ENS DE LYON

Développement de la culture scientifique et technique et égalité des chances

8-9 décembre 2011
Académie de Dijon

Jean-François Pinton

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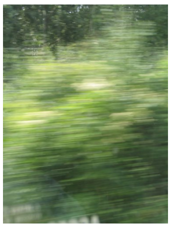
Représentation des enseignants de mathématiques, SPC, SVT et technologie concernant les démarches scientifiques et d'investigation.
Réjane Monod-Ansaldi et Michèle Prieur

RECHERCHE

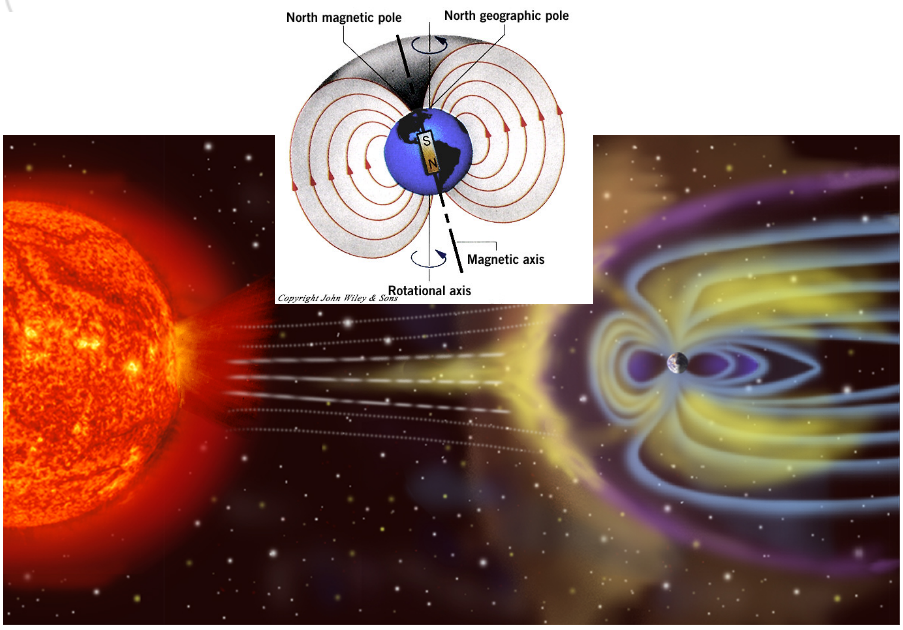


- L'aventure de la connaissance,
  pour « l'honneur de l'esprit humain »

- Les frontières de la connaissance
  exploration « floue »
  barrières reconnues

- Un exemple, en physique

- Quelques implications



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1000 (approx) Chinese discover that lodestone floating on "boat" prefers south-north direction

1600 William Gilbert's "De Magnete": Earth itself is a great magnet.

1777 Coulomb introduces his torsion balance & inverse squares law.

1820 Oersted discovers magnetism due to electric currents. Ampère starts an explanation

1831 Faraday discovers electrical induction, later introduces disk dynamo.

1834 Gauss develops spherical harmonic analysis of the scalar magnetic potential.

1896 Pieter Zeeman discovers splitting of spectral lines emitted in magnetic field.

1906 Bernard Brunhes publishes first evidence of reversely magnetized rocks.

1918 Alfred Wegener publishes "The Origin of the Continents and Oceans."

1919 Joseph Larmor proposes self-sustaining dynamo action.

1933 Thomas Cowling proves self-sustained dynamos are never axisymmetric.

1946 Walter Elsasser tries to calculate dynamo solutions.

1963 Morley, Vine and Matthews : magnetic banding of the ocean floor iand polar reversals.

1966 Lowes and Wilkinson disk dynamo in Cambridge

1966 Steenbeck at al propose "alpha dynamo," generalizing an idea of Parker.

1972 Ponomarenko and Roberts analytical dynamo flows.

1981 First precision mapping of the Earth's field from space, by Magsat.

1997 Glatzmaier et al. use computer to simulate the Earth's dynamo and its reversals.

2000 Fluid dynamo experiments in Riga (A. Gailitis et al.) and in Karlsruhe (Muller & Stieglitz)

2006 First turbulent fluid dynamo (VKS)

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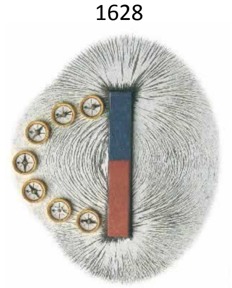
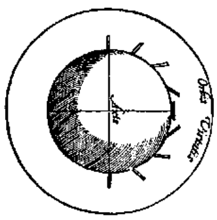
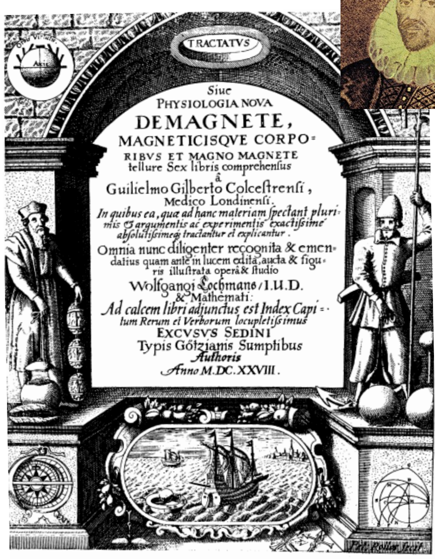
1628

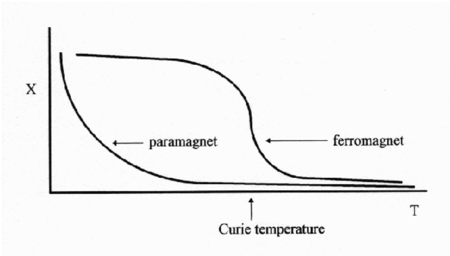


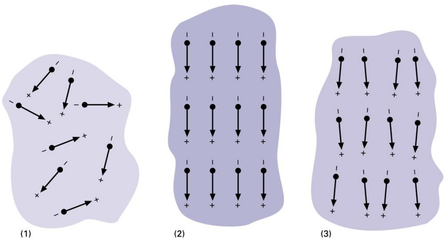
Gilbert's terrella





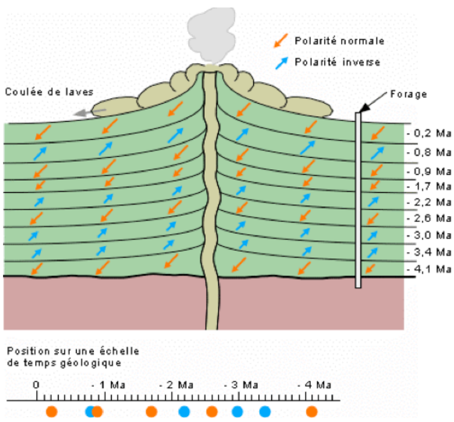
1895 **Curie temperature**



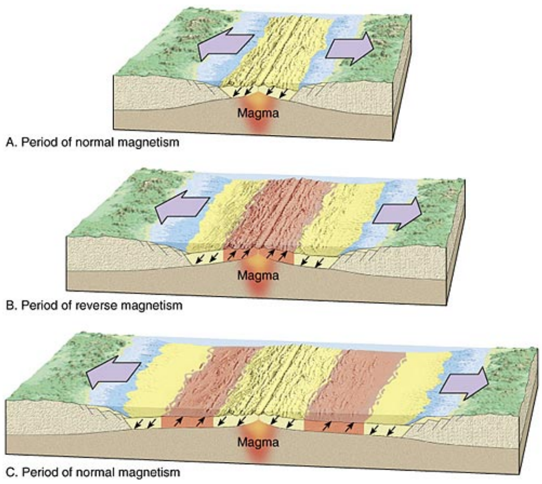


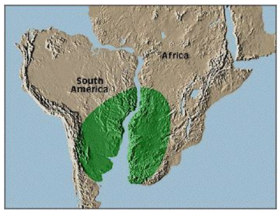
1905 **Bernard Bruhnes**

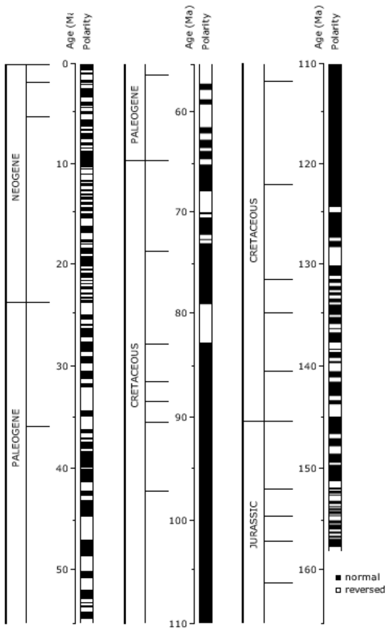
- Professeur U. Dijon puis Clermont Ferrand, Dir. Obs. météo du Puy-de-Dôme en 1900.
- Roches volcaniques du Massif Central Coulée de Pontfarein (St Flour, Cantal)
- Cf. commémoration Vulcania, 2007.



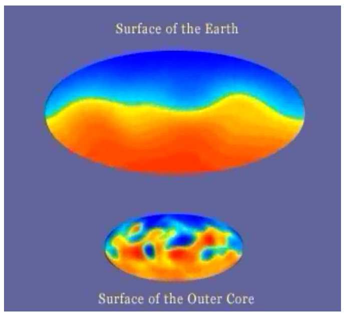
1918 **Alferd Wengener**

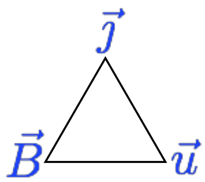






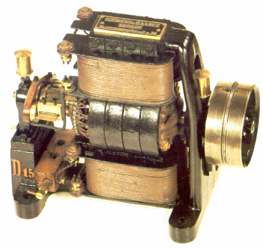
- 771 reversals
- period ≈ (100-300) x 1000 ans
- 5 000- 10 000 for a reversal
- Last one 780 000 yrs ago

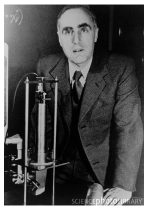




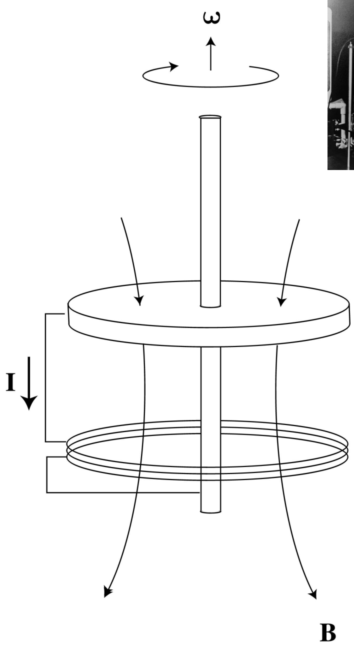
- $(u,B)_{prescribed} \longrightarrow j$: generator
- $(j,B)_{prescribed} \longrightarrow u$: motor
- $u_{presecribed} \longrightarrow (j,B)$: dynamo

The Siemens' brothers dynamo (1867)





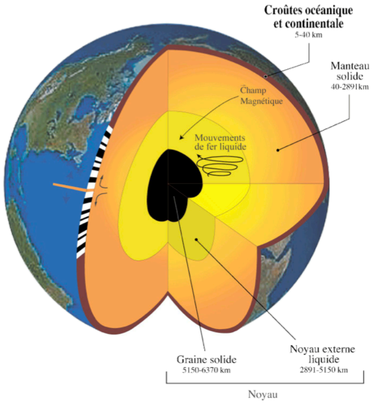
Bullard's dynamo (1955)



1919

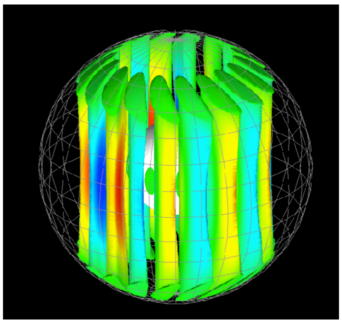
Joseph Larmor

«Such internal motion induces an electrical field acting on the moving matter ; and if any conducting path around the solar axis happens to be open, an electrical current will flow round it, which may in turn increase the inducing magnetic field. In this way it is possible for the internal cyclic motion to act after the manner of the cycle of a self-exciting dynamo, and maintain a permanent magnetic field from insignificant beginnings, at the expense of some of the energy of the internal circulation. »



1931

Thomas Cowling



- A maths theorem: axisymmetric dynamos cannot be sustained by axisymmetric motions
- One of many anti-dynamo theorems

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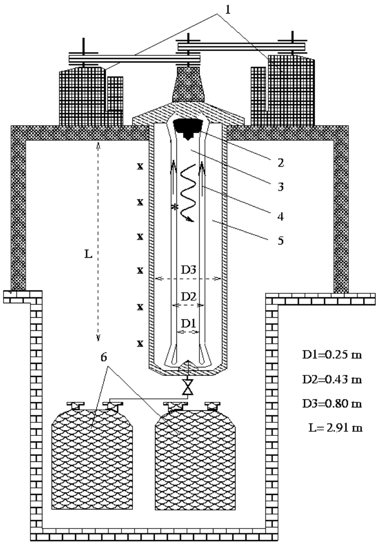
2000

Riga



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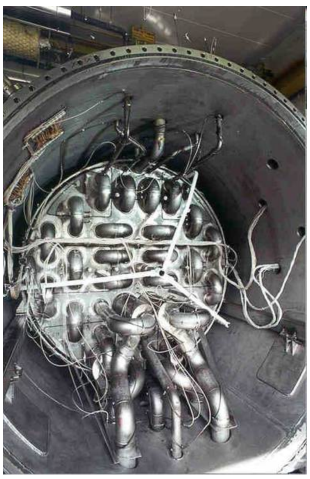
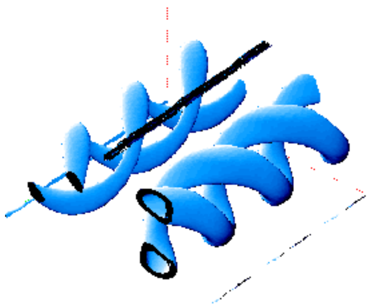
2000

Karlsruhe





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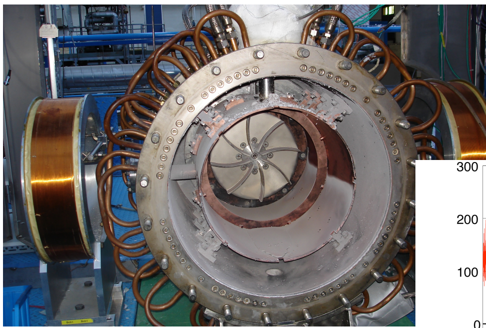
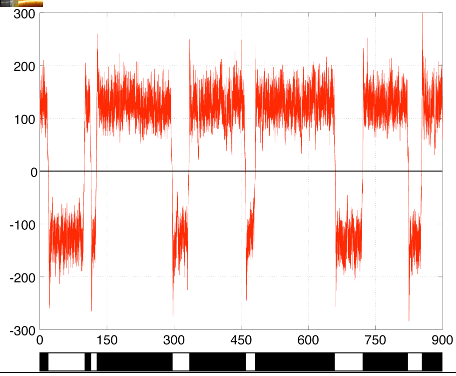
2007 **VKS experiment**





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RECHERCHE

- Démarche réductrice : nb minimal d'ingrédients
- AR observation / modélisation
- Pas de frontières maths / physique / chimie / géologie / etc…

RECHERCHE

- « on n'a pas inventé l'électricité en essayant de faire des meilleurs bougies »
- l'explication de la dynamo (« fondamental ») est née des travaux d'ingénieurs comme Siemens (« appliqué ») qui exploitait les découvertes des « savants »
- research is question-based, curiosity driven
- « sans technique un don n'est qu'une sale manie »
- l'organisation « sociale » de la recherche: la parole est à celui qui contribue!

ENSEIGNEMENT

- sciences à l'école:

  un jeu de lego

  l'observation est essentielle … la conceptualisation aussi

  construction d'une « boite à outil »

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ENSEIGNEMENT

- ne pas confondre
  - science et progrès
  - science et conscience
  - science et langage de la science

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DES INITIATIVES À L'ENS DE LYON

- Classes passerelles
  - Second concours
    - Le projet IDEX et l'égalité des chances
      - L'ifé

Dernières remarques

- La science *n'est pas* un outil de sélection de l'école au lycée,
- La recherche est un formidable vecteur de création,
- Le savoir scientifique est essentiel dans la formation de citoyens !