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BAKALÁŘSKÁ PRÁCE

Téma: Analýza vysokoškolské chemické učebnice z genderového hlediska

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DECLARATION

Prohlašuji, že jsem práci vypracovala samostatně s použitím uvedené literatury a souhlasím s jejím eventuálním zveřejněním v tištěné nebo elektronické podobě.

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Prague, May 22, 2009

Alena Vosková

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Thanks

Abstract

This thesis is focused on gender in chemistry textbooks. It follows other similar researches done in different fields of science such as in sociology and physics. My work builds on the methodology of discourse analysis introduced by Norman Fairclough. After a short introduction which stresses the wider connections of the thesis, it is shown how sciences are gendered and similar researches are mentioned. On the works of classical representatives of gender studies I show examples of similar researches and their outcomes. In the methodology part I show the connection between discourse and language and I deal with the principles of discourse analysis. In the analysis part I introduce biochemistry and organic chemistry textbooks under study. In the analysis I focus on the gender representation in the textbooks, study the construction of science, the field and nature, and focus on the relationship between the author and reader and how it is constructed in the textbooks. I analyse the means of attraction for the students, such as tasks, questions and interesting narratives connected to the subject. I also focus on the illustrations, their purpose and usage. In the end the field of biochemistry and organic chemistry is introduced as a predominantly male domain with a few traces of efforts to attract women into the field.

Představení bakalářské práce

Bakalářská práce se zaměřuje na výzkum genderu v chemických učebnicích, opírá se obdobné výzkumy provedené v různých oblastech vědy, ať už sociologie, či fyziky. Vychází z metody diskursivní analýzy, která je představena především Normanem Faircloughem. Po krátkém zasazení práce do širšího kontextu této problematiky, se první část zaměřuje na oblast vědy a nato, jak je spojena s genderem. Na příkladech prací klasických představitelů genderových studií (Sharon Traweek, Emily Martin, Alison Jaggar, Evelyn Fox Keller, Carolyn Merchant, Susan Hodgson) ukazuji, jak je věda od svého počátku maskulinní. Představuji několik výzkumů, které jsou stejně jako tato práce zaměřeny na vyhledávání genderu ve školních učebnicích. V metodologické části se zabývám s problematikou diskursivní analýzy a jejími principy, které jsou pak využity v samotné analýze. Další části nabízí nahlédnutí do akademických učebnic biochemie a organické chemie, jejichž některé části jsou zkoumány z genderového hlediska. Pozornost zaměřuji na výskyt genderu, například v typech oslovení čtenáře, v používání generově rozlišujících zájmen, atd. Dále se zabývám utvářením oblasti vědy, chemie a přírody, zkoumáním postavení autora a čtenáře, jakož i prostředky pro upoutání pozornosti, ať už se jedná o zajímavosti spojené s daným tématem, nebo o otázky a úkoly k dané kapitole. Studuji i typy a využití ilustrací a nakonec představuji učebnice a oblast biochemie a organické chemie prioritně jako mužskou doménu, i když s nevýraznými prvky snahy o přiblížení tohoto odvětví ženám.

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"The world cannot afford the loss
of the talents of half its people
if we are to solve the many
problems which beset us."
Rosalyn Yalow, Nobel prize Laureate
(for medicine and physiology) 1977

1. INTRODUCTION

Since the 1990s there are organizations in North America, Australia and within the European Union that are concerned about the continuing under-representation of women and girls in science, technology, engineering and mathematics (STEM disciplines). The organizations are aware that this inequality should be explored and then overrun. The Institutions like The National Science Foundation (NSF)[1], The American Association of University Women Educational Foundation (AAUW)[2], The American Chemical Society, The Helsinki Group[3] under The European Commission, UNESCO[4], and some individual universities, for example the Ira A. Fulton School of Engineering at Arizona State University[5], have been very progressive and proactive about this issue; in the Czech Republic there is an institution called Women and Science that also fund programs with this concern but on the government level there are only minor and superficial concerns about this issue.

All these institutions support programs and researches focused on women in sciences. The programmes and projects target many areas that are connected with this issue, for example the problem of women leaving the field of science after their graduation and the fact that they do not

[1] www.nsf.gov
[2] www.aauw.org
[3] http://ec.europa.eu/research/science-society/index.cfm?fuseaction=public.topic&id=281&groupid=2
[4] http://portal.unesco.org/education/en
[5] http://www.fulton.asu.edu/fulton/departments/cedar/wise.php

choose the science field as a career at all. For example Cathy Foley in her presentation on the Conference: Changing the Research Landscapes: 10 Years of Women and Science (2009) states that according to her research (Girls to Scientists: What makes some girls take on the challenge while others don't? On Australian Institute of Physics) girls are interested in variety fields of science like boys but they drop off, loose their interest or do not use their education in career. (Foley, 2009) On the two scissor graphs added in the attachments (5, 4) I show how the loss of interest by girls is represented in the scientific field according to the grade.

Part of my thesis is interested in the curriculum reforms, so further on I am going to introduce two programmes focused on pedagogy and curriculum changes. According to AAUW girls and women lose their interests in sciences between the age 10 to 18 (McGowan, 1999, 547) so the educational factor, especially the approaches of teachers and textbooks are considered important within the decision of further study and career of girls and women. In the statistics materials (see attachment 6) from the most areas of sciences it is clearly visible that women are underrepresented at school and after it.

Women remain a minority among researchers in the EU (29% in 2003, which is slight increase from 27% in 1999)[6] in the post-communistic countries the problem with underrepresentation of women in science is slightly bigger than in the rest of Europe. However between the years 1999-2003 the rates of women's PhDs graduates grew by 21% and of men by 15% in the Czech Republic. On the other hand in the United States there was growth by women to 3% but a loss by men to 2%. In the whole EU the increase of women's PhDs was 7% and of men 2%. For further statistics see the attached materials (see attachment 1-4).

[6] http://ec.europa.eu/research/science-society/pdf/she_figures_2006_en.pdf

As an example of programmes focusing the curriculum changes and the reform of teaching styles I name two projects. First is the **Program for Gender Equity in Science, Mathematics, Engineering and Technology**[7] This programme, sponsored by NSF, started in 2001. It seeks to broaden the participation of girls and young women in all fields of science, mathematics, engineering and technology (STEM) education by supporting research, demonstration, and dissemination projects that will lead to change in education policy and practice. Its typical projects investigate gender-related differences in learning; gender-related differences in educational experience, interest, and performance; and pedagogical approaches and teaching styles that are not gender biased or that are encouraging to female students. During the years 1993-2001 this project has supported more than 250 curriculum innovations.

Another example of a programme creating a different approach to teaching is the programme **ChemCom: Chemistry in the Community** (Schwartz, 2006) sponsored by American Chemical Society (ACS) and by (NSF), which started in 1991. The goal of this program was to create an Ideal Curriculum for Science, especially for chemical textbook. The outcome of this program was a secondary school text which uses the new pedagogical strategy – student-centred and context-based approach – and is focused on the connections of chemistry to the real-world social problems. The textbook was first published in 1988 and the fifth edition was issued in 2005. The research focused on the approach of the students to chemistry "*as a topic of study, a necessary components of modern society and a factor in their daily lives*" (Schwartz, 2006, 989) showed that the course resulted in significant changes in attitude towards chemistry and its importance.

According to all the institutions participating on the exploring of the science fields from gender perspective, there is deep inequality. The

[7] http://www.nsf.gov/pubs/2002/nsf02107/nsf02107.pdf

under-representation of women and girls both at schools focused on science and on the work markets in science areas is worth researching. The main question of my thesis is: How are chemistry textbooks gendered? Questions supporting this main question are: Does gender influence scientific textbooks? How are biochemistry and organic chemistry textbooks gendered? How are the readers addressed? What kind of imagery is used? How are the studied field, nature and science constructed? What are the pedagogical approaches of the textbooks as a study tool? Are there the teaching styles, described in the programmes above, used, and how?

In the first part of my thesis I will look how the feminist scholars describe gender and how it is presented in science and scientific textbooks. For the thesis I use the methods of discourse analysis, which is described in the second part. The third part focuses on the analysis itself. I will analyse several textbooks of Biochemistry and Organic chemistry. From the textbooks I will analyse the prefaces, introductory parts and acknowledgments and also a chapter on proteins from one book from each field.

2. GENDER IN SCIENTIFIC TEXTS

After the introduction where I have showed how important is the situation of women in science considered by European Union, United States and institutions all over the world, where they fund and support programmes and projects that research and try to improve the situation of women and girls at schools and work-markets, I am going to introduce the field of science and scientific texts from gender perspective.

2.1. Science and gender

In most societies gender is *an organisational principle of society.* (Smetáčková, 2005) – it makes the social life easier; however it gives limits to individualism. It means that some groups of people are on gender principles (combined with some others: race, age, and sexual orientation) advantaged or disadvantaged. Marcela Linková (Linková, 2007) writes that all men have profit from this kind of system especially symbolically – higher confidence, reputation, status, economy and political influence; however women are disadvantaged – there exists "the glass ceiling" (an invisible barrier that limits women's career).[8] Gender as a term usually refers to differences between men and women, not only as biological beings but as social beings. Some people say that gender is *socially constructed* (Smetáčková, 2005). "Gender divides humans into two categories: male and female. It is a system which organises virtually every realm of our lives; whether we are sleeping, eating, watching TV, shopping or reading, gender is at work.... It operates as a set of hierarchically arranged roles in modern society which makes the masculine half the equation positive and the feminine negative." (Cranny-Francis et al., 2003: 1-4)

In the Encyclopaedia of Women and Gender (Worell, 2001) gender is defined as the psychological, social and cultural feature and

[8] (Linková, 2007); also in: (Smetáčková, 2005)

characteristics "that have become strongly associated with the biological categories of female and male. Gender can become manifest in a culture as essential sex differences, as ways to organize women and men via laws and implicit policies, as the language and discourse to describe what's normative for women and men and as interpersonal processes reproducing that society's meaning of what it means to be a woman or a man". But it is very important to distinguish between sex and gender. "Sex denotes a set of structural physiological characteristics related to reproduction and divides animal species (including humans) into female and male. Gender is specific to humans. "Gender is a social category used by most societies as a basis for socialization and social status" (Worell, 2001, word: gender).

Our world is divided in social dichotomies – public and private, masculine and feminine, objective and subjective, power and love.(Keller, 1985) And because we belong into the society which is influenced by the dichotomies that are very persuasive, we also surrender to some kind of dichotomies, made by the society, so according to the expectations of the society men should be – strong, dominant, rational, and active, they should have strong ambitions, and they should be more the provider and protector of the family. (Keller, 1985) On the other hand women should be *attractive, emotional, and passive, they should care about the family.* (Smetáčková, 2005) From this point of view it is clear, that the private life and home is more connected with women and the social and public life with men. Some other differences have been described by Becky Francis and Christine Skelton (2001). According to them the "*differences between masculinity and femininity have its roots in Enlightenment thought – hard vs. soft*[9]*, activity vs. passivity, reason vs. emotion, transcendence vs.*

[9] In Wendy Faulkner (2000) '25(1): 87-119? - We can find the distinction between "*soft*" and "*hard*" technology – hard technology means big complicated machines and soft machines are the small one (for example kitchen apparatuses).

embodiment". But those differences - the world divided in two (dualism) – have been introduced as early as 4th century BC in Greece by Aristotle who sets one series of nouns against another, sorting them into opposites – "*on the one side are terms such as Limit, Odd, One, Right,* ***Male****, Resting, Straight, Light, Good, Square; on the other side, Unlimited, Even, Plurality, Left,* ***Female****, Moving, Curved, Darkness, Bad, Oblong.*" (Cranny-Francis et al., 2003, 48 – highlighted words by me)

From the antiquity, nature was gendered as female and "she" was connected with women. It was personified as a female being. She was either a "*nurturing mother*" (Merchant 1980, xvii), who offered all needs of human beings but she was also a wild and uncontrollable, making storms, draught and general chaos. Women and nature were on lower stage than culture, art and sciences, which have been traditionally associated historically and symbolically with men. *So women and nature should be subdued to men and be kept in their places*. (Merchant 1980, xvii) According to Carolyn Merchant (1980), who studies the interconnections between women and nature, "*women and nature need to be liberated from the anthropomorphic and stereotypic labels that degrade the serious underlying issues*". (Merchant 1980, xvii).

There have been ideas of improvement of the women's social status in various historical times, but the recording of those is very brief, for women have never written the history (they did not write the historical texts and they were not the subject of those texts). As far as 19th century women found some support in the democracy and enlightenment ideas. Some women associations have been founded – The American Association of University Women.

Science, as well as gender, is a socially constructed category (Keller, 1985) and there is continued perception that scientists are male. Modern sciences came into existence in 17th century, with Bacon and other great scientists and philosophers. These new sciences separated from

philosophy and religion and started to emphasise more on experiments. Since their beginning women were excluded from the new science (they were doing the alchemy, which believed in the equality between men and women given by God). New science in this period is connected with the accusations of witchcraft and with the publicly spread fear of women and their alleged powers. The powers of women were allegedly driven by their sexuality. According to new scientists women were dangerous and the new science promised protection from this danger. The witchcraft persecutions in 17th century and the stories "The white devil", "Antony and Cleopatra " were all connecting women's sexuality with political and social disorder. New science was thus established as a power against women so it is clear that there were no place for them.

Francis Bacon contributed close association between scientific knowledge and power, and he identified the aims of science as the control and domination of nature. According to him the science leads to the sovereignty, dominion, and mastery of man over nature (he talks about *raping* and *conquering* nature.) (Keller, 1985, chapter 2) For example Bacon used very sexist language within his scientific ideas – when talking about nature, he used words as: rape, torture and conquer - in the birth of modern science in 17th century he saw "*the birth of masculine time*" and, "*Men should without hesitation penetrate into all openings of the nature…"* (Pavlík 2005: 32-38)

The new science was successful until the two world wars, where the scientists used science for political and ideological benefit – racism based on biological differences, experiments done on humans, creating of atomic bomb, etc. After disillusion from these events the look at the scientists changed. They were reconsidered as men or women with their prejudices, experience and their usage of historical theories and language, which were burdened by historical connotations, e.g.: "*the failure of the idea of science as neutral and unprejudiced*" (Pavlík 2005 in:

Smetáčková, Vlková 2005, chapter Gender a věda). Because science is created by scientists and the scientists are created within the socialization (in the society or even in the scientific community) it cannot be impersonal, but it is deeply a personal as well as social activity, and cannot be neutral. (Keller 1985, 37; Pavlík, 2005) Every scientist does the research with some hypothesis and expectations and if it is not done with some kind of emotion it would be boring and not possible, the emotions are driven by the justification of getting the research to the end. The scientists are not able to be neutral if they were neutral, they would probably never invent or develop anything.

Some people think that it would be good for sciences if women bring some of their different seeing of the world into the sciences. Alison Jaggar (1992) in her essay wants to find out whether emotions can be at least helpful or whether they are necessary for gaining knowledge. She is showing us that emotions are part of our lives and we cannot get rid of them; every our move is influenced by them – every experiment, observation, and work is influenced by our emotions. Some people, especially men, want to despise them, but emotions cannot be ignored. And moreover "*lack of awareness of emotions certainly does not mean that emotions are not present subconsciously or that subterranean emotions do not exert a continuing influence on people's articulated values and observations, thoughts and actions*." (Jaggar 1992, 152) Emotions create values; if we like something we appreciate that, if we are interested in something, we are trying to find out more. Every our move, every experiment, every invention in science or elsewhere was done because of emotions.

2.2. Gender in scientific textbooks

Our knowledge is gained by education and experience. But it would be impossible to try to repeat all experiments made by all the scientists

before us, so we must rely on their work and learn all from books. A textbook could be called a manual of instruction or a standard book in any branch of study. They are produced according to and for the demand of educational institutions. Their history reaches to the ancient Greece, where they were written specifically for educational purposes. The modern textbook has its roots in the standardization made possible by the printing press and its designer Johann Gutenberg in mid 15th century (Wikipedia)[10], the book by Mikoláš Koperník titled *De Revolutionibus orbium coelesticum libri VI* (Six books about the circling of sky spheres) is considered as the first scientific book.

Textbooks have become the primary teaching instrument for most children since the 19th century. Textbook as a study tool has great influence on the reader, who is positioned a consumer of facts. Potter and Rosser (Elgar, 2004) who examined life science textbooks for factors that might deter girls' interest in science (what pictures and images the authors use, in what situations are women and men depicted in the pictures, how is the reader addressed, using of gender inclusive language and on the other hand using male addressing meaning also women), consider that *"because the textbook is a major factor that influences the teaching of science, it stands as an important element that may aid in attracting girls to or deterring them from studying science*" (Elgar, 2004: 879). Moreover, as Macaulay and Brice write in their study of syntax textbooks, "*seemingly trivial things like example sentences can contribute to a hostile environment… for women*" (Elgar, 2004: 479).

Women in the 18th and 19th century should take care of house and were not to be educated, but first chemistry textbooks for women in France brought some difference, even they were not so different from co called popular science books, describes Natalie Pigeard (2000). She stresses that in this (18-19th century) period women started to be

[10] http://en.wikipedia.org/wiki/Textbook

educated from the same books as men, however these men were uneducated workers. The authors of these popular rather than scientific books (written for workers, women and children) were struggling with the difficulties with style of such books, contents and with the amount of science terms, definitions and experiments – "*popular books have to transform textbook knowledge into everyday terms*." (Orland 2000, 343) They usually include chapters on "*nutrition and food, detergents, colouring and bleaching agents as well as heating and lighting*". (Orland 2000, 343)

Gender in these textbooks is visible in the simplification and reduction which was degradation to all women that wanted to learn something more. These textbooks were written not only for women but also for children so it seems that the author put women on the same level with curious children who wanted to do some experiments, but still they were encouraging women to do experiments, creating their scientific mind. Now there are no textbooks directed only at women, or at least not on the academic level.

There have been made analyses of textbooks with different specializations – in sciences, on textbooks for children and other texts. For example the Emily Martin (1999) is studying biological textbooks from gender perspective and writes that it is certain that "*culture shapes how biological scientists describe what they discover about the natural world*". (Martin, 1999) She claims that most biology texts show the reader just one-sided look at human reproductive organs and the processes in human body. The major textbooks describe the menstruation as "debris" (waste, product of no use). Many textbooks call the menstruation "*ceasing, dying, losing, expelling*" (Martin 1999). But the description of male productive organs is quite different, the authors are enthusiastic about the quantity of sperms that a man can produce – "*Whereas the female sheds only a single gamete each month, the*

seminiferous tubules produce hundreds of millions of sperm each day"[11] The texts imply that the process of making sperms is "remarkable" and it involves something that menstruation does not: production of something deemed valuable. (Martin, 1999)

Another example of a textual analysis from gender perspective could be bachelor work by Karolína Kuncová (2004). She made a textual analysis on sex education for primary schools. She focused on explicit and implicit messages, incoherency, neglected themes, stereotypical connotations and the whole atmosphere of the textbook. She found out that some themes (for example gynaecology) are according the authors important only for one sex – girls, and the sexuality of girls is more problematised than the one of boys, there are gender stereotypes of women and men described both in pictures and main text – like girls cry more than boys, girls start with sex earlier because they find older boyfriends who force them to it etc. All these stereotypes are transferred on the reader and are taken as granted because they are in the textbook. (Kuncová 2004) Ann Elgar (Elgar, 2004) did also a study of scientific sociology textbooks, she studied the textbooks from gender perspective; she focused on drawings and photos depicting men and women, and also on the language use. She found that images of men overwhelm the images of women, who are mostly presented in just female topics – pregnancy, childcare etc. The gender inclusive language is used rarely and there are cases when grammatically male form is used on both sexes. (Elgar, 2004)

But there are more research works done on scientific engineering books. For example Susan Hodgson (2006), who studies scientific textbooks, focuses on the influence of the textbooks on the establishing of science community. She refers to increasing narratives in the textbooks, as this phenomenon is according to her a means for recruiting

[11] From the classic text Medical Physiology edited by Vernon Mountcastle in: (Martin 1999)

new students who would follow the story line given in the textbook. "*In this sense the pedagogic texts are political* – they are never outside of the socio-historical conditions of production. Furthermore, no text ever simply 'displays', and through close reading, and through discursive approach to texts, one can begin to excavate the worldview of a community and the taken-for-granted assumptions that it holds." (Hodgson 2006, 178) She analysed sample texts and she concluded that from the narratives (interest readings, stories told in the textbooks, biographies, etc.) the students learn the principles inside the community, they follow the storyline and adapt to the conditions. One phenomenon was clear all along the texts – there were no women. The told stories were male from the beginning to the end and women were "*absent in the sense of not existing within any frame of community consideration*". (Hodgson 2006, 184)

This thought of connection between establishing communities and their texts in physics is also shared by Sharon Traweek (1992). She was observing the life, study and work conditions of young particle physicists in America and the influence of textbooks. The stories told both in the textbooks and in classrooms about the heroes of this scientific field which shows the students the continuity of their study field (using adverbial phrases – then, today, to date…) and their own insignificance. The students believe that the membership in scientific community is solely determined by scientific merit, so the competitiveness among young scientists is considered as just and effective. According to all these stories the scientists are persistent, dominant and aggressive, ultimately penetrating secrets mysteriously concealed by a passive, albeit elusive nature. "*The female exist in these stories only as an object for a man to love, unveil, and know*". (Traweek 1992, 103) She does not claim that women are not able to reach the science community, but she shows us

that the characteristic of a successful member of this community is culturally considered to be male.

Changing of approach to women inside the scientific community is crucial for the future engagement of women in sciences. Women are discouraged by the stories in the textbooks. The changes in the curriculum that are parts of the projects and programmes mentioned in the introduction should encourage women to study sciences and to be interested in them and what is most important to be then accepted in the scientific communities. That is why analysing the textbooks is so important. Analyses of textbooks revealed many problematic passages, which discriminate or teach readers something obsolete, some stereotypic opinions and views of the world, society, men, and women. But there has been done few researches on the academic ground and especially in the field of natural sciences. That's why I am analysing the chemistry field.

3. METHODOLOGY

I was working with Discourse analysis (DA[12]) as understood and explained by Fairclough (1989, 1992, 1995, 2003); I have chosen Discourse analysis, because it is used for textual analysis and it reveals the layers of the actual text and then it analyses and interprets it from different points of view. My thesis view in this case is gender in the textbooks.

3.1. Language as discourse

On the turn of 19th and 20th century the linguist Ferdinand de Saussure came with a new thought that signs derive meaning from their relation to other signs (contrasted to what was believed earlier that words are just simple and transparent medium to reality). In contrast to Saussure, Ludwig Wittgenstein came in the same time with another conception – that the meaning of a word largely derives form its use and so the meaning of the words is not fixed. In this period the language was reconsidered and it "*has become recognised as the primary medium through which social interaction takes place*" (Silverman 1993, 115).

Discourse in linguistics refers to extended samples of either spoken or written language, it emphasises interaction between speaker and addressee or between writer and reader. Discourse is also used for different types of language used in different sorts of social situation – newspaper discourse, classroom discourse, textbook discourse. However the term discourse is used in wider sense in social theory and analysis, for example in the work of Michel Foucault, to refer to different ways of structuring areas of knowledge and social practice. (Fairclough, 1992, 2003) But language is not shaped by the individual but by the society, it varies according to the relationship between participants in the interaction, according to the social event, situation or the social goals

[12] See mainly Fairclough (1989,1992, 1995, 2003)

which the participants follow, etc. "*Today individuals working in variety of disciplines*" recognise that language use is linked to "*wider social and cultural processes*" and so they begin to use textual analysis as a method for studying social change. (Fairclough, 1992:1)

Fairclough (1992), with using the term discourse and discourse analysis, focuses upon language; he is trying to create the analysis method that would be more focused on linguistic aspects of the texts (TODA – textual oriented discourse analysis). He regards text as one dimension of discourse: the written or spoken product of the process of text production. Fairclough regards the language use as a form of social practice, rather than a purely individual activity of a reflex of situational variables, discourse is a mode of action, one form in which people may act upon the world and especially upon each other, it is also a mode of representation. Discourse is a way of representing aspects of the world – the processes, relations, and structures of the material world, the 'mental world' of thoughts, feelings, beliefs and so forth, and the social world. Different discourses (for example discourse of love, work, family…) are different perspectives on the world, which in turn depends on their positions in the world, their social and personal identities, and the social relationships in which they stand to other people. (Fairclough, 2003, 1992).

The discourses operate through the texts and create the meaning of it. Banister et al. (1994: 94) gives the examples of two single discourses in three different phrases – the medical discourse operates in the phrase: "*my head hurts so I must be ill*" and sexist discourse operates in the phrase: "*my head hurts but not in the way that yours does when you are trying it on [pretending it] in the way women do [when they do not want sex]*". Fairclough (2003) gives the examples of the implicit meanings of grammatical features of the text. For instance the nominalization and passive clauses have one simple consequence – the agents of processes

(people who initiate the process) are absent from the text like in the sentence "*The modern world is swept by change.*" The word change is nominalised and the whole sentence is also a passive clause which helps the writer to hide the initiator, the agent.

Discourse is constituted by social structure but it is also constitutive – it contributes to the constitution of all dimensions of social structure – social identities, subject positions of social subjects and types of social self. It also helps to constitute the relationships between people and yet it contributes to constitution of system of knowledge and belief. For example "*…when we talk to each other, we are engaged in a discourse of communication or in a discourse of talking."* (Lemke, 1995: 10-11)

Discourse is used in a more narrow sense for language as an element of social life which is dialectically related to other elements, because "*It is discourses that form the objects of which they speak…*" (Banister et al., 1994: 100) Texts as elements of social events have causal effects – they are able to "*bring changes*" (Fairclough, 2003: 8) in our knowledge, beliefs, attitudes and values. It is because the meaning of the text does not emerge only from what is explicit but also from what is implicit (or rather we must reveal it). The implicit could be revealed by our interpretation, which is partly an aspect of understanding what words or sentences or longer parts of texts mean, but it is also partly a matter of judgement and evaluation. Potter and Wetherell use discourse analysis in the study of social psychology and they are focusing on the change in meanings –"*that what a person says does not remain consistent from one occasion to another, but varies according to the functions of talk...*" (Fairclough, 1992:20)

The systematic analysis of texts, the revealing the hidden message in the texts, (spoken or written), could display the system used for oppression and disadvantaging individuals or specific group of people, for example women.

3.2. Discourse analysis

Discourse analysis analyses our social environment, relationships, and our behaviour (whether in talking or in writing). But even when DA focuses on social events, the materials to observe are always words. Discourse analysis deals with documents that are defined by Hendl (2005: 132) as "*everything written or just recorded*". DA is also suitable because it is widely used in feminist research – as Reinharz (1992) states the interpretative content analysis is used in feminist research for analysing the "*cultural artifacts and documents*" (Reinharz, 1992: 150) so it is applied on analysis of women's magazines, letters, newspaper columns, even on photographs and movies, and on historical texts.

Fairclough (1995) gives other reasons for the usage of Discourse analysis in social research (theoretical, historical, methodological and political reasons) but, according to him, the most important is the fact that the language is widely misperceived as transparent, the social analysts are not aware of the social and ideological work of language, and this characteristic of the text could be revealed and interpreted with discourse analysis. Discourse analysis is focused on language functions, relations between the language and power (van Dijk 1993) and gaining knowledge, yet it is not only concerned with power relations in discourse but also with how power relations and power struggle shape and transform the discourse practises of society or institution. DA could be mainly concerned with textual analysis in case it studies the explicit and implicit formulations, intertextuality of the studied text, position of the authors and the audience and also pictures if they are part of it. "*Texts are analysed in terms of a diverse range of features of form and meaning appertaining to both the ideational and interpersonal functions of language.*" (Fairclough, 1992:36) Discourse analysis is interpretative. It studies the meanings of words that are not explicit, because according to

Susan Speer (2005), the meanings of the words are fluid not fixed. The linguistic meanings are socially constructed, contextually variable and continually subject to negotiation and modification in interaction – "*thus, in order to understand what an utterance is doing, we need to analyse the local contextual and sequential environment in which it is situated.*" (Speer 2005, 23)

According to Fairclough (1992) discourse analysis could be organized under four main headings: vocabulary (how individual words relate to other individual words), grammar (under this heading it deals with words combined to sentences), cohesion (studies how the sentences are linked together) and text structure (deals with larger text as a whole). In DA Fairclough (2003: 36-37) considers also the "external" and "internal" analysis. Whereas the analysis of the external relations of the text includes the analysis of their relations with other elements of social events and with social practices and social structures; the analysis of internal relation of the text includes:

1) Semantic relations – it seeks for meaning relations between words and longer expressions, between elements of clauses, between clauses and between sentences and over larger stretches of text (Allan 2001, Lyons 1997);

2) Vocabulary (or 'lexical') relations – the analysis observe the relations of collocations, i.e. patterns of co-occurrence between items of vocabulary (words of expressions). For example, 'work' collocates with 'into' and 'back to' more than with 'out of' in the texts of Blair's 'new Labour' party in the UK, whereas in earlier Labour texts the patterns was reversed – 'into work', 'back to work', 'out of work' (Fairclough 2000b, Firth 1957, Sinclair 1991, Stubs 1996);

Yet deeper insight in the text offers again Fairclough (1989), who emphasises the description, interpretation, and explanation, and he formulates the questions to be asked when doing the Discourse analysis:

1) What experiential values do words have? – Discourse analysis seeks for ideologically burdened words, rewording, and overwording; it also focuses on the meaning relations between words (synonyms, hyponyms, and antonyms), formal or informal words or euphemisms, and metaphors;

2) What experiential values do grammatical features have? – DA observes the unclear agency, nominalization, active or passive sentences, positive or negative; it should reveal which modes (declarative, questions, imperative), modality, distinction between you and we.., connection of the clauses are in the text used;

Fairclough also provides some clues of what aspects of the text could mean. For example the overwording shows preoccupation with some aspect of reality, which may indicate that it is a focus of ideological struggle. (Fairclough, 1989: 115) Another example is from using metaphors which are means of representing one aspect of experience in terms of another – on an example from the newspapers – "*riots spread as cancer*" (but different use of metaphor needs different ways of dealing – riot can be negotiated, but cancer must be eliminated). (Fairclough, 1989: 120). For example a simple choice of words helps to create a social relationship between participants (formal situation needs formality of social relation and vocabulary). (Fairclough, 1989: 118) Usage of types of clauses can change the meaning of the sentences, it must be considered whether there are responsible agents for some event or if they are hidden behind the clause (passive sentence). (Fairclough 1989, 124). Also the pronouns that can have some relational value are important to observe

and interpret. For example the co-called 'inclusive' *we* (inclusive for the speaker or writer and the reader), or 'exclusive' *we* which means without the reader; or the usage of more "familiar" *you* which directly address the probably unknown audience. (Fairclough 1989)

In my analysis I will follow the example of Fairclough. I have explored some main headings under which I observed and interpreted the repeating phenomena of using some kinds of words, type of addressing reader, the way in which the writers constructed the field, nature and sciences, and the pedagogical approach of the writers to the readers/students.

3.3. Selection of textbooks for discourse analysis

In order to explore the questions of the thesis introduced in the introduction I have selected textbooks from two chemistry specializations – Biochemistry and Organic chemistry to see whether there are any differences in different fields. The academic textbooks are more specified than textbooks on lower stages; it is because they should go deeper in the subject. There are textbooks on the whole chemistry (general chemistry textbooks), but because they need to touch every field of chemistry, they explain each field only superficially. I chose biochemistry, which studies the life, the processes of life, structure of living organisms, function of cells, chemical reactions in the body etc. Goals of biochemistry can be narrowed to description and explanation of the processes in living organisms and then applying this description on other disciplines as pharmacology, nutrition, medicine and agriculture. (MkKee, 1999) On the other hand organic chemistry studies chemical compounds that are based on carbon and other elements that are formed in living organisms. (Boxer, 1997) Both these fields study living organisms; biochemistry studies their structure and functions and

organic chemistry studies how organisms are created. Both fields are important parts of the curriculum of all future chemists.

I have visited four specialized libraries in Prague – The Institute of Chemical Technology in Prague, Carolinum (The Technical Library), The Institute of Organic Chemistry and Biochemistry in Prague, and the Library of the Faculty of Science (the department of Organic chemistry).

On the shelves in the libraries is a great range of different textbooks with focus on this field. There are different editions from one textbook, different amount of textbooks from the same author, title, and edition. The vast majority textbooks were in English. I spoke to the students of chemistry and also to the librarians who are acquainted with the frequency of borrowed textbooks and they have listed the most used books, which I have included in my selection. From the initial range of 50 textbooks that were available (during the period of my study) on the shelves in the libraries I have chosen 14 which were not published earlier than in 1977, and I have chosen only one edition (the most current). I have chosen 7 textbooks on biochemistry. From organic chemistry field I have chosen also 7 textbooks.

4. TEXTUAL ANALYSIS OF BIOCHEMSITRY AND ORGANIC CHEMISTRY TEXTBOOKS

This chapter explores the introductory parts of all selected textbooks and one chapter from both the biochemistry and organic chemistry textbook. First all selected textbooks will be introduced, then I will analyse all the prefaces, introductory parts, acknowledgements and paragraphs about the authors (if included), and one chapter from one book from each field.

In the analysis I explored pedagogical aspects of the texts, i.e. how the authors address the reader, how they construct the reader and what means of assistance they provide, how they talk about themselves and about their work. I focused on how the authors talk about the field and how they construct and legitimise the subject of their book, how they construct and talk about nature and society, and how they construct and transfer knowledge. I was also interested in how they talk about the production of the textbook, for example the ways in which they acknowledge their assistants, colleagues and others who participated in their book. And finally I observed the kinds of imagery used in the textbooks.

For the unifying of the analysis I have separated different aspects of the texts under few blocks. Those are: Introduction of the textbooks; Textbook as a study-tool; Construction of the scientific field; Textbooks' imagery; and Male face of science.

4.1. Introduction of the textbooks

Because some of the textbook have got the same title, or the titles are too long, or they have the same author, I will refer to these texts by the following abbreviations.

4.1.1 Biochemistry

Biochemistry, An Introduction – Trudy McKnee, James R. McKnee (McKee, 1999, **BI**) – **McKeeBI**

Principles of Biochemistry – Geoffrey L. Zubay, William W. Parson, Dennis E.Wance (Zubay, 1995, **PB**) – **ZubayPB**

Biochemistry – Donald Voet, Judith Voet (Voet, 2004, **B**) – **VoetB**

Biochemistry – Lubert Stryer (Stryer, 2006, **B**) – **StryerB**

Biochemistry, Chemical Reactions of Living Cells – David E. Metzler (Metzler, 2001, **BCHR**) – **MetzlerBCHR**

Molecular Biology of the Cell – Bruce Alberts, et al (Alberts, 2002, **MB**) – **AlbertsMB**

Textbook of Biochemistry with Clinical Correlations – Thomas M. Devlin (Devlin, 2002, **BCC**) – **DevlinBCC**

4.1.2 Organic chemistry

Organic Chemistry of Biological Pathways – John E. McMurry, Tagh P. Begley (McMurry, 2004, **OCHBP**) – **McMurryOCHBP**

Organic Chemistry a Modern Perspective – David E. Lewis (Lewis, 1996, **OCHMP**) – **LewisOCHMP**

Organic Chemistry – Jonathan Clayden, Nick Greeves, Stuart Warren, Peter Worthers (Clayden, 2001, **OCH**) – **ClaydenOCH**

Organic Chemistry – John E. McMurry (McMurry, 2004, **OCH**) – **McMurryOCH**

Organic Chemistry – Douglas C. Neckers, Michael, P. Doyle (Neckers, 1977, **OCH**) – **NeckersOCH**

Essentials of Organic Chemistry – Robert Boxer (Boxer, 1997, **EOCH**) – **BoxerEOCH**

Organic Chemistry Structure and Function – Peter C. Vollhardt, Neil E. Schore (Vollhardt, 2007, **OCHSF**) – **VollhardtOCHSF**

They are textbooks with specified titles, some meant for lower stage audience (**BoxerEOCH**) and some focused on specialized part of the field (**DevlinBCC**). Textbooks from both fields are intended for students of chemical courses and for the course tutors. According to the titles of the books, there are textbooks for lower level – for example: *Principles of Biochemistry* (**ZubayPB**) and *Essentials of Organic Chemistry* (**BoxerEOCH**) which are not intended for the advanced audience. On the other hand there are more difficult textbooks intended for higher educational levels. The authors of **McMurryOCHBP** "assume" that readers of their book have some background in organic chemistry which would be needed to follow their reasoning. In the first sentence to the preface they are telling the readers that the book is not a comprehensive biochemistry book, but it is "*written for an audience of advanced undergraduates and graduate students in all areas of bioorganic and biological chemistry*" (**McMurryOCHBP**, xxvii). Students who like to be challenged could be addressed by this, but those not so sure of their sufficient knowledge could be discouraged. The authors of **ZubayPB** chose to write a less detailed textbook meant for "*middle*" level audience – according to the title of the book it is intended for the beginners in the field and it provides the basic information.

It is difficult to decide which title of a textbook is better, if having an easy, short and clear title, or one specifying the function of the textbook, its focuses and sometimes the targeted audience. By the specifications students could think that something is missing in the textbook that it is too narrow, and that the book is not focusing on the whole field. On the other hand with the not specified title, the textbooks are not to be easily differentiated and must be known rather under its author. And some courses need specified textbooks because they claim to go deeper in some part of the field, as it is for example in **DevlinBCC**.

The structure of all the textbooks is very similar. Almost all the textbooks have interesting, colourful cover page (the example of **BoxerEOCH** cover page is the attachment 1). The average length of a textbook is around 800 pages, but there are some exceptions. The thickest textbook is "Molecular Biology of the Cell" (Alberts, 2002) with its 1600 pages. All textbooks have content tables; some have also the brief content table and extended tables of contents. The sorting of chapters varies only a little, it also depends on the focus of the textbook, but all books go through the field from general easy topics (that are to introduce the field and explain the basics) to the most important and more demanding topics. For example the chapter on proteins appears in all biochemistry textbooks in the middle of the textbooks, and it is quite long, on the contrary protein chapter in organic chemistry textbooks is always given in the end, very often together with other topics, and it is, compared to biochemistry, very short. On the other hand the structure of this chapter is in both fields the same, always there is introduction about proteins, then a part on amino acids, then an explanation of peptides and in the end there is a part on proteins. All textbooks use also graphical supplements – figures, graphs, boxes, pictures, colour coding etc. Some textbooks are focused on more figures than text (**BoxerEOCH**, **ClaydenOCH**, **ZubayPB**) some give the same space to text and figures, and some textbooks prefer the textual description (**MetzlerBCHR**, **McKeeBI**). In some textbooks (**MetzlerBCHR**, **DevlinBCC**) we can find micrographs of viruses, and cells. In all textbooks the structural formulas (see attachment 2) outweigh other types of figures. Almost all textbooks have some kind of interesting information, often given in specialized boxes, or on the side of the main text. This special reading very often includes the references on famous chemists, for example in: **McMurryOCH**, **ZubayPB**, **MetzlerBCHR**, **BoxerEOCH**, and **McKeeBI**. All textbooks were written and published in the USA.

Introduction of selected chapters

In the sections on chapters I explore how the textbooks under study describe and explain molecules that are significant in human body or in nature (in case of the organic chemistry textbook). I will take as an example textbook chapters on proteins and to compare the field I will explore proteins in both biochemistry and organic chemistry.

In both textbooks the chapter on proteins is together with amino acids and peptides. In **McKeeBI** the chapter on proteins is placed as the fifth chapter which has forty pages, the chapter is divided in three parts – amino acids, peptides and proteins. In this textbook the proteins are discussed also in the 6th chapter, which is about enzymes, which form a large and important group of proteins, and also in chapter 16 which discusses the protein synthesis. In **BoxerEOCH** textbook proteins are explained in the 28th chapter called Amino acids and Proteins along with Amino acids and peptides. The chapter is 26 pages long, it is clear that there is much less space given to proteins than it is given to them in the biochemistry. In both textbooks the proteins are depicted as essential constituents of human body and nature.

4.2. Construction of science and the subject field

Almost all textbooks are struggling with the amount of information that "should" be given in the chemistry textbooks. The author of **LewisOCHMP** emphasises that "modern" organic chemistry is more complex than it used to be, and that it is still developing. This modernization of organic chemistry have also another effect, the authors of the textbooks have two possibilities how to deal with ever rising amount of knowledge – they can expand the texts or make some cuts. Almost all of the authors talk about this omitting and the struggle which is connected to it. The problem is always about what to put in the book and what to leave out. For example the author of **ClaydenOCH** is writing

about omitting what has "*little value*". The field is growing - "*the pace of discovery has become explosive*" in the end of twentieth century. For example **MetzlerBCHR** textbook is struggling with the "*impossibility*" of describing "*all the spectacular advances in knowledge in these areas in a single book.*" (**MetzlerBCHR**, xvii) The authors of **StryerB** had a problem "*what to include and "what to exclude*" from the amount of information. Also in the **AlbertsMB** the authors are saying they are challenged by the still expanding information. "*There is a paradox in the growth of scientific knowledge. As information accumulates in ever more intimidating quantities, disconnected facts and impenetrable mysteries give way to rational explanations, and simplicity emerges from chaos.*" (**AlbertsMB**, v) The information in the field of sciences is growing and the scientists are revealing the nature and overcoming the chaos. But although biochemistry is advancing in understanding the cell biology of infection, the "*infectious disease remains one of the greatest unconquered dangers in our world.*" (**AlbertsMB**, v) The advancement of the science field is huge, but as **AlbertsMB** claims, there are still new diseases that are mortal. Even when the scientists are gaining more knowledge about our body and nature, it does not solve all the problems that human body and nature have. So even the scientists are able to conquer nature for a while, there has always been something new to discover and to reveal. The **DevlinBCC** textbook focuses on the influence and importance of evolution (nature and living organisms constantly evolve). The world and nature is so variable, "*one of the most striking characteristics of life on earth is its enormous variety and adaptability*" (**DevlinBCC**, xi), but still beyond the variety it is proven that all life is related on the "*molecular level*". Here the authors are connecting all living organisms; they are creating the image of the whole nature that is based on molecules from which everything alive is constructed. The process of gaining knowledge

is still more difficult because of the amount of it. The authors provide thus the connections of the field to the everyday-life and social problems.

The author of **LewisOCHMP** emphasises that the best memorization is by being acquainted with the thing. That is why he relates all the chemical concepts to "*everyday things*". He gives the readers opportunity to see that the organic chemistry is all around us – proteins and lipids (our body), soap, nylon, Teflon etc. He is giving the readers a "test" where he shows that they already know much about organic chemistry. For example he asks: "*Do amides react vigorously with water?*" (**LewisOCHMP**, xiv) And he explains that our skins are made of a protein, which is an amid, so the answer is clear. According to **McMurryOCH** there is need to show the students the applications of what they learn, that's why he uses special boxes which connect the subject to other fields – industry, day-to-day life – "*these applications enliven and reinforce the material presented in the chapter.*" (**McMurryOCH**, xxiii) All applications which could be important or interesting for the student are highlighted, which helps the students to orientate in the text and could help also to memorize the examples. The author of **BoxerEOCH** emphasises that "*chemistry is not merely a head-aching agony of memorization*" (**BoxerEOCH**, xiv), he focuses on the alleged fun which could be found in learning and practising. He gives examples of the thing from our background that are the objects of the organic chemistry and are close to us, or which we use everyday – soap, antibiotics etc. These essentials should interest the students so he created boxes with "*mini-essays*" where he gives the topics related both to the chapter and to the "*reality of our lives*". Every chapter in these textbooks include applications of the subject in biology, medicine and industry. For example topics like – What effects human health?

Every-day life is what all the students are accustomed to. On this basis the chemistry is getting closer to their lives and it is more comprehensible for them.

Construction of the field in the subchapters

The authors of **McKeeBI** emphasise in the subchapter that proteins are very important in human body, "*they (proteins) are essential constituents of all organisms. Most tasks performed by living cells require proteins*." (**McKeeBI**, 80) The authors do not refer to any technologies or discoveries that are connected to proteins. The proteins' variety is "*astonishing*" and it is thanks to this variability that they have many functions, from metabolic regulation, transport and defence, to catalysis and they are "*primary structural components of muscle, connective tissue, feathers, nails and hair*." (**McKeeBI**, 80) Also in **BoxerEOCH** the proteins are the main subject, the chapter starts with describing the term protein, which has origins in Greece – from Greek "proteios" (of first importance). According to the author the proteins are "*absolutely vital to life. Protein is an integral part of skin, muscle, hair, connective tissue, nerves, and blood*." (531) It is clear that they are part of organic chemistry, because they are the building stones of human body and other organisms.

The authors of **McKeeBI** are fully focused on description, function and effects of proteins in human body. The authors use the descriptive verbs and formulations – proteins are, they can… but they also use the active verbs in describing the functions of proteins – they "*direct and accelerate reactions; they can increase and perform, induce or stabilize strained reaction; they are involved in diverse functions, in cell movements and they are active in cell division…*".(**McKeeBI**, 80, 94) There is a protein that is responsible for nitrogen fixation and some proteins "*provide protection and support*". (**McKeeBI**, 93) Proteins are protective - "*the protein found in skin cells that aids in protection the organism against*

mechanical and chemical injury" (**McKeeBI**, 94). The immunoglobulins (or antidotes) are produced by lymphocytes when foreign organism such as bacteria invade an organism. (**McKeeBI**, 94) The author of **BoxerEOCH** uses also the descriptive verbs and formulations – proteins are…, they can…, they contain…they carry…; when talking about proteins as agents. On the other hand he uses more singular than is used in **McKeeBI**. "*A simple protein yields on hydrolysis only amino acids*." (**BoxerEOCH**, 544) But he does not mean some individual protein but all proteins that are classified as simple, the same with describing "conjugated protein". In **McKeeBI** proteins are almost mainly in plural, an exception occurs when mentioning and individual protein – "*collagen is composed of three left-handed polypeptide helices…*" (**McKeeBI**, 107)

It seems as if the proteins alone were responsible for life. Proteins can do that, proteins support different processes in body. Some proteins are active, some passive. The active ones for example transport the oxygen, the passive are part of our skin and because of them we are protected against mechanical injury. On the other hand, both chapters are also about toxic proteins that cause diseases and death, but to those proteins very little space is given. There is just half a page on mutations and sickle cell anaemia in **McKeeBI**, where we can read the "Special box reading" about cholera. Almost all authors provide the reader with complemented interesting texts that are to attract the reader, get him/her interested in the subject and connect the raw scientific facts to everyday lives. But all these texts are separated from the main text, in a box, or in different colour, or on a side of page. The authors are not able to get the social world, the everyday-life examples in the main text. They need to have the scientific knowledge separated from the non-scientific. But not life or death are emphasised, it is given the same space for what proteins do for life and what proteins do "against" it. These special interest boxes are not so rare in the whole textbook of **McKeeBI**, but in

the chapter on proteins there is only one. The other special interest boxes are focused on many areas from medicine to industry.

Proteins as the most important agent in the chapter on proteins are active members in all processes in human body and nature; they are introduced as parts of our body (and nature) that are responsible for many processes in human body (and nature). They are active agents in our body, but passive parts of nature which is revealed by scientists. The authors use passive clause whenever mentioning where the proteins "are found" and active clauses, whenever mentioning what proteins "do". The passive clauses show the passiveness of proteins in connection the scientists, who are not mentioned as agents but are concealed by the passive sentence. So even in the chapter the model active scientists could be found even in not so explicit way as it is in the introductions. By this example the nature is both passive and active; and the passive side is subordinate the scientists. The active side of nature is here represented by the significant role that proteins have in our body and it emphasise the significance of proteins.

4.3. Textbook imagery

All of the authors use some kind of colour identification, to connect interrelated subjects for better orientation. Also the things that the students must memorize are often marked in colour, box, bold or another type of visual emphasis that helps the student identify the important message. The symbols and graphic images "*are intended to help the textbook reader to remember and mentally cross-reference key biochemical concepts and principles through image association.*" (**ZubayPB**, xxi) We can find this colour highlighting in **McMurryOCH**, and in **BoxerEOCH** (colour-coding and colour background). Generally all of the authors use the images, colours and graphics to attract the students. The author of **McMurryOCH** claims that he, contrasted to older editions, changed the design and layout of the book, so it has "*a*

more aesthetically pleasing look." (**McMurryOCH**, xxi) There are often pictures on the cover and on the introductory page to each chapter that are not so related to the subject but they connect it to the everyday life. For example on the cover of BoxerEOCH, we can see a beetle among some chemical formulas and the whole picture is complemented with flowers (see attachment 9). These visual supplements are means to lighten the given facts and connect the textbook to the everyday lives which is connection supporting girls´ thinking and so these features of the textbook can be attractive also for the female audience.

The authors of **StryerB** are focusing on comprehensibleness of the models of molecules which "*make it easier for the student to develop an intuitive feel for the shapes of molecules and comprehension of how these shapes affect reactivity*." (**StryerB**, vii) Some textbooks work more with these visual effects than with the text itself and rely thus more on the imaginative skills of reader and on skills to comprehend these illustrations; some textbooks prefer textual description only complemented with few visual illustrations (**BoxerEOCH**, **ClaydenOCH**, **ZubayPB**). For example the textbook **BoxerEOCH** uses predominantly visual representations of described molecules and on the other hand **MckeeBI** uses more text complemented only with illustrations, also in (**MetzlerBCHR**, **McKeeBI**).

Kinds of imagery in the subchapters

Because of the complexity of protein molecules the complete models depicting even the smallest of the polypeptide chains (that connect the molecules of proteins) are almost impossible to comprehend, that is why the textbooks use simpler images that highlight specific features of a molecule. The most used models in the textbooks' chapters are structural formulas (see attachment 5), they are the easiest illustration of a molecule and it simplified it as much as possible. The other model is ball-stick model (see attachment 6), which shows a bit more than the

structural formula, because it is focused on the shape and angles of the molecule. There is also space-filling model (see attachment 8) which shows the visual features of the molecule, its shape and it is probably the one model which is closest to how the molecule factually appear, it "*illustrates the volume occupied by molecular components and overall shape*" (**McKeeBI**, 95). The authors of **McKeeBI** also use a very uncommon model for showing the reader the three-dimensionality of a molecule presenting it on an illustration of a hand, where the thumb and fingers show the shape of the molecule. The shape of the molecules is also visible on the often used ribbon model (see attachment 7). This model is used only for proteins and it represents the spiral characteristics of protein molecules.

The whole illustration of a molecule is not possible so the scientists must use only simplifications and reductions in order to describe and depict the molecule. This effort is connected to their effort to make the nature simple and comprehensible and have it conquered. They are thus turning the nature in simplified geometrical forms and so they put the nature under control.

In **McKeeBI**, there is one "Box reading" which is focused on the protein toxins. This box is clearly separated from the main text, in a box and having different colour, and we can find there two kinds of illustrations. There is a space-filling model and two photos that are showing the posters from the cholera period. The posters are clearly social connected, historical and could be given the specific time and place, they are clearly separated from the factual and scientific illustrations, which are not to be connected to any time, they are without any context to history. They only represent the simplified model of a molecule. The imagery in special interest boxes always try to connect the subject to the everyday lives, but still these boxes are separated from the main text.

Photos of men or women were included very rarely, for example in one (**MetzlerBCHR**) there were 5 photos in the beginning chapter. Those photos presented famous chemists, always men. Using of colours is very important for distinguishing the topics and emphasising important information, it provide another structural order of the text for better orientation. The usage of models and figures is necessary in chemistry; they provide the imaginative side of the field; however, the easiest models, structural formulas, are used predominantly. It is because these types of models give the student more information in whole than other models. The ball stick model or the space-filling model provide the whole visual effect of the molecule, but the structural formulas provide information about content, bonding and sometimes even shape.

The imagery of the textbooks is almost all represented as male, if there are images of chemists, they are male. The models of molecule are simplifying and ordering nature and concealing the fact that scientists are not able to record the real visualisation of a molecule. The traces of female features could be find in the special interesting reading sections, where there are made connections to the everyday lives also in pictures, but all these sections are separated from the main scientific text and thus are only complementary.

4.4. Pedagogical aspects of textbooks

All authors claim to include some kind of supporting material for the students such as reviewing chapters, solved problems, examples with key answers or some kind of a study manual. All try to give the readers as much help as possible, their reason for this could be the saleability of the textbooks and improvement of students' knowledge. No aid directed at women in chemistry field were included, perhaps only the questions and tasks focused on discussion and special interest reading could be considered as a helpful step to getting women involved and interested in

the study field. In many "interest readings" could be found topics from everyday lives and social world, so the authors get the chemistry closer to everyday life, which could be interesting both to women and men, but this connection with the social life is more attractive the women.

Some authors use direct addressing of readers some do not address the reader at all, and some use the gender inclusive language. The addressing of the reader in **VoetB** is a bit unbalanced, most of the time the authors just talk about the readers, not talking directly to them but only describing them. "*Students who lack these prerequisites…The student should realize…*" (**VoetB**, vii) But once in the book we can find the gender inclusive language – "*…it permits the instructor to teach a course of his/her own design…*" (**VoetB**, viii). The author of **McMurryOCH** differentiates between genders using the possessive pronouns he/she. "*If the student answers one of these review problems incorrectly, **he or she** may be directed depending on the question…*" (**McMurryOCH**, xxv) The only book which differs strictly between denominations he/she is **BoxerEOCH**. We can find there five examples of this differentiation, which can be found through the whole preface. The author does not address the readers directly, he talks "about them", but he uses the gender inclusive language. "*The student should have previously taken the minimum of two quarters (or one semester) of general chemistry…The level of coverage is designed to provide the student the organic chemistry needed either in furthering his/her education of in practising his/her profession.*" Or another example: "*Following the solved problem, the student has the opportunity to test his/her mastery of the material just covered…*" (**BoxerEOCH**, xiv-xvi)

In **McMurryOCHBP** the author uses indirect addressing like "*This textbook, written for an audience of advanced undergraduates and graduates*" (**McMurryOCHBP**, xvii), but in the end the author as though changes the way of speaking and addresses the readers directly: "*Good*

luck in your studies." (**OCHBP**, xviii) This approach is applied also in **NeckersOCH** where the authors use indirect addressing in the whole preface but in the end they switch and talk to the readers: "*We hope **you** will find the reading of this book as enjoyable and stimulating as we found the writing of it to be.*" (**NeckersOCH**, viii) This approach preserves the authors' superior position but make the readers feel somehow supported by the author. In the **LewisOCHMP** in the chapter aimed at students the author speaks directly to the readers, students – "*The majority of you…, for most of you…, this is true for those of you…*" (**LewisOCHMP**, xiii – xv)

The indirect addressing is used for describing the textbook, and the field. It is just one-sided conversation, but when it comes to the direct addressing, the authors start to communicate with the reader, they are making a contact. The direct addressing occurs mostly in the ends, after the paragraphs of introducing the textbook. It is the last sentences that are arranged to get directly to the reader. And the intended message is always the same and quite clear – this book is written for you (reader) and we (authors) hope you will profit from it. This addressing gets the author closer to the reader and the reader feels as though the author is talking right to him/her.

The gender inclusive language is used only by three authors and even they do not use it all the time and use also the "neutral" denomination "reader/student" The problem with differentiation between he/she is that it could be easily avoided, as it is done by most of the authors. If they don't want to bother writing he/she they just keep repeating "the student" or "the reader" or they use plural. The fact is that I have never come across the denomination "he" after "the student". But the avoiding of using the denomination he/she by using the "neutral" student or reader shows that the authors are aware of the gender problem but they don't want to solve it by using the gender inclusive language. Moreover because the science is stereotypically perceived as

male the gender neutral addressing would be most probably taken as male addressing.

Pedagogical approach to the subchapters

The whole chapter in the textbook **McKeeBI** does not address the reader at all, the writers describe the functions and shapes and effects of proteins but they never mention the reader, they never turn to him/her. The reader is visible only because of the questions given in the main text which are meant for the students and the facts speak only for themselves not including the reader. On the contrary in **BoxerEOCH** textbook the author addresses the readers directly and involves them in the explanation – "*we will first study…, now let us examine*" (**BoxerEOCH**, 531). It is a very familiar style of writing and communication with the reader. This approach of explaining the subject is a manoeuvre to make the field seem friendlier. The readers are becoming a part of the exploring process, they are getting on the same level as the writer and they seem to be involved in the explaining process.

In the **McKeeBI** chapter there are two questions asked inside the main text that develop deeper thinking of the reader about the stated problem, they consists from descriptive part and following question on given theme. The questions are separated from the main text in boxes but they are connected to it thematically. And right in these boxes we can find the interrogative pronouns – "*why do you think… Does it surprise you…*?" (**McKeeBI**, 97) By these the authors turn to the reader and force him/her to cooperate and get involved into the text. The reader is supposed to read the main text and answer the given questions. At the end of the chapter a set of questions can be found. Here the reader is involved in the process of gaining knowledge, but still all the questions are clearly separated from the main text. In the **BoxerEOCH** text there are no questions directly in the main text but there are 30 questions at

the end of the chapter. These problems, as they are called there, take two pages. There are no keys to these questions but through the whole chapter (and also other chapters) there are solved problems that could help the students with solving these problems.

All the textbooks are full of tasks, questions, and discussion materials, which are to check student's knowledge, and understanding, and sometimes their purpose is to show the students the solving process. This student-centred approach (questions along the main text, discussion tasks etc.) is one of the goals of the programme ChemCom (sponsored by ACF and NSF), which support women in sciences. There are many types of questions and tasks. Chemistry is a diverse field and so even the questions are diverse – creating some potions, calculate some equation, discuss some problems. The diversity of questions and tasks has the advantage being convenient to both women and men.

4.5. Male face of science

The authors of **McKeeBI** suggest that there are active and passive observers. According to them "*life is a mystery*" which could "*enchant or terrify*" 'us', but we could look at life and nature from two points of view. One could be the view of (what they called) a normal human – who see the "*beauty and majesty of natural world*" and it could be the view of a biochemists (scientists), who look beyond the beauty and want to discover. Both could be "*awed and humbled by the intricacy, sophistication and resilience of living organisms*." (**McKeeBI**, xiii) The active observers are scientists who are curious and inquisitive and they observe the living organisms, nature, which is though passive and let them to examine it. This creates the image of a scientist – who should become from the students – so they could belong to the scientific community. The authors of **VoetB** are emphasising that biochemistry was created by scientists; it is a socially created subject, even though it

is based on natural laws. The scientists created biochemistry for the need of the knowledge about human body and nature. "*This remarkable expansion of knowledge [in biochemistry] is work of thousands of talented and dedicated scientists*." (**VoetB**, vii) The field is according to the authors of **VoetB** so "*fascinating*" that the knowledge about it is still growing, and "*will no doubt lead to even more spectacular gains in our ability to understand nature and to control our destinies. It is therefore essential that individuals embarking on a career in biomedical sciences be well versed in biochemistry*". (**VoetB**, vii) The authors here again describing the scientists as active and according to the authors the scientists do not only seek the knowledge they want to intervene and 'control our destinies'. The authors of **McMurryOCHBP** view the laboratory experiments and analogous real biochemical reactions outside the lab being on the same principles. "*Biochemical transformations are not mysterious*." (**McMurryOCHBP**, xvii) The author wants us to understand that the biochemical transformations can be revealed and explained. Using the lab experiments could be explained the organic life outside. Thanks to technology in laboratories the living organisms are no longer mystery.

The textbooks create an image of a scientist who is conquering and revealing the nature. Scientists are thus active agents who are studying passive nature. This finding support the idea that nature is taken as passive, which is traditionally connected to female characteristics and active is connected with male characteristics, which shows us the male features of scientist. However the future active scientists are for now students that should read and study and consume the given text. The knowledge, presented in the textbooks is not to be discussed, it is given and unchangeable. This fact is visible on the formal scientific language used in most textbooks; this type of language oversees the reader for discussion but supposes that the reader will study the subject as it is

given. So the students are now perceived as passive although they have the models of active scientists who they should become.

Most of the analysed textbooks are written primarily by male authors. There are two books with female co-authors; both women are wives of the other author. It is **VoetB** and **McKeeBI**. Both women are stated on the cover. In case of **McKeeBI** Trudy McKee is stated on the first place which means a lot, because usually if there are more authors they are stated in alphabetical order, as it is in the second case with Judith Voet (**VoetB**), she is on the second place after her husband James Voet. This importance of Trudy McKee could mean her significant contribution, even main contribution to the production of the textbook.

In all textbooks there is majority acknowledged men, some authors thank the students who helped with the production of the book. For example in the **McMurryOCHBP** they are thanked for reviewing the drafts (among the students were 2 women and 4 men). Students are acknowledged also in **AlbertsMB**, **McMurryOCHBP** and **NeckersOCH**, where they are inscribed even as contributors, not just the reviewers as the students are in other textbooks. Here the students are already taken to the scientific community; they contribute to the creation of another means of transferring scientific knowledge. However the acknowledged number of women shows that the majority students who helped were male. Women acknowledged are most often on the positions of secretaries who typed the drafts and manuscripts into the computer. They can be also found in the editorial staff. On these positions they were responsible for design, grammar, style, editorial works and graphics of the textbooks. But even on these positions women predominate only rarely. Women are most often thanked for "*guiding and support*" (**McKeeBI,** xiv), in the **ZubayPB** women from editorial staff are thanked for their "*skills*", "*enthusiasm*" and "*dedication*". (**ZubayPB**, xiv)

Among the contributors and reviewers can be found many women,[13] but in the whole account there are still vast majority of men. There are two books where women wrote whole chapters of the textbook. It is **AlbertsMB**, where 4 women cooperated on writing these textbooks by writing some chapters or their parts, but in the textbook women are not stated under the selected chapters. Men contributors were very often thanked for advice, helpful suggestions, sharing thoughts and criticism (**StryerB**, xvii). Other acknowledged group were wives of the authors and sometimes the whole family. They were all thanked in majority for patience and support. In the **StryerB** the wife of the author is acknowledged as one of the contributors; she cooperated on the book, giving advice on style and design.

The scientist's model in the subchapters

In the chapters the activity of scientists is no longer visible. There is only clear the passivity of the reader who is consuming the facts and is presented with some solved problems. Only in the given questions without keys the students are to solve them, but not alone, the teacher should always give them the guidance or at least the right answers. The scientific community is represented by mentioning famous scientists, but this phenomenon is very rare in the textbooks and it is definitely not the common and necessary part of the chapters. In the chapter **McKeeBI** we can find two chemists that bring some important developments to the discussed subject - mention about Linus Pauling and his colleagues, and then Christian Anfinsen. Another famous chemist is mentioned in the Special interest box included in the chapter - Robert Koch. All names are added to some process in chemistry (for example denaturation of proteins) which is connected with them. All other references are aimed only indirectly on biochemists generally – "*Biochemists distinguish four levels of the structural organization of proteins.*" (**McKeeBI**, 103). In

[13] see the table in the end of this section

chapter on proteins in **BoxerEOCH** there are no references to famous chemists or scientists, these are mentioned in the specific Box reading – on history, agriculture, medicine, biochemistry, etc. along the whole textbook. But there are no such in this very short and brief chapter.

The clear under-representation of women in the authorship of chemical textbook is remarkable. The textbooks are male domain, except for very few rarities when the married couple is working together. Many women who contributed were not from the scientific community (but from the editorial stuff). Men were thanked for intellectual input and contributions but women for their ability to feel, for their emotions and support in hard times. Women here are getting to the stereotypical female position of kind, emotional and helping assistant. On the other hand men are thanked for their support in knowledge, ability to criticise and evaluate. The acknowledgments are creating the male image of scientist and along with it also the image of women who are contributing to the textbooks but not on the scientific level and so are excluded.

Table 1 – number of men and women mentioned in acknowledgements

textbook	**women**	**men**	**Mentioning family**
McKeeBI	3	41	YES
ZubayPB	22	137	NO
VoetB	10	85	NO
StryerB	2	37	YES
MetzlerBCHR	14	23	YES
AlbertsMB	9	13	YES
DevlinBCC	10	10	YES
NeckersOCH	12	58	NO
McMurryOCH	3	11	YES
ClaydenOCH	1		YES
BoxerEOCH	14	46	YES
LewisOCHMP	5	17	NO
McMurryOCHBP	6	23	NO
VollhardtOCHSF	2	31	YES

5. CONCLUSION

The textbook is used as an educational material and thus it transfers knowledge and norms of the subject. The textbooks are structured according to how the field is structured but every author tries to put it the textbook something different, something that would distinguish it from other textbooks. So the author has a great influence on the field that is explained in the textbook.

The current authors of chemistry are struggling with the amount of information that should be given in the textbooks, the field is growing and it is thanks to scientists who are discovering still new information about nature and life. They soften this amount of information by connecting the subjects to the everyday lives which make it comprehensible for the reader. The everyday-life examples and Interest Box reading of this kind are targeted on variety of readers, the topics are definitely not only about engineering and industry, which could be taken again only as fields of men, but they are focused also on kitchen or food chemistry, this field are clearly targeted on women audience. However, the connections of chemistry to the real-world social problems are one of the demands of the programmes mentioned in the introduction. This connection is thus considered as female friendly and it supports the efforts for increasing the number of women in chemistry field. And Roychoudhury et al. (Elgar, 2004) found that women students needed both to feel a sense of control and autonomy over the science they were learning and also to be able to make connections between science and their daily lives. So these features of texts are considered as important for women and could be a step to making chemistry more attractive for them.

The nature is clearly positioned in the passive role, the scientists are revealing its layers and through technology they discover its “mysteries” on the other hand they are not able to depict the nature as they would

like to, so they must rely on simplifications of illustrations of molecules, to make some order within the comprehension of nature. This system of ordering and effort to systematize everything is also traditionally perceived as male characteristic. The small parts of nature, proteins, are perceived as active when they are to create and build the nature, these features of proteins could be considered as male characteristics, but the nature as a whole remain in passive position. In the contrast to passive nature there are the active scientists who reveal it and discover. The traditional perception of male features is thus connected to the model of male scientist who is active in conquering.

In the supporting materials I have not found any trace of only male features. The given aids, problems and questions were diverse, not directed on one type of question or test, and so targeted on diverse audience. But the amount of solved problems and questions to discussion show the attempt to create the student-centred pedagogical approach (ChemCom programme) but all these features of the text that could be considered as more women targeted are always separated from the main text. The authors are not able to connect these to the main scientific text, they use different colours, boxes or put those pedagogical features next to the main text.

The under-representation of women in science is visible on the example of female authors and contributors to scientific textbooks. There are very few women mentioned as authors or contributors to chemistry textbook under the study. Women in chemistry textbooks are found in acknowledgments under the section of typists, editors, and reviewers. They are acknowledged for qualities that are typically connected to women and on the other hand men are acknowledged for qualities typically perceived as male.

The female factor within the language of the textbook could be found only in three textbooks, where the author uses gender inclusive

formulations 'he or she'. In all other textbooks are mostly used neutral denominations – student or reader, which are due to the traditional perception of nature as male domain considered as male denominations. The writers are avoiding the necessary differentiation between male and female denomination.

Chemists mentioned across the textbooks were male, but it is not surprising, when the community and its scientist, created by male authors, have, or supposed to have, the characteristics traditionally taken as male, like activeness, curiosity, competitiveness etc. Scientists are represented as actively revealing and conquering nature, which is passive, and traditionally represented with female gender. And according to Susan Hodgson (2006) the students follow the story line that is created by the images and references. The story line presented in these chemistry textbook shows only men as scientist. Even the small compounds and molecules that are part of nature are influenced by male point of view. Proteins can are presented as active when participating on processes in nature and human body, but also as passive, when they are remitted to the observation done by active scientists.

There are first signs of improvement in form of same cases of gender inclusive language and topics focused on everyday lives. But the most important demand, the authorship of women, is still far away. Maybe the female students educated on these textbooks will be more science and especially chemistry focused.

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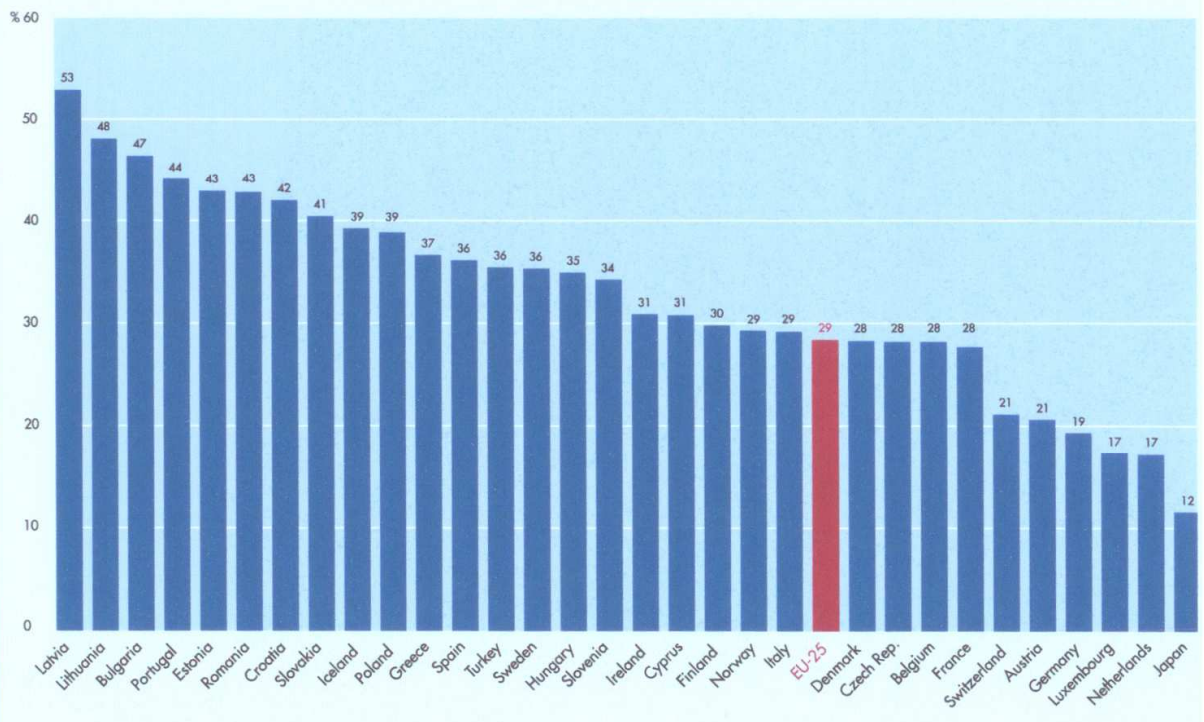
Table 2.2: Proportion of female PhD (ISCED6) graduates by narrow field of study in natural science and engineering (400 & 500 fields), 2003

	Science, Mathematics & Computing				Engineering, Manufacturing & Construction		
	LIFE SCIENCE	PHYSICAL SCIENCE	MATHEMATICS & STATISTICS	COMPUTING	ENGINEERING & ENGINEERING TRADES	MANUFACTURING & PROCESSING	ARCHITECTURE & BUILDING
EU-25	54.4	33.0	31.6	18.6	17.1	32.0	31.3
Austria	50.3	21.8	24.4	9.5	16.1	36.4	20.0
Belgium	40.3	29.8	35.4	3.2	13.4	0.0	21.4
Cyprus	100.0	-	-	-	-	-	-
Czech Republic	50.9	28.6	31.7	10.3	19.9	47,6	25.8
Denmark	33.6	-	-	-	23.8	-	-
Estonia	28.6	18.2	0.0	100.0	15.4	100.0	0.0
Finland	62.0	39.3	34.3	13.9	23.6	42.9	34.4
France	53.4	34.3	24.3	18.8	22.8	37.7	27.8
Germany	46.7	22.8	27.9	11.9	6.8	24.2	22.3
Hungary	43.0	37.4	25.0	30.0	33.3	32.1	16.7
Ireland	60.2	52.4	0.0	21.4	24.1	58.8	0.0
Italy	72.4	45.2	42.4	25.0	13.5	25.6	48.9
Latvia	66.7	0.0	-	66.7	41.7	33.3	0.0
Lithuania	88.9	28.6	75.0	0.0	44.1	-	42.9
Netherlands	-	39.9	-	-	18.0	-	-
Portugal	73.0	56.7	58.3	28.0	28.0	51.6	42.6
Slovakia	71.4	48.9	46.2	20.0	23.9	26.9	33.3
Slovenia	65.0	34.5	20.0	15.4	10.4	28.6	57.1
Spain	54.5	46.8	40.4	22.8	16.0	62.9	24.0
Sweden	51.7	32.4	16.0	21.6	24.1	32.7	39.3
United Kingdom	56.6	32.6	24.1	23.3	16.2	33.4	21.3
Bulgaria	77.8	49.2	30.0	-	33.3	42.9	0.0
Norway	-	0.0	-	-	13.3	-	20.0
Romania	57.6	:	:	:	37.5	-	42.9
Switzerland	42.6	23.3	22.2	7.5	16.9	-	5.0
Turkey	54.1	31.7	28.6	28.6	14.7	42.5	39.8
United States	45.7	27.7	27.0	21.0	17.2	-	45.7

Source: Eurostat Education statistics
Exceptions to the reference year: NL, NO: 2002
Data unavailable: EL, PL, IL
Most tertiary students study abroad and are not included: LU, CY
Countries with small numbers:
400: CY (1); EE (32); IS (2); LV (7); LT (36); NO (2)
500: CY (0); EE (7); HU (37); IS (0); LV (16); LT (41); MT (0); NO (25)

Figure 1.6: Proportion of female researchers, 2003



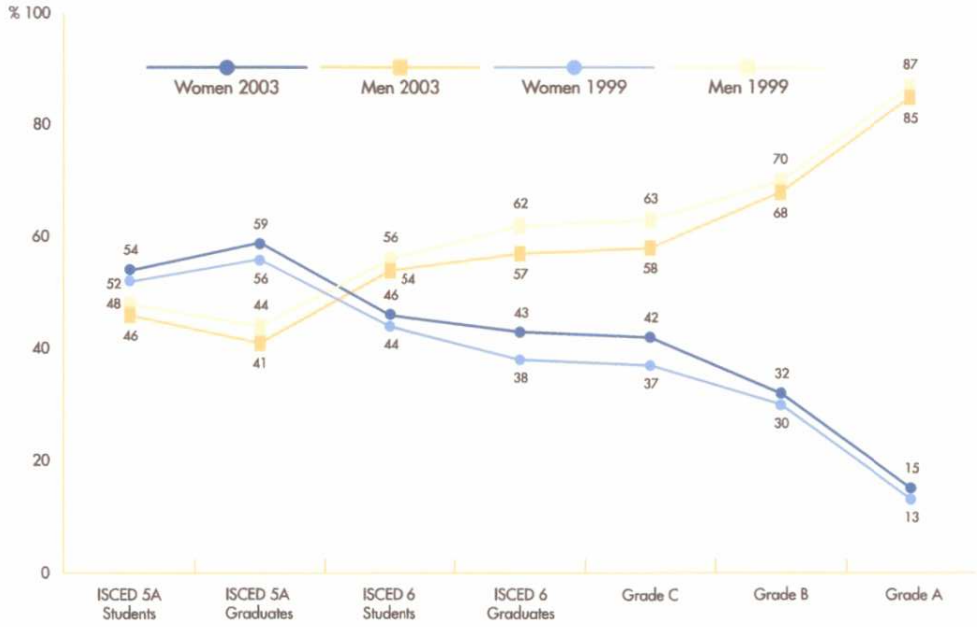
Source: Eurostat S&T statistics, EU-25 calculated by DG Research
Exceptions to the reference year: PL: 2000; AT, FI, TR: 2002
Data unavailable: MT, UK
Data estimated: SE

Table 3.2: Proportion of female grade A staff by main field of science, 2004

	NATURAL SCIENCES	ENGINEERING AND TECHNOLOGY	MEDICAL SCIENCES	AGRICULTURAL SCIENCES	SOCIAL SCIENCES	HUMANITIES
EU-25	11.3	5.8	15.6	14.9	16.6	23.9
Austria	4.4	3.7	8.9	5.6	9.6	19.1
Belgium	7.7	4.2	8.3	3.6	11.5	13.0
Cyprus	18.8	0.0	-	-	11.1	0.0
Czech Republic	9.2	4.5	14.2	9.1	13.0	14.5
Denmark	6.9	1.4	14.9	16.2	13.2	15.2
Finland	11.3	6.3	21.6	16.0	28.6	35.1
France	12.3	6.5	15.3	:	17.0	30.1
Germany	5.6	3.8	5.8	8.9	8.0	16.3
Italy	15.9	6.1	11.1	11.8	17.1	29.4
Latvia	0.0	:	38.5	:	39.3	36.4
Malta	0.0	0.0	8.3	0.0	0.0	0.0
Netherlands	5.3	3.1	6.3	11.0	11.5	16.3
Norway	9.9	4.9	16.8	14.0	18.3	24.6
Poland	16.9	8.7	28.2	24.3	20.6	22.5
Portugal	27.5	5.0	26.2	27.0	20.4	X
Slovakia	13.0	6.6	17.0	3.5	17.3	20.6
Slovenia	3.8	5.4	19.0	20.4	14.5	17.8
Sweden	11.7	7.1	15.3	18.2	19.7	25.8
United Kingdom	8.2	4.9	22.0	14.7	21.2	17.2
Switzerland	7.3	10.1	18.1	12.8	23.4	19.9
Turkey	25.7	15.6	34.5	13.6	24.3	20.3

Source: WiS database DG Research, EU-25 calculated by DG Research
Exceptions to the reference year: LV, TR: 2000; FR: 2001; AT: 2003; CY, NO, PT: 2003
FTE instead of HC: NL, IL (2001)
Data unavailable by field of science: BG, EE, EL, ES, IE, IS, HU, IL, LT, LU, RO
BE: sum of BE-FL + BE-FR
PT: H included in SS
Data are not necessarily comparable between countries due to differences in coverage and definitions

Figure 3.1: Proportions of men and women in a typical academic career, students and academic staff, EU-25, 1999-2003



Definition of grades:

A: The single highest grade/post at wh research is normally conducted

B: Researchers working in positions as senior as top position (A) but m senior than newly qualified PhD hold

C: The first grade/post into which a ne qualified PhD graduate would norm be recruited

ISCED 5A: Tertiary programmes to prov sufficient qualifications enter into advanced resea programmes & professi with high skills requiremer

ISCED 6: Tertiary programmes wh lead to an advanced resea qualification (PhD)

Source: Eurostat Education data, DG Research, WiS database seniority Grades.

2003

ISCED5A Students:
Data unavailable: FR
Exceptions to the reference year: LU: 1999; EL: 2002

ISCED6 Students:
Data unavailable: FR, LU, DE, SI
Exceptions to the reference year: EL: 2002

Grade C, B, A:
Data unavailable: IE, LU
Exceptions to the reference year: CY: 2002; FR, PT: 2001; EL: 2000
NL: FTE; SI: Data estimated; FR: Grade C unavailable

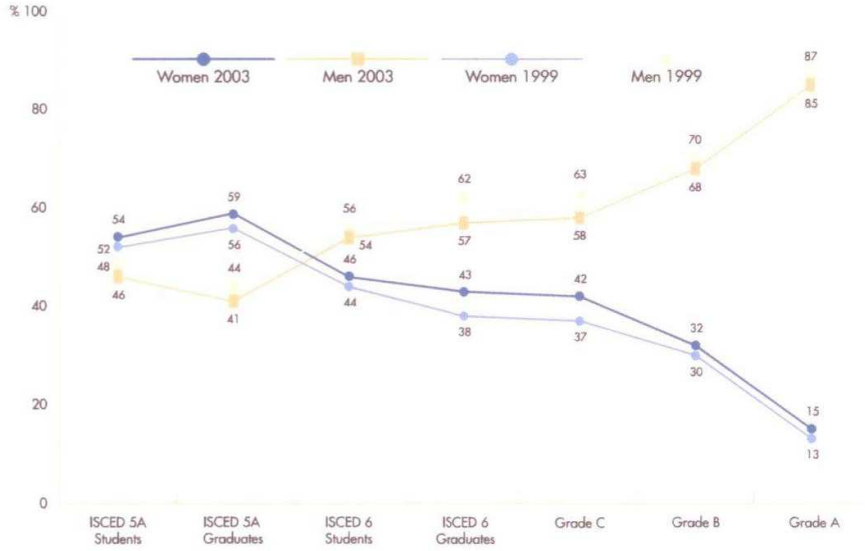
1999

ISCED 5A Students:
Exceptions to the reference year: BE, PT: 2000; EL: 2002. Data unavaible
Exceptions to the reference year: PT: 1998; BE: 2000; CY: 2001; EL: 20

ISCED 6 Students:
Data unavailable: DE, FR, LU, SI

Grade C: Data unavailable: FR, Exceptions to the reference year: AT: 1998; PL: 2000; FTE: NL, BE (FR)
Grade B: Exceptions to the reference year: AT: 1998; FR, PL: 2000; FTE: NL
Grade A: Exceptions to the reference year: AT:1998; FR, PL: 2000; FTE: NL

Figure 3.1: Proportions of men and women in a typical academic career, students and academic staff, EU-25, 1999-2003



Definition of grades:

A: The single highest grade/post at which research is normally conducted
B: Researchers working in positions not as senior as top position (A) but more senior than newly qualified PhD holders
C: The first grade/post into which a newly qualified PhD graduate would normally be recruited

ISCED 5A: Tertiary programmes to provide sufficient qualifications to enter into advanced research programmes & professions with high skills requirements
ISCED 6: Tertiary programmes which lead to an advanced research qualification (PhD)

Source: Eurostat Education data, DG Research, WiS database seniority Grades.

2003

ISCED5A Students:
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1999

ISCED 5A Students:
Exceptions to the reference year: BE, PT: 2000; EL: 2002. Data unavaible: FR
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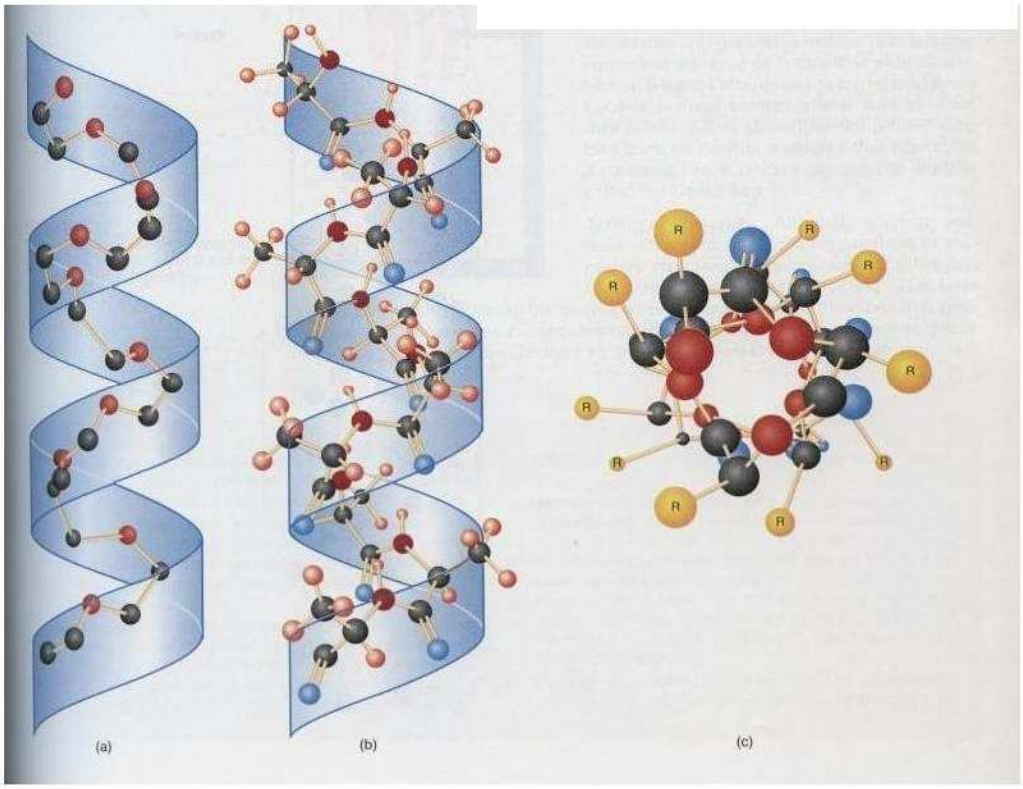
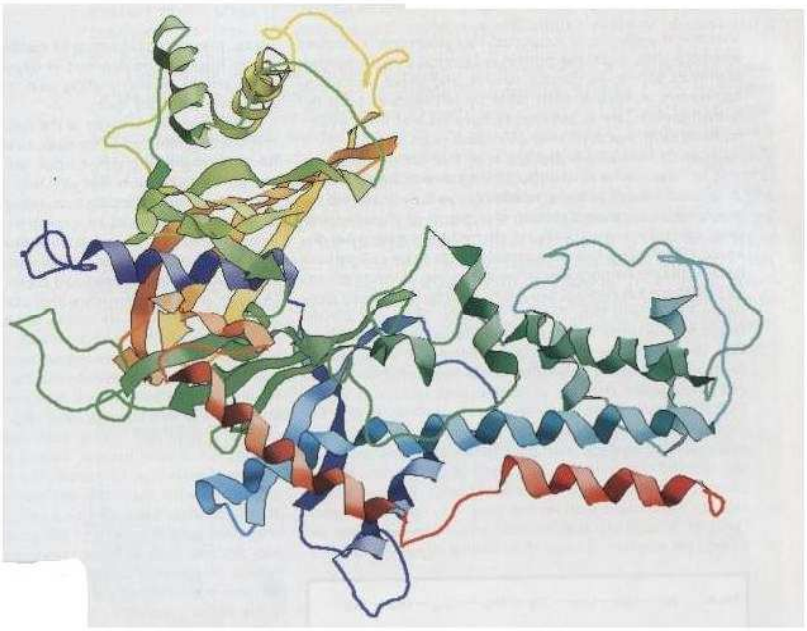
ISCED 6 Students:
Data unavailable: DE, FR, LU, SI

Grade C: Data unavailable: FR, Exceptions to the reference year: AT: 1998; PL: 2000; FTE: NL, BE (FR)
Grade B: Exceptions to the reference year: AT: 1998; FR, PL: 2000; FTE: NL
Grade A: Exceptions to the reference year: AT:1998; FR, PL: 2000; FTE: NL

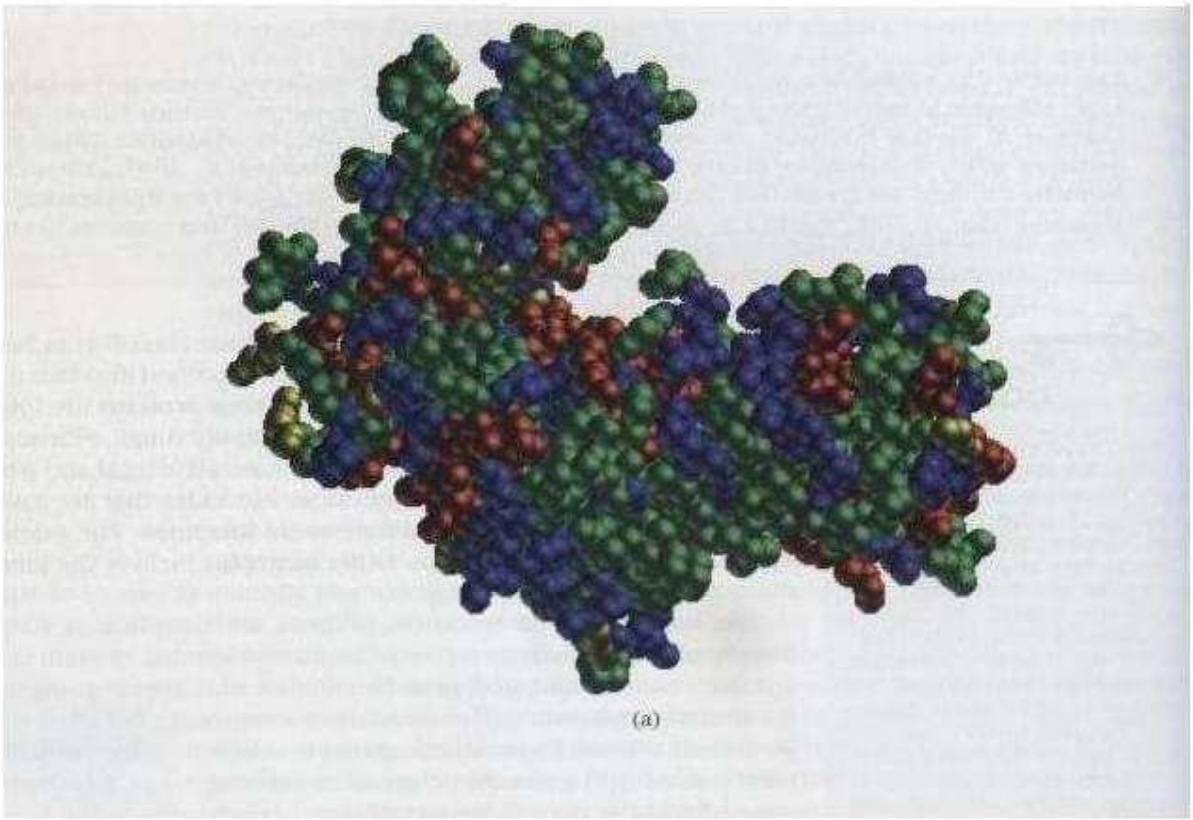
Ball-stick model (MkKee, 1999: 97)
Attachment 6



Ribbon model (MkKee, 1999: 95)
Attachment 7



Space-filling model (MkKee, 1999: 94)
Attachment 8



Cover page (Boxer, 1992)
Attachment 9