How really NEW can be a discovery?

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Archimedes

- The greatest ancient physicist and mathematician jumped naked from public bath shouting „Eureka” („(*I have*) found it!”) when he realized how to determine volume of body (in consequence the physical law of buoyancy/floating)

- „Eureka” is the archetype for discovery – something sudden, unexpected which strikes the person who did it!

How do we explore world?

- Our animal brain is oriented for finding causal links in environment. It is necessity of living
- If no cause seen humans invented myths to save paradigm (gods/ghosts/devils/…)

Human's restrictions

- The perception of world (observed phenomena) is a function of our experience, knowledge, terms, expectations and paradigms about world.
- Example: cargo cults on New Guinea (or how to understand airplane if you live in neolith?)

- Science is a questionable system of believes based on experience but stabilized by hierarchy (authorities).

- How then a discovery is possible?

Discovery is always only a small step forward!

Few examples:

Radioactivity - Becquerel (1896)

Nuclear fission – Hahn, Meitner,… (1938/9)

Neutrino – Pauli (1932)

1896: Becquerel's discovery of radioactivity, however…

The 19th century was fertile in new techniques. Nicéphore Niepce (1765–1833) invented photography and communicated his passion for this process to his nephew Abel Niepce de Saint Victor (1805–1870), who spent about 15 years from 1851 working on heliochromy. At that time, fluorescence and phosphorescence were already known, and, as said, Edmond Becquerel tried to fix a colour print. Abel Niepce was particularly interested whether a compound exposed to light or to sun might retain an impression to this exposure in the dark.

The answer to this question was provided in a first series of papers (1857–1858) [4–7] presented to the Academy of Sciences by Chevreul, who had carefully followed and encouraged the work of Abel Niepce. The latter's results are summarized in the statements:

- Some compounds exposed to light exhibit in the dark the same effect as that produced by the direct action of light,
- Cardboards impregnated with both uranium nitrate and tartaric acid are "active", the intensity being stronger for the former compound,
- The "activity" remaining on the exposed cardboard is revealed by its action on a photographic plate,
- The "activity" is persistent and acts at a distance in the dark; it cannot pass through glass,
- The effect is not due to phosphorescence,
- Finally, the activity is attributed to invisible "chemical" rays.

It is amazing how closely these experiments resembled those performed by Henri Becquerel about 30 years later. However, some questions remained unanswered:

- Niepce mentioned that the cardboard must be dyed with a uranium salt solution until the color becomes as yellow as straw. Was the amount of uranium sufficient to darken the photographic plate?
- How long was the impregnated carboard in contact with the plate?
- What was the actual sensitivity of the photographic plate? At that time a wet collodion preparation was still in use, whereas Becquerel already disposed of dry photographic plates.

Today, these experiments cannot be reproduced under their original conditions J. Orcel and F. Kraut [8] have carefully examined the leading role played by Abel Niepce and have concluded that even if he had performed the right experiments, he could not have proposed a correct interpretation. A similar confusion prevailed in the discovery of uranic rays by Becquerel, but the great merit of the latter consisted in his proof that the observed effect was due to uranium.

Abel Niepce de Saint Victor In 1857-8 observed that some compounds darked photo plate as light does

Text from: M.Genet, The discovery of uranic rays, a short step for Henri Becquerel but a giant step for science, in: One hundred years after the discovery of radioactivity, Special issue of Radiochimica Acta, 1996

Was Becquerel aware about findings of Abel Niepece de Saint Victor?

Based on M.Genet, The discovery of uranic rays, a short step for Henri Becquerel but a giant step for science, in: One hundred years after the discovery of radioactivity, Special issue of Radiochimica Acta, 1996

1. In the Henri father's (Alexandre Eddmont Becquerel) book „Light: it causes and effects" published in 1869 the observations of Niepce are cited! – however they were interpreted as result of sun irradiation, so a kind of long term luminescence.
2. Gabriel Bertrand (bio-chemist) published in 1946 short note (a testimony) with his recalls of talk in 1893 with H.Becquerel about the Abel Niepece observations. They did some chemical experiment together to clarify one hypothesis.
3. The whole story was well known in these years, In 1905 H.Becquerel was even accused by Gustave Le Bon of plagiarism!

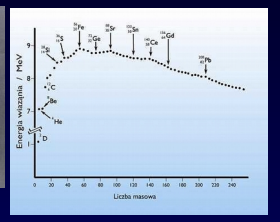
The answer for this question is „for sure YES" !

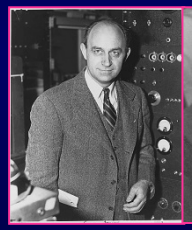
Why then H.Becquerel is considered the one who discovered radioactive decay?

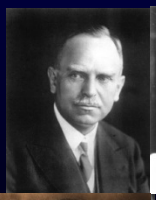
- The discovery was the reinterpretation of know to H. Becquerel (but not widly) feature
- The W.C.Roentgen discovery of X-rays unblocked minds – enabled to find another to luminescence interpretation (small step!)
- Becquerel was a member of French scientific establishment (sad, but it helps!)

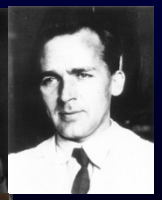
1938/9: Hahn and Meitner - discovery of nuclear fission

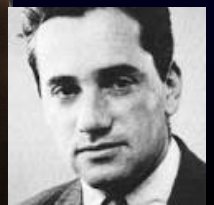
- In 1933 on base of only shape of nuclear binding energy Leo Szilard predicted possibility of fission, the chain reaction and even complete A-bomb construction (1934: UK patent for A-bomb!)
- In 1936-7 Irene & Frideric Joliot-Curie and (independently) Enrico Fermi did several experiments on uranium irradiation in which fission occurred but they misinterpreted it (barium was takes as radium)
- 1938 Otto Hahn and Fritz Strassmann made similar experiment, Lise Meitner & Otto Frisch gave the interpretation of fission











Some questions related to fission discovery

- Why Szilard did not discovered it in empiric way? (politics?)
- Why Fermi or Jolit-Curies did not discoverd it?

(Too much devoted to scheme?)

- Why Lise Meitner did not received Nobel prize for discovery?

(politics? – woman & Jewish?)

1932 – Pauli predicts neutrino

- To save physical paradigms (three the most importants laws of conservations – of energy, of charge and of spin) he predicted „invisible” (notdetectable) particle – the neutrino
- Predictioction confirmed by experiment (C.Cowen & F.Reines) in 1956
- But Wolfgang Pauli not C.Cowen & F.Reines is considered the one who discovered neutrino!

Important question

What the discovery is?

The observation of new feature or the proper its interpretation?

:

Abel Niepce de Saint Victor **did** observed radioactive decay but misinterpreted it

Joliot-Curie and Fermi **did** observed fission but misinterpreted

Pauli **did not** observed neutrino but gave proper interpretation

The interpretation more important then observation!

What we already see but cannot made proper interpretation and why?

- Physicists now search for „new physics” – some model which extends Standard Model (SM).
- Does it frame modern physics? Maybe there are features within SM or within another extension of SM?

Some examples of challenges

- Can we influence the life time for an alpha emitter by modification of the barrier of nuclei potential ?
- The even-even nuclei is more stable than others but we do not observe di-neutron or di-quark. However tri-quark (as well as quark-antiquark) exists. Do we really know why? What does it tells us?
- All weak interacting particles are fermions. Is the spin h/2 a kind of a weak forces charge?
- Is there a structure of space-time? Is it continuous or not?
- What is the relationship between space structure and fundamental forces?

Next open questions…

- Why electron and proton has the same electric charge? (famous question of prof. A. Staruszkiewicz)
- Why there are **three (not one, two or four)** generations of both leptons and hadrons?
- Is the force between *u* and *d* quarks in nucleon the same as between two *d* or two *u*?
- What wave-particle dualism tells us about space?
- What tells us Fermi exclusion principle about space structure and nuclear forces?

Few more...

- Do the dark matter exists and what it is?
- Can dark matter transfer (decay?) to „normal” matter?
- Have we already observed processes which are in fact beyond our knowledge and we cannot explain them ?

New or old Physics?

- What is the deeper structure of matter since in SM we have 30+ „elemental particles”? How to guess it? Are we in position of Abel Niepce here?
- Is there unknow physics still to be discovered inside SM!
- Do the physics beyond SM exists?

Instead of Conclusions

- One should keep open mind to challanges.
- Go outside schemes.
- Try to find non-conventional answer but also new (more proper) questions
- Try to find other possible explanation that exists. Maybe we are in the dead end and have to return?
- Get konwledge from modern psychology to understood how brain is working and where are limitations and how to skip them

Thank you

- *I wish all the best in discovery NEW in nature!*