

Opportunities of Biographic Method in Improvement of Physics Teacher Training

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Abstract: the article addresses the opportunities opened by use of bibliographic method in training future teachers of physics. Definition of biographic method and biography is given. Giving example of a number of biographic the author shows that use of this method allows to humanize physics course, to disclose the contexts in which the discovery was made in detail, facilitate training of a teacher not only as professional but as highly-educated person, because it allows to broaden the world views of students, introduce diversity into the contents of physics course, to prepare creatively-working teacher.

Key words: Biographic method • Biography • Physics • Teacher • Scientist • Discovery

INTRODUCTION

By now when science and technologies are developing very quickly, informatization of education and the whole society is on the way, the task of better training of school physics teacher is of utter importance. One of the ways to solve this problem is to use biographic method in teaching. While training a teacher at university it is important not only to form his professional skills but develop his general culture as well. Biographic method allows to humanize physics as a science, to increase interest not only in studying physics but in the history of its development, to disclose broadly the context in which some discovery was made. This fact is assumed both by available biographic literature: stories told by scientists, recollections of colleagues, friends, students, correspondence etc. [1-3], monographs devoted to separate scientists [4,5] and by learning [6,7], reference literature [8,9]. Potentialities biographic method usage in sociology are also discussed [10]. In this article the potential of this method in regard to studying physics is considered.

Biographic Method: The biographical method is the collection and analysis of an intensive account of a whole life or portion of a life, usually by an in-depth, unstructured interview. The account may be reinforced by semi-structured interviewing or personal documents. Rather than concentrating upon a 'snapshot' of an

individual's present situation, the biographical approach emphasises the placement of the individual within a nexus of social connections, historical events and life experiences (the life history) [11]. About the big importance of a biographic method it is specified also in work [12].

In order to understand the processes of formation and development of a personality of a physicist you must study his biography thoroughly, consider his generalized biographic portrait-this must be done in regard to all most significant scientists whose contribution into science is studied in university course of physics. Biography is a particular life of a scientist since the moment of his birth to his death: his social origin and status; relations in the family; natural abilities and interests; teachers and mentors; circle of friends, specialization; socio-political activity; special, breakthrough moments of life; age and life duration etc.

It is obvious that uniqueness and specific character of scientific views, prominent contribution into physics development can not be explained only by the biography of scientists, but there is relationship between world views and biography [13].

MATERIALS AND METHODS

- Use of biographic method will allow to find out *the circumstances which made many physicists study physics*. For example, it is known that prominent

English scientist, who discovered the phenomenon of electromagnetic induction, Michael Faraday was an assistant in bookbindery shop and one of the customers presented him a pass for free attendance of public lectures of Humphrey Davie which fascinated Faraday very much. When Faraday brought to his teacher the bound notes of his lectures he was accepted to work with him as an assistant. French scientist who discovered the law of interaction of electric charges, Charles Coulomb was fond of sciences when he studied at a prestigious College of 4th nations in Paris. His participation in the contest of projects organized by Paris Academy of Sciences made him conduct research work (he invented torsion balance). Young Englishman Thomas Young who contributed into many natural sciences showed interest in sciences when he was conducting geodesic shooting-he helped to his neighbor, a land-surveyor. German scientist George Ohm who investigated the laws of electric current started to learn physics when after very long looking for a job he was granted a position of a school teacher, though he had mathematical education. Thanks to the friendship of Fermi family with engineer A. Amiday an Italian Enrico Fermi was fond of mathematics and physics which resulted in his prominent discoveries in nuclear physics and winning Nobel Prize.

Scientists were greatly influenced by their teachers. Thus, the first physics lessons were given to one of the future inventor of energy conservation law, James Prescott Joule, by John Dalton, the author of the law of gas pressure; influenced by him Joule started his experimental researches. French mathematician and physicist who made fundamental discoveries in electricity and magnetism Andre Mary Ampere became interested in research activity thanks to prominent mathematician and physicist Pierre-Simon Laplace. Among the followers of the founder of the 1st international school of physicists-experimenters of German scientist August Kundt there were the finder of high penetration radiance Wilhelm Roentgen, Peter Lebedev who was the first to prove the Maxwell's conclusion about pressure of light, German scientist who discovered one of the series in hydrogen atom range, Friedrich Paschen and many others. Many scientists came into the science because of family traditions which also made them discover important phenomena in physics. For example "crowned" family dynasties of physicists-Nobel prize winners-Henri and Lawrence Bragg, Niels Bohr and Oge Bohr, Pierre Curie and Maria Skladovskaya-Curie, Iren Curie and Frederic Joliot-Curie, Josef John and George Paget

Thomson. German physicist, Nobel Prize winner, Gustav Hertz who experimentally proved Bohr 's postulates (Frank-Hertz experiments) was a nephew of Henrich Hertz, one of the founders of electrodynamics, experimentally proved the existence of electro-magnetic waves.

As we see, "it can't help paying attention to numerous, obviously not coincidental, family correlations. It is known that living in a family and mutual exchange of information and ideas, moral support and just personal example make family relations exclusively favourable factor for cross-semi nation and development of talents" [14].

Many scientists had other main speciality but went into physics because felt their mission. Thus, the first researcher of magnetic characteristics, Englishman William Gilbert was a doctor by profession, the authors of energy conservation law Robert Maier and German Helmholtz, Englishman Thomas Young also performed medical practice. Secretary of London Royal Society, who formulated the law of flexible deformation, Robert Hook was, apart from physics line, a botanist, architect, inventor. The first discoverer of atmospheric electricity Benjamin Franklin was a worker at printing-house, he also was engaged into publishing activity. Prominent French physicists who discovered the laws studied within university and school courses, physics- Charles Coulomb, Etienne-Louis Malus, Sadi Carnot- had a speciality of military engineer. The inventor of light diffraction, Augustin-Jean Fresnel worked as engineer of road construction and repair in different departments of France. Rich English land-lord Henri Cavendish practiced physics and chemistry as a hobby having inherited big fortune.

- Use of biographic method allows to find out *the factors and conditions of formation of certain world views.*

Thus, Aristotle was the last great philosopher-contemplator in antic astronomy. One of his deductive ideas was as the same as of Pythagoras': "sphere is an ideal form" and this determined the scientific vision of planet orbits for centuries. Danish physicist Hans-Christian Oersted was fond of Schelling philosophy whose idea about universal relationship and interdependency of phenomena made Oersted to look for experimental proofs of the relationship between electricity and magnetism.

Henri Ampere wrote the work "Experience in the philosophy of sciences or analytical narration of natural classification of all human knowledge". French philosopher and physicist Pierre Gassendi was famous for his propaganda of Epicureanism and atomism and an attempt to reconcile them with Christianity. Albert Einstein was a follower of Spinoza's rationalism and pantheism. He was convinced in full harmony of nature, in objective reality of physical phenomena and ability of human brain to reflect nature processes in scientific theories. Niels Bohr can be regarded as Kant's follower who considered cause-and-effect as "synthetic assumption a priori" not taken out of experience. The founder of Periodical system of elements, Dmitry Mendeleev, unmasked spiritualism, which was popular among scientists too. James Jeans, one of the authors of thermo-radiation law, was one of the leaders of Cambridge school of modern physical idealism. There is a fact of fierce struggle between physicists-idealists Ernst Mach and Wilhelm Oswald and the supporters of atomic theory Ludwig Boltzmann. This struggle exhausted the Boltzmann's forces and resulted in committing by him a suicide. Paul Ehrenfest also committed a suicide not finding himself in new non-classical physics.

- Use of biographic method allows to find out *facts and reasons of combining scientific work with socio-useful activity.*

Thus, B. Franklin fought for independence of American States, participated in elaboration of American Constitution. English physicist who became famous for research of thermo-phenomena Benjamin Rumford performed secret orders of Great Britain commanders, fought for independence of America, was a government official in Bavaria. Ole Rømer who was the first to measure the speed of light participated very actively in social and political life of Denmark. He invented new taxation system, when he was asked by the king he performed a series of engineering tasks, was a senator and finally became the head of State Council. Pier Laplace participated in political life and always supported the winners regardless of their views even they were rebels. Being active member of Napoleon's Jacobinic Club he was a Minister of Internal Affairs, a member of the Senate, was awarded the title of Count. In 1814 he voted for retirement of Napoleon, when the Bourbons were restored in power he got peer and a marquis titles. Such position allowed him to go on with research work actively. Another final was expecting

French chemist and physicist Antoine-Laurent Lavoisier. Being a tax-farmer Lavoisier made a big fortune part of which he spent on scientific research, but because of his participation in farmer-tax campaign why he was sentenced in 1794 a death penalty.

During World War I a Nobel Prize winner, who discovered an electron and was a teacher of many others Noble Prize winners, English physicist Joseph John Thomson was elected a member of Government Commission which was organizing scientific researches important for sea fleet. In particular, Cambridge scientists solved the problem of finding enemies' submarines. Worried with policy conducted by Nazi government of Adolf Hitler E. Rutherford in 1933 became the President of Academic Aid Council whose purpose was to help those who left Nazi Germany. The following scientists were actively fighting against fascism during World War II: P. Langevin, F. Joliot-Curie, A. Abraham, E. Cotton. But W. Gerlach-"favourite physicist" of Adolf Hitler, J. Stark-obergruppenfuhrer of SS, P. Jordan-one of the first M. Born's followers were working for Nazi. A. Einstein was always a pacifist; he never participated in creation of atom bomb. The message of "father of atom bomb" D. Oppenheimer was internationalization of atomic energy and use of it exclusively for peaceful purposes. Oppenheimer's opponent and the father of American H-bomb, E. Teller was a supporter of weapons race.

- Use of biographic method allows to find out the particularities of personal hobbies, leisure.

For example, Thomas Young participated incognito in circus, knew 9 languages, was fond of decipherment of Egyptian ideographs. George Ohm, while he was studying at Erlangen University, was the best billiardist and skate-runner of the university. Roentgen went on for alpinism and rowing, skating, sledging and hunting. The Curie couple were supporters of healthy way of life, they rode bicycles for much time. Their son-in-law Frederick Joliot-Curie was a forward of youth national football team, like Niels Bohr. P. Lebedev, I. Tamm, P. Dirac and B. Pontecorvo went on for alpinism. G.G. Thomson was fond of botany, he read a lot about flowers. R. Hook was taught by a painter and made drawings in his scientific works by himself, besides that he played organ and sang in Church choir. Christian Huygens played harpsichord, one of the founders of quantum mechanics H. Kramers played violoncello and the inventor of uncertainty principle, Werner Heisenberg, accompanied him playing piano.

A. Einstein was fond of playing music with Max Plank and Max Born. Indian physicist Chandrasekhara Raman, who won Noble Prize for discovery of combined light scattering, was fond of national music, conducted experimental and theoretic research of string instruments and Indian drums.

Physicists also were fond of writing. Alessandro Volta narrated his thoughts in regard to electric phenomena in the form of poem. H. Ørsted was the author of well-known essay "Boundaries of the poetry and prose". Creators of electro-magnetic field theory, James Maxwell, August Kundt were writing comical sketches, poems, caricatures for their contemporaries. The scientist who formulated the principle of exclusion of electronic shells filling, Wolfgang Pauli was fond of psycho-analysis and knew his founder, Carl Gustav Jung. Wolfgang Pauli wrote poems etc.

CONCLUSION

Teaching experience has shown that every section of university course can be enriched with numerous data from biography of famous scientists. Thus, the lectures convey in brief form not only main ideas of some theory but the information about historical epoch during which these discoveries were made, not only the names of the scientists but additional facts, for example, in regard to outlook position, or political situation in which the scientists worked; at practical classes the problems with the elements of historical specification are constructed and solved. At seminars more detailed reports should be prepared by students about life and work of physicists of different epochs, the generalization tables should be drawn up, students must write library research papers about famous physicists and their discoveries. Biographic data should be included by future physics teachers into their course and diploma works devoted to investigation of some physics' phenomenon, theory, law.

While collecting biographic data a student can not only learn more about physical law, discovery made by the scientist but will have an opportunity to compare and generalize scientific, historical and bibliographic facts, to re-fill his own knowledge-not only of physics, but other sciences as well. Student of physics can get acquainted with the scientist "in person", by which human vision of the world is achieved. In order to inculcate an interest in discipline the teacher must regularly and on his own study the life and contribution of prominent scientists.

Example of a scientist who devoted himself to science must be a guiding light for a teacher and through him-for students.

Inference: Thus, use of biographic method will facilitate improvement in physics teachers training:

- Firstly, it will allow to humanize disciple of physics, making the course more personality-oriented;
- Secondly, it allows to disclose the context of discovery of some physics phenomenon;
- Thirdly, it facilitates training of a future teacher of physics not only as professional but as highly-educated person as well, because it allows to broaden the world views of students, introduce diversity into the contents of physics course, to prepare creatively-working teacher.

REFERENCES

1. Arago, F., 2000. Biographies of famous astronomers, physicists, geometers. Vol. II and III. Izhevsk: Scientific and Publishing Centre "Regular and Chaotic Dynamics".
2. Bernstein, J., 2005. Max Born and the quantum theory. *American Journal of Physics*, 73: 999-1008.
3. Bleich, A.R., 2000. The story of X-Rays: From Rontgen to Isotopes. New York: Dover.
4. Quinn, S., 1995. Marie Curie: A Life. New York.
5. Clark, R.W., 1971. Einstein: The Life and Times. New York.
6. Von Laue, M., 1950. History of Physics. Academic Press.
7. Lotstsi, M., 1970. History of Physics. Moscow: Mir.
8. Khramov, Yu., 1983. Physicists: biographical reference-book. Moscow: Nauka.
9. Golin, G. and S. Filonevich, 1989. Classics of physics (from ancient times to the beginning of XX century). Reference-book. Moscow: Higher School.
10. Michael, E., 1996. The purposes and processes of biographical method. In, Scott, David (ed.) *Understanding Educational Research*. London, UK, Routledge, pp: 159-174.
11. Miller, R., 2005. Biographical research methods. Four-Volume Set. Series: SAGE Benchmarks in Social Research Methods. Date Views 11.12.2013. srmo.sagepub.com/view/the-a-z-of-social-research/n6.xml.

12. Sabirov, A.G., 2013. Specific Character and Functional Potential of Social and Humanitarian Cognition Methods. Middle-East Journal of Scientific Research, 17(3): 292-295.
13. Sabirova, F., 2010. Data on succession in science as a mean to foster the youth. Science and school, 1: 7-11.
14. Physics in the system of culture, 1996. Moscow: Philosophy institute of RAS, pp: 23.