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CREATING AND DIFFUSING SCIENTIFIC INFORMATION – SOME ISSUES

1. Introduction

Changes in the production structure, first from agriculture to industry and then from industry to services, have led to information[1] becoming an important factor of production. As Castells [1996, 5] writes:

> The global economy is now characterized by the almost instantaneous flow and exchange of information, capital and cultural communication. These flows order and condition both consumption and production. The networks themselves reflect and create distinctive cultures. Both they and the traffic they carry are largely outside national regulation. Our dependence on the new modes of informational flow gives enormous power to those in a position to control them to control us. The main political arena is now the media, and the media are not politically answerable.

In mainstream neo-classical economic theory it is assumed that markets function properly, based on the assumption that perfect information is available. However, the following rhetorical question may be asked, why do scientists

[1] Information can be defined as "data that have been organized and communicated" [Porat, 1977, 2], while knowledge is "a set of organized statements is transmitted to others through some communication medium in some systemic form [Bell, 1973, 175]." In this article, information and knowledge are rather used as synonyms.

write about such issues when information, theoretically, is available? Coase [1937], by explaining the importance of transaction costs (costs of searching for information, negotiation, as well as monitoring and enforcement of contracts or agreements) for the existence of firms gave an impulse for bringing informational issues to the attention of economists. Akerlof [1970] in his famous article on "The market for lemons" showed that markets malfunction or may even not exist or disappear when there is a lack of information or asymmetric information exists.[2] Informational problems are an important reason for market failures, which is one of the arguments that has been used to criticise the uneven effects of globalisation [Stiglitz, 2002]. As Woźniak [2000] argues, most social and economic problems exist in less developed countries, while almost all scientific research is carried out in highly developed countries. The creation and control of information may create a comparative advantage and lead to increasing disparities in economic and social development.

The type of scientific research carried out may depend on many factors, such as demand[3] and the research budget available, creating the threat that the principal (funder) influences the methods used and conclusions [see Veblen, 1904].[4] The issue of funding is related to incentives for scientific research, the question who is the owner of the research and the methods of making the results available (information diffusion). Independent scientific research and trust in such science is crucial. Recently, scientific research has been biased by multinational companies and pharmacological industries [Criscuolo, 2005]. Universities are trying more and more often to obtain outside funding, which brings up the issue of where the barrier between true, independent science and "corrupted" research is. The property rights on scientific research, as well as patents, influence the distribution of the results (information / knowledge) and *e.g.* medical practice and innovations. One question is whether information should be privately owned (providing incentives for research, but limiting access which is based on payment) or be a kind of public good (where everyone

[2] Asymmetric information means that one party possesses private information which is unknown to the others. This information has economic value, and may be a reason for having a competitive advantage in business, but also creates incentives for opportunistic behaviour (lying and cheating) [Molho, 1997].

[3] This is connected with what Landreth and Colander [1994, 8] describe as "publish or perish" rules, the cruel competitive world faced by each potential full professor at many universities.

[4] Other factors may be, for example, rules and regulations (internal and external), political factors, taboos and codes of conduct, culture and other social factors, the fruitfulness of certain research methods, the existence of interest groups and the mental model of a researcher. Regarding the last issue, Landreth and Colander write: "Because graduate school is so important in determining an economist's mindset, and because publishing is so important in determining an economist's success, the content of graduate courses in economics and the decisions of editors of economic journals greatly influence the direction of economic thinking [1994, 9]." This may also apply to other social sciences.

may have access for free, but incentives for research are weaker). However, even when information is publicly accessible, it has to be "translated" and diffused among the population. Some ways of manipulating and different means of presenting scientific material in various types of media will be discussed.

2. Funding, property rights, the direction of scientific research and diffusion of results

"Need is the mother of invention." This catchphrase has been treated as a driving factor for people such as Einstein, Nobel and Pauling. The inventions and theories they came up with, are used by society (*i.e.* dynamite) or constitute the base for other scientific inventions. For example, Linus Pauling and his idea of a double coiled chemical bond, gave rise to the discovery of double helix DNA and classifying sickle cell anaemia as a molecular disease. It may be argued that these people were the representatives of truly independent science in the service of society, driven by moral incentives [Pauling, 1949]. Although patents existed, scientific information often seemed to be a kind of public good.[5] Sheldon Krimsky [2006] argues that such an approach to research has become less and less popular since World War II, as more and more universities have established relationships with corporations and do 'tailored research' for them. Thorstein Veblen [1904] had already argued a century earlier that business was taking control over universities, promoting their own narrow interests. An argument in favour of business involvement is that, for example, companies are able to apply research in production processes. However, focus on applied research, with its short-term direct benefits for identifiable stakeholders, may lead to theoretical research, which has more uncertain long-term benefits for society as a whole, receiving less attention.

Funding for science is strongly related with ownership. Private enterprise is willing to provide funding for scientific research when it is expected that a profit can be made. One of the first patents was awarded to Galileo Galilei in 1594 for a water pump, which was a revolutionary piece of equipment used in melioration work. In recent history, patents have been awarded for more and more controversial inventions. In February 2000, the biotechnological company Human Genome Science obtained a patent from the American Patent Bureau for the isolation of a gene that was responsible for HIV and they are able to block the receptor of an amino acid called CCR5. This creates the opportunity

[5] In economic theory, a public good is characterised by non-excludability (everyone has access) and non-rivalry in consumption (the use by one person does not reduce the possibility of use by another person). However, in reality access to information is often limited for *e.g.* people outside research centres, while obtaining information is costly.

to work on different medications that may cure AIDS in the next one or two decades [Krimsky, 2006, 103].[6] In order to stimulate such research, patents may be useful. However, there are, as so often is the case, two sides of the coin. Patents imply private property on information, knowledge, production processes etc. This provides an incentive for research and development, as when an invention is successfully introduced, the company has a monopoly for the duration of the patent and can expect to earn a good profit [see *e.g.* Thomas and North, 1973]. However, an issue is whether monetary incentives are and should be the most important. Furthermore, economic issues are strongly related with ethic and moral issues. Aristotle [1995] had already asked the question of what is the aim of production – is it the accumulation of goods or using goods to achieve a good life? From the point of view of social development, production, and incentives for production, this should be discussed in the context of expanding human capabilities, related to freedom from suffering, illness, oppression, but also access to *e.g.* education, health care and social and economic life [Sen, 1999]. Production of knowledge, information, medicines, or whatever is a mean to achieve a certain goal, achieving a good (quality of) life.

However, the higher prices and profits resulting from patents imply that people who cannot afford such patented goods have no access. When scientific information becomes more expensive, regions and universities where such information may be needed the most as a result of underdevelopment may fall even further behind. A well-known case is medicines for AIDS [see Stiglitz, 2006]. The high price of these medicines makes production and product innovation attractive. If this research did not take place, there would be no cure. However, a yearly course of drugs is often more expensive than the national income per capita in less developed countries in *e.g.* Africa where AIDS is killing thousands and thousands of people. This brings up a moral question – when the knowledge / medicines are available, can we let people die because of their lack of income? Another issue is, to what extent patents should be allowed and whether large companies abuse their market power. For example, to protect a patent, the owner needs funds to enforce his rights in court. For this reason, inventors may sell their patents to large companies.[7] Research and development in developing new medicines may be very expensive, while the

[6] Biotechnology creates great opportunities for *e.g.* eliminating certain illnesses. However, when a gene is discovered to be responsible for a certain disease, this may be an argument for private insurance companies to exclude people with such a gene from health insurance or increase the price of the insurance. Furthermore, when cures make use of a certain patented method, their price increases. As a result, ill people without money or insurance may not be cured at all.

[7] As always, there are two or more sides of the coin. A reason for small companies to sell a patent may be that a large company buying this patent is able to protect it, while another issue is the high costs of access to *e.g.* distribution channels. However, the cost of patent protection may be high due to the opportunistic behaviour of large companies themselves – can an individual win

risk of failure is high, which is another argument in favour of patents. However, as Stiglitz [2006] argues, large western-based corporations may obtain patents on "traditional knowledge" in less developed countries. They in fact "privatise" common knowledge from a poor country where people do not have the funds to defend their rights in American or European courts. A related issue is whether individuals or groups should be the owners of scientific facts. As Melville Nimmer, a lawyer from the USA, wrote:

> The discoverer of a scientific fact as to the nature of the physical world, a historical fact, a contemporary news event, or any other 'facts' may not claim to be the author of that fact. If anyone can claim the authorship of facts, it must be the Supreme Author of us all. The discoverer merely finds and records [Nimmer, 1977, 1015–16].

An important question is whether a part of nature, an element of the human body, can be treated as an invention and be patented? A new rule was introduced after World War II, treating genes as new chemical elements; under the condition that the gene must be isolated and presented in such a form that does not occur in its natural state and that allows further investigations. The law seems to be clear. However, a great struggle between scientists and funding organisations has been going on [Krimsky, 2006]. Corynne McSherry [2000] argues that not too long ago professors could make multiple copies of a published journal article and distribute them to their classes. Scientists could share biological materials and genetic data freely with their colleagues, only by asking.

Robert Merton [1942, 273] formulated some criteria for scientific norms, goals and methods in an idealistic world, in order to ensure science is free from pressure from *e.g.* interest groups:

– Communalism – the substantive findings of science are a product of social collaboration and are assigned to the community. The scientist's claim to 'his' intellectual 'property' is limited to that of recognition and esteem.

– Universalism – knowledge claims are judged through "pre-established impersonal criteria consonant with observations and previously confirmed knowledge" and not through race, gender or social status.

– Disinterestedness – scientists should have no personal or financial attachments to their work. The institutional goal of science is recognition not money.

– Organized Scepticism or Originality – black boxing of the facts. Before any judgement is made about a particular theory "all the facts are in."

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a court case with a multinational employing the best lawyers? Furthermore, the cost of market access may be high due to barriers to entry, created by large companies themselves.

Is it possible to achieve such an idealistic picture of science? It is necessary to keep in mind that a scientist, independent of the fact whether he/she is a mathematician, physician, biologist, sociologist, economist or a historian, is a human being, who is under the influence of numerous factors outside the field of science. Kazimierz Ajdukiewicz [1985] discusses this problem in his work *O wolności nauki* (On the freedom of science), in which he presents factors that influence scientists. Scientific freedom requires that scholars have the freedom to choose the issues and problems, the freedom to choose the methods, freedom of thought and freedom of speech.

The freedom of choice of the issues to be researched is influenced by whether a human being has an adequate amount of means for living and the acquisition of the research apparatus at his disposition, which creates the opportunity to research the issues that he is interested in. However, his freedom can be constrained by limiting access to the subject to be researched or making the apparatus necessary for research inaccessible, as well as by prohibiting travel to the place where the subject of interest is located. People who are materially dependent on a patron are more limited in the choice of the problems to be researched. Although they possess the scientific skills, they are not allowed to research their topic of interest because, for example, it cannot be applied directly in practice and is not of interest to the patron. One example of this may be the lack of appreciation of purely theoretical research that does not find direct application.

The freedom of choice of method can be influenced by the monopolisation of certain methods as correct, a constraint that can be justified on moral grounds – for centuries, for example, autopsy of a corpse for scientific purposes was prohibited – but more dangerous is the introduction of limitations in the name of defending the scientific character of "the only correct method."

Ajdukiewicz [1985, 273] writes that freedom of thought is mainly based on whether one has the right and the ability to believe in anything and that only matter-of-fact arguments support these beliefs and not the obligation or necessity to believe in anything that is not based on rational argumentation, the more so when it concerns something for which counter-arguments exist. Ajdukiewicz calls the declared obligation to accept a certain statement, without regard to its justification, "normative dogmatism." Freedom of thought can be expressed as "thinking with your own head" instead of "thinking with the head of someone else."

There also exists methodological dogmatism, which appears in the form of a statement, theory or theorem that has only been partly justified, but is treated as final. It even happens that some people hold on to certain views although there exist sufficient reasons for rejection.

A person enjoys complete freedom of speech, when others with their intentional activity do not prevent or make it difficult for him (her) to express what

he (she) wants to say and do not force him to express what he does not want to [Ajdukiewicz, 1985, 266–7]. Ajdukiewicz argues further that freedom of speech is based on freedom of speech in science. In order to achieve freedom of speech, four conditions should be fulfilled:

1. enrich science in a significant way;
2. formulate in a proper and clear way;
3. the firmness with which views are expressed should be justified;
4. when an author does not have enough knowledge about a discipline, he/she should not write about it.

Limiting the freedom of speech can be due to granting only supporters of a certain direction of thought the possibility to express themselves (*e.g.* limitation resulting from military secrets, secrets of state, patents, pressure from certain social or political groups).[8, 9]

Merton [1942] had already noted the increasing violation of *e.g.* disinterestedness, and that science cannot exist without funding from the private sector. It may be argued that science has changed from a social service into a profession. However, being a professional scientist at a university or research institute cannot be separated from monetary incentives – however idealistic our view of science, scientists need to earn a living and only a few have the resources to be really independent of funders / patrons.

The issue of freedom of choice and "thinking with your own head" discussed above are related to the issue of patents and property rights on information, which provide incentives for research and development which, together with the usefulness of scientific information, may be a reason for private companies to fund scientific research. However, the source of funding may create problems. An example from Harvard University of problems created by the source of funding is given by Krimsky [2006, 76–80]. In June 2001, Public Citizen [Claybrook, 2001], one of the biggest consumer associations, published a report about companies polluting the environment having a significant influence on Harvard's scientists. John Graham, the founder and director of the Centre for Risk Analysis, had been promoted to the chair of the office of information and regulatory affairs that was a part of the office of management and budget. The report showed that research on the negative effects of smoking, which

[8] This problem is also discussed in Pomorski [1990, 26–7].

[9] It is interesting to consider, when discussing academic freedom or freedom of speech, how freedom is related to what Sen calls human diversity, caused by the existence of personal characteristics (*i.e.* age, sex, physical and mental capabilities) and external characteristics (*i.e.* social and natural environment), both influencing the desired outcome. Academic freedom (or the freedom to achieve something) can be analysed using Sen's distinction between *freedom* and *means to freedom*. Freedom concerns freedom to choose between different alternatives that can be achieved with the available budget, while means to freedom, for example, concerns freedom from problems (illness, hunger, insecurity – *i.e.* necessities) [Sen 1992, 2, 31, 36].

showed that the risk of passive smoking was low, was funded by a tobacco producer. Research questioning banning the use of mobile phones on certain occasions was funded by AT&T Wireless communications. John Graham received funds from more than 100 large corporations and government bodies. There is nothing wrong with funding, but one question is what is the reason for the donation of such grants and whether they influence the reliability of the outcome of the research. When the funder provides grants *e.g.* for reasons of public relations, there seems to be no real problem. However, above all, the funder often decides about the topic of research, limiting the freedom of choice of the scientist [Ajdukiewicz, 1985]. Furthermore, is the funder interested in outcomes that are contradictory to its business interests? When outcomes are unfavourable, does this threaten future funding for scientists? Who is responsible for the publications and who for the scientific research – the donors or researchers? These issues may lead to serious problems, such as the perceived unreliability of data provided by different interest groups.[10] Furthermore, specific interest is likely to lead to focus on those results that are favourable for the interest group. For example, producers of pesticides may emphasise tincreased agricultural output and employment, while consumer associations may emphasise health risks.[11]

3. Diffusion of scientific information

Currently, in many research programmes it is emphasised by the funder that diffusion of the results of scientific research is of crucial importance – *e.g.* dissemination of information is crucial in many EU research programmes. This brings up the question who is the audience of scientific information. In this context, two key issues have to be distinguished:

1. the process of creating knowledge, understood in terms of generating data, organizing data – creating information and analysing the information in order to produce knowledge,
2. the types of audience and the need for understanding science.

So why does society need to understand science? First of all, science creates the basis for technological development. The social and economic advance that the developed part of the world has encountered throughout centuries was

[10] For example, environmental non-government organisations may refuse to use data provided by polluting enterprises and the other way round. This may hamper co-operation and the creation and implementation of policy.

[11] Similar arguments count for government funding for research on issues which are *e.g.* "politically delicate." Does a government or government agency want to have research published which contradicts their policy aims or the aims of the leading party in power?

due to innovations. One only has to think of the development of medicine and health care, increasing life expectancy, or the development of transport and information technologies (the Internet, mobile phones) which reduce the costs of communication significantly. In order to take advantage of scientific knowledge and new technologies, society should know what the advantages are and how to use new technologies. What if people believe that mobile phones cause cancer? What if they do not understand the advantages and disadvantages of new information technologies, which increase labour productivity or make life easier, but are not introduced due to the fear of job loss or, as Augustine [1998] argues, a kind of "monster of Dr. Frankenstein" syndrome? In this respect, trust in science and scientists is of great relevance.

When information diffuses through society, people are more likely to know how to apply new technology and how to use new knowledge, are more likely to accept it, and, a point whose importance should not be underestimated, it may stimulate interest in science (people becoming scientists themselves) and create possibilities for the many small innovations that appear when using new technology. As Augustine [1998] argues, we must take for granted that skyscrapers do not collapse, elevators do not break down, dams do not break, aeroplanes do not fall from the sky, etc. When constructing a new highway or underground, people should understand the advantages and disadvantages, as a lack of acceptance can lead to blocking beneficial changes, while a lack of information may lead to the introduction of undesirable and / or harmful changes. Regarding consumption goods, it may be quite relevant for the purchase decision to know the influence of smoking on your health or the advantages and threats of genetically modified organisms. Regarding the desirability of new technology, it should not be forgotten that many inventions can be used in constructive and destructive ways. Dynamite is useful in *e.g.* mining, but can also be used for terrorist attacks. Nuclear energy can be used for electricity production, but also for the production of atom bombs. As mentioned, research in bio-technology may be used to increase the quality of life, but such knowledge may also easily be used against citizens.[12]

A problem is that selling science is a business which is quite difficult. The science literacy rate is low – maybe one to three percent of the population

[12] This is what George Orwell in fact showed in his book 1984 (written in 1948, but first published in 1949). For example, the use of cameras in public places may be useful in reducing crime rates, as detection and identification of the criminal is easier. However, it remains a question as to what extent society should allow the restriction of privacy for the sake of feeling safe, an ongoing process in developed countries. Much depends on the honesty of the people behind the cameras. Should we believe politicians who argue that when we have nothing to hide, we have nothing to fear? In other words, should we trust the honesty of the rulers / controllers or scientists, in order to reduce the dishonesty of "common man"?

completely understand scientific texts [Miller, 1998; Woźniak, 2000]. However, even an educated economist may have difficulties in understanding physics or biology essays, and vice versa. Besides the problem of understanding, people have a limited amount of time to spend on obtaining scientific information (leaving aside the question of whether they are interested in it). The issue is that there must be a system to reveal scientific information in such a way that it is understandable for a larger public, while not using up too much time. An obvious problem is that when we "summarise" arguments, relevant information may be lost. This is a problem with "popular science", which sometimes is seen as a "corrupted version" of real science. The point is that when science is not popularised, knowledge remains esoteric (for insiders only). Furthermore, popularising science is relevant, as even for students scientific publications are not the main source of information. A questionnaire among 623 Polish, Lithuanian and Greek students shows that about 72% reported that TV is their most important source of information about economic, social and environmental issues, followed by the Internet with 69.5% (three answers possible). Newspapers were mentioned by 40%, while only 7.5% of the respondents mentioned scientific publications. Trust in scientific publications was high, while trust in the reliability of information on the Internet was medium-high (slightly higher than newspapers) [Platje, 2007].

A problem with popularising science is that many people seem to be rather interested in sensation, scandals, murderers etc. and such stories are often described in quite in-depth-detail. Many daily newspapers or weekly magazines contain very little, if any, scientific stories *e.g.* about climate change or stem cells, while other newspapers may have a scientific section. The selection of scientific information which is considered to be relevant for the reader and the way in which it is presented may depend on the profile of a newspaper, as well as the market segments it focuses on. An example is the problem with stem cells presented on different occasions in the "Journal of Experimental Haematology," a purely scientific journal, the scientific section of "The Independent" and in the so-called recent news section of "The Sun".[13]

The title of the articles in these publications express a completely different approach:

– Journal of Experimental Haematology [Jianq et al., 2002]: "*Multipotent progenitor cells can be isolated from postnatal murine bone marrow, muscle, and brain*"

– The Independent (5 March 2002): "Key adult stem cell study had "significant flaws."

– The Sun (28 March 2002): "Docs get clone embryos OK."

[13] The Independent and The Sun are British newspapers.

The title in the Journal of Experimental Haematology shows the scientific nature of the article, as it presents the problem as a stem cell study. The Independent seems to focus on people not involved directly in science as the usage of common language suggests it will be readable and understandable to them. Regarding The Sun article, one may wonder whether the title concerns an article or rather a short story full of slogans, a completely laid back expression, targeted towards "plain folks." The article in The Independent was written by the science editor, Steve Connor. In the article itself, other scientists such as Catherine Verfaillie from the University of Minnesota and Phillip Campbell, the editor of the chief of Nature are cited, with the aim of increasing the perceived reliability of information. The language is generally adapted to popular science norms. Scientific terms are frequently used and explained so the layman can understand them. The Sun, by using the general term "researchers", does not refer to scientific authorities. It refers to more "popular" authorities than scientists – like the Bishop of Oxford (regarding moral issues) and the paralysed superman actor, Christopher Reeve, for whom cloning was seen as a life saving opportunity.

While the aim of the Journal of Experimental Haematology seems to be presenting the results of the research and opportunities for developments for medical use, The Independent seems to try to find a balance between selling news and educating the reader, using facts and figures. The Sun appears to sell sensation, something new and exciting for society, while putting much less emphasis on accuracy of information. This difference in the message and way of communication seems to be caused by the differing marketing strategies used in order to sell the main product – press.

However, another issue is that many journals and newspapers have a certain explicit of implicit mission, which influences the facts they present, on the basis of which the reader should form an opinion and eventually take part in the process of decision-making of local investment projects. One example is the case of the Rospuda Valley in the North-Eastern part of Poland. There is a project to build a by-pass of the town of Augustów, as much traffic, including large amounts of heavy traffic, goes through the city. The problem is that the planned by-pass partly crosses the Rospuda Valley, a nature reserve hosting lots of endangered species, natural peat fields etc. protected in the Nature 2000 programme. On the other hand, the by-pass should relieve the inhabitants of the town from intense heavy traffic and pollution, while infrastructural improvement may attract more tourists and investment. The ecological association "Chodorek" questions the project proposed by the government agency for national roads and motorways (GDDiK – Generalna Dyrekcja Drog Krajowych i Autostrad) from the point of view of its ecological impact and conformity with European Union laws and proposes an alternative project.

It is interesting to analyse the debate presented on different websites, which present completely different pictures of the situation. The first site is www.rospodatak.pl ("Rospoda tak" meaning "Rospuda yes") presents the point of view of proponents of the current by-pass project, showing that this is the best social and economic alternative. According to this website the planners of the by-pass have serious concerns about damaging the natural environment, but the proposed project is presented as the only way of solving the problem. This is done by showing different propositions from experts and comparing the different variants. The "ecological by-pass" is presented as senseless and chaotic, created by people who are, according to this website, not competent in this field. The authors emphasise the social and economic advantages of the current proposal and argues that the "ecological by-pass" also disturbs the natural environment. The website www.imcg.net/threat/01.htm shows the point of view of the "environmentalists." The environmentalists focus more on their priority, the protection of the environment, even at the expense of higher construction costs. They are against building the by-pass through forests and moors, as this affects nesting sites and the flow of the hydrological system. The by-pass they propose goes through agricultural fields, is longer and may lead to the destruction of more private possessions. The whole discussion seems to be based on the oversimplification of the arguments of the other side. The proponents of the current project emphasise that human beings also need to be protected (from the danger of accidents, pollution, etc.), implicitly accusing the environmentalists, who do not negate the need for a by-pass, of "environmental terrorism."

It is not up to us to judge which option is better. The point is that the information presented varies depending on the producer and the expected recipient of that information. The conflict of interests here is much more about the perception of a problem, rather than the problem itself. Often, when there are two sides, both have good arguments for their position. However, priorities may differ and the non-disclosure of information and distortion of the arguments of the opponent makes finding optimal solutions (assuming that they exist) more difficult.

4. Concluding remarks

In this article, some issues of creating and diffusing scientific information were discussed. There are many factors that pose a threat to the objectivity and freedom of science, such as political pressure, the influence of funders and mental models of scientists. In this context it may be useful to quote Myrdal.

> The only way in which we can strive for "objectivity" in theoretical analysis is to expose the valuations into full light, make them conscious, specific and explicit, and

> permit them to determine the theoretical research ... there is nothing wrong, *per se*, with value loaded concepts, if they are clearly defined in terms of explicitly stated value premises [Myrdal, 1970, 55–56, quoted in Blaug, 1992, 120].

In other words, one can argue that we should strive to make the social sciences as objective as possible. This is in fact a Bayesian-type of argument. Bayesians would argue that only higher or lower degrees of truth in statements can be discovered, not ultimate truth [Landreth and Colander, 1994, 15]. In this case, a higher degree of objectivity may be achieved.

Other issues are property rights, incentives and social advantages resulting from science. When private property on scientific information and new technology exists, this provides strong incentives for research and development. However, as a consequence this may lead to increasing differences between the rich and the poor, the developed and underdeveloped, as the poor not only have less resources for research and development, for buying the products resulting from such science (*e.g.* medicines), but also less resources for protecting their own rights.

Private property in scientific research may also hamper future research, as many researchers may have no access to information and thus cannot use it in their own research. However, even when information becomes public, a question remains as to whether people understand this information and in what way this research is popularised. Two case studies were presented identifying the problem of oversimplification related to the target groups of media and the threat of manipulation of information for one's own purposes. The last issue is important when stakeholders should interact to find solutions for issues such as poverty, climate change, environmental deterioration etc. What happens when people do not trust the information provided by the press or other stakeholders? At such a moment they are unlikely to come to appropriate solutions for existing problems.

References

Ajdukiewicz, K., *Język i Poznanie, Tom II – wybór pism z lat 1945–1963* (Language and Cognition, vol. 2, selection of works from 1945–1963). Warszawa, Państwowe Wydawnictwo Naukowe, 1985.

Akerlof, G.A., "The Market for "Lemons": quality, uncertainty and the market mechanism", *Quarterly Journal of Economics*, 84, pp. 488–500, 1970.

Aristotle, *Politics*, transl. Barker, E., Revised with an introduction and notes by Stalley, R.F. Oxford: Oxford University Press, 1995.

Augustine, N., "What We don't Know does Hurt Us. How scientific illiteracy hobbles society", *Science*, 5357, 13/03/1998, pp. 1640–1641, 1998.

Bell, D., *The Coming of Post-industrial Society: a venture in social forecasting*. New York: Basic Books, 1973.

Blaug, M., *The Methodology of Economics*, second edition. Cambridge: Cambridge University Press, 1992.

Castells, M., *The Rise of Network Society. The information age: economy, society and culture.* Volume I. University of California, Berkeley: Blackwell Publishing, 1996.

Coase, R.H., "The Nature of the Firm", *Economica*, 4, pp. 386–405, 1937, Reprinted in: Coase, R.H., *The Firm, the Market, and the Law*, Chicago: The University of Chicago Press, 1988.

Claybrook, J., Statement of Public Citizen President Joan Claybrook on the John Graham Nomination to the Senate Governmental Affairs Committee, available at:
http://www.citizen.org/congrzess/regulations/bush_admin/articles.cfm?ID=5779
last viewed on 10.05.2007

Criscuolo, P., "On the Road Again: researcher mobility inside the R&D network", *Research Policy*, 34(9), pp. 1350–1365, 2005.

Jiang, Y., Vaessen, B., Lenvik, T., Blackstad M, Reyes M, Verfaillie, C.M., "Multipotent Progenitor Cells can be Isolated from Postnatal Murine Bone Marrow, Muscle, and Brain", *Journal of Experimental Haematology*, 34(6):809, pp. 896–904, 2002.

Krimsky, S., *Science in the Private Interest. Has the lure of profits corrupted biomedical research.* Lanham Maryland: Rowman & Littlefield, 2006.

Landreth, H, Colander, D., *History of Economic Thought*, third edition. Boston: Houghton Mifflin Company, 1994.

McSherry, C., *Who Owns Academic Work? Battling for control of intellectual property.* Cambridge: Harvard University Press, 2000.

Merton, R.K., *The Normative Structure of Science*, 1942, in: Storer, N.W., *The Sociology of Science*, pp. 267–278. Chicago: University of Chicago Press, 1973.

Miller, J., *The Measurement of Civic Scientific Literacy*, in: Public Understanding of Science, 1998, available at: http://216.239.59.104/search?q=cache:_8gi_fGs2DEJ:pascal.iseg.utl.pt/~ccti/Documents/Miller1998.pdf+scientific+literacy+in+UK+percentage&hl=en&ct=clnk&cd=1&gl=uk

Molho, I., *The Economics of Information – lying and cheating in markets and organizations.* Oxford: Blackwell Publishers, 1997.

Myrdal, G., *Objectivity in Social Research.* London: Gerald Duckworth, 1970.

Nimmer, M., "The Subject Matter of Copyright Under the Act of 1976", *24 UCLA L.REV.*, 978, pp 1015–1016, 1977.

Orwell, G., *Nineteen Eighty-Four. A novel.* London: Secker & Warburg, 1949.

Pauling L., Itano, H., Singer, S.J., Wells, I., "Sickle Cell Anemia, a Molecular Disease", *Science*, 110, pp. 543–548, November 1949

Porat, M., *The Information Economy: definition and* measurement. Washington D.C.: US Department of Commerce, Office of Telecommunications, publication 77–12, 1977.

Platje, J., "Knowledge and Sources of Information and Priorities on Sustainable Development in Higher Education," in: Leal Filho, W., Manolas, E., Sotirakou, M., Boutakis, G. (eds.), *Higher Education and the Challenge of Sustainability*, pp. 247–257. Soufli: Environmental Education Center of Soufli, 2007.

Sen, A., *Development as Freedom.* New York: Anchor Books, 1999.

Stiglitz, J.E., *Globalization and its Discontents.* New York: W.W. Norton, 2002.

Stiglitz, J.E., *Making Globalization Work.* New York: W.W. Norton, 2006.

Veblen, T., *The Theory of Business Enterprise.* Stanford University: C. Scribner's Sons, 1904.

Woźniak, T., *Propaganda Scjentystyczna – funkcje społeczne przekazów popularnonaukowych.* Warszawa: Wydawnictwo IfiS PAN, 2000.