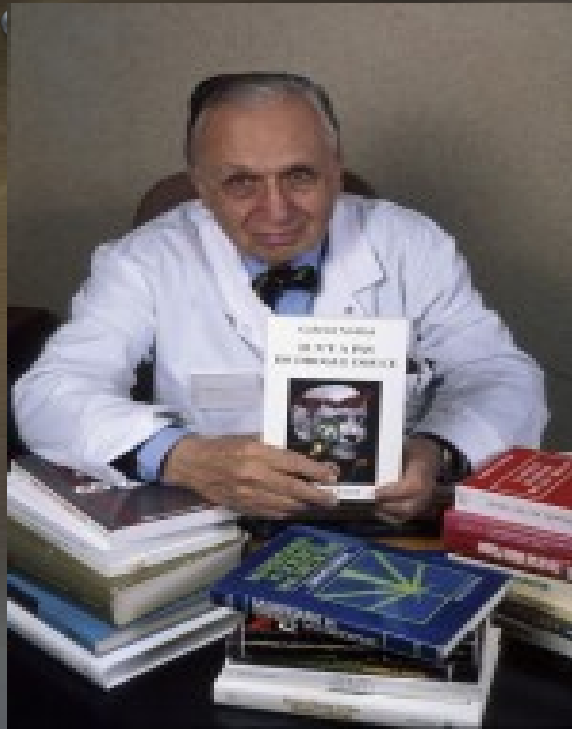


# Steps involved

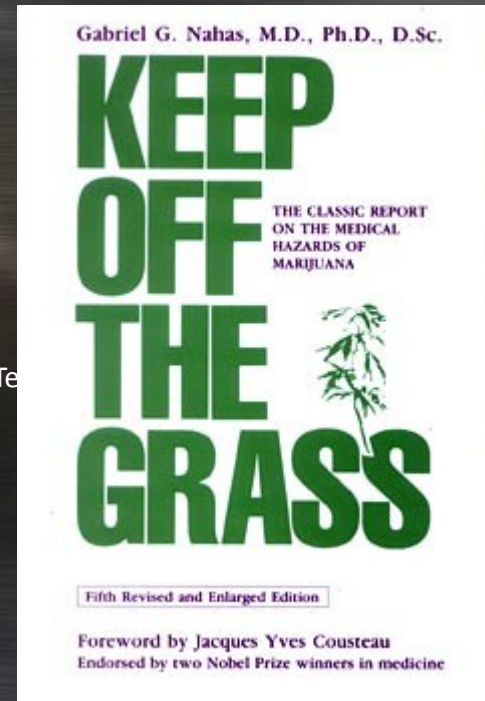
- A question arose in the mind of Schöenbein through an accident. He hypothesised that his work resulted into an explosive material.
- He conducted a systematic experiment to test the hypothesis. Once the hypothesis was confirmed he went on to understand the mechanism.
- He suggested a possible technological implication of his new material Nitrocellulose. It was great Alfred Nobel from Sweden who used it to make dynamite along with nitroglycerine.

# Gabriel Nahas

Gabriel Nahas with his books



His famous book





# Story of Marijuana

- Gabriel Nahas, an Egypt born scientist, was working with a hospital attached to the University of Columbia. In 1969 he attended a PTA meeting in the school of his daughter.
- The Chief guest for the meeting was a Police Officer. In his speech he said “Young boys and girls in USA, now a days, use a new drug. We feel it is harmful but the court releases them as there is no evidence of illits effects. It would behelpful to police department ifsomeone takes up the systematic study to find out the effects of this drug on human body”.

## Marijuana .....

- Gabriel Nahas decided to work on the subject. He got some information from the police officer and then went to the library to find out more about the drug.
- Literature survey showed that the drug is known by different names like hashish, ganja, bhang, charas, etc. Its technical name was Marijuana.
- His search revealed that the use of the drug originated in Himalayas, sadhus used to take it to establish dialogue with god. The use then spread in different parts of the world.



## Marijuana ....

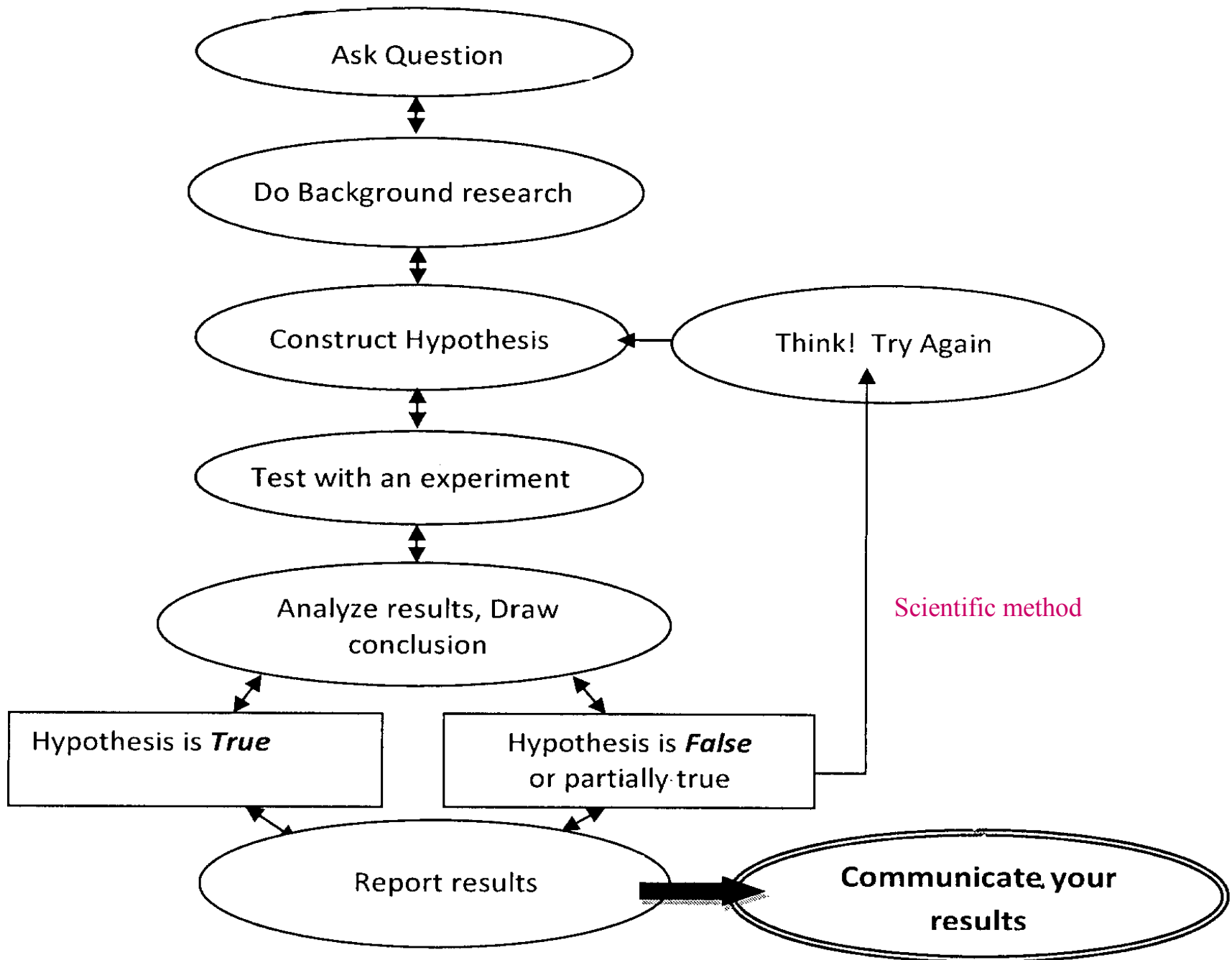
- He set out to conduct a systematic study in his laboratory. He applied for a grant and obtained sample of the drug from custom department.
- His study revealed that the drug is harmful to human beings in three ways:
  - It deforms red blood cells creating breathing problems.
  - It affects white blood cells bringing down the immunity of a person.
  - It badly affects sperm production in men that passes on defects to next generation.

## Marijuana ....

- He published his work in the form of articles and books.
- He also wrote to the Health Department of the Government of USA as he believed that the responsibility of a scientist does not end at publication.
- He had to stand in a court to prove the results of his laboratory work. A committee of experts was appointed to testify his findings.
- Finally, a law was passed banning the use of Marijuana, in any form, in 1980.

## Steps involved

- Motivation to work on a problem through a lecture in a school.
- Literature survey to find out more about the problem. Remembered his childhood experiences from Egypt and arrived at an hypothesis.
- Designed experiment to test the hypothesis. It was a team effort as he was not an expert in all the areas like testing of blood and sperms.
- The work resulted into a law benefitting the entire society.





# Natural science

- The scientific method of research, which was outlined earlier is based on the model of research in the natural sciences where
  - (1) procedures are public,
  - (2) definitions are precise,
  - (3) data collection is objective,
  - (4) findings are replicable,
  - (5) the approach is systematic and cumulative and
  - (6) the purpose is explanation, understanding, and prediction (Luthans, 1973).



# Social science

- Many researchers often question the applicability of scientific method to social/management research on the grounds that organisations and individuals making them up differ from the phenomena in natural sciences (Gummesson, 2000).
- The main objections seem to be with reference to rigour, precision, exorcism of value laden questions, and dominance of verification and proof. Nevertheless, scientific method has a role play in management research.

# Special features of science

- Science is a systematic and rigorous way of acquiring accurate knowledge of the facts, structure, processes, and behaviour of any phenomenon.
- It is a cyclic process involving observation, conceptualisation, generalisation (hypothesization), and verification.
- Science proceeds in steps, with Popperian pessimism. Often Kuhnian revolutions take place in scientific knowledge, destroying old concepts and setting up new ideas.



# Inductive and deductive logic

- Logic, both inductive and deductive, is an essential part of scientific method.
- Induction works backwards from facts or phenomena; deduction works forward from the researcher's own perception of phenomena based on earlier work.
- The hypothetico deductive method, in which hypotheses are carefully formulated and rigorously verified, forms the backbone of scientific method.





# Social Science Research

- The aspects of scientific method that are derived from the positive scientific approaches of natural sciences are considered by many social scientists as not wholly applicable to research in management and social sciences.
- It is proposed by these social scientists that human behaviour and organisational phenomena cannot always be objectively analysed as natural science.
- Nevertheless, both inside perspective of social science and objectivity of natural science are required to successfully research and analyse management problems.



Thank you

*Any Question?*

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