

THE MEDIABILITY OF GENOMES A STORY FROM THE “BOOK OF LIFE”

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Abstract

The changing relationship between science and the mass media has been characterised in theory as an increasing orientation of science towards the media. This study aims at supporting the media orientation concept empirically for the field of human genome research.

German and British print media coverage of the final phase of the human genome sequencing provided an empirical basis in looking for indicators of a media orientation. Using a quantitative content analysis, 386 articles from four German and four British newspapers have been studied. The appearance of articles in almost any newspaper section illustrates the intertwining of the scientific with political, economic and ethical discourses in the media debate. The media attention peaks indicate the success of events such as a White House press conference. A public presentation of the sequence drafts occurred prior to their scientific publication. Individual scientists became media stars.

Triggered by its far reaching implications, its “Big Science” nature and the competition of publicly and privately funded scientists to finish the first drafts of the human genome, human genome research is indicative of the media orientation of science. It is therefore highly likely that the rationalities of the media system gain an influence on the research field or even beyond it.

Keywords: Human Genome Research, Media, Content Analysis

1. Introduction

“Today, we are learning the language in which God created life” said Bill Clinton, then American president, on 26 June 2000. In the White House, scientists of the international Human Genome Project as well as of the private firm Celera had gathered to announce the completion of the first sequence draft of the human genome¹. The scientists referred to the draft as “the first glimpse of our own instruction book, previously known only to God” and the day is called an “historic point in the 100 000-year record of humanity”.² The event gained worldwide attention, especially by the mass media (hereafter media).

The Human Genome Project (HGP) has been accompanied by media attention since its very beginning in 1990. The mapping, sequencing and functional analysis of the human and other animal model organisms’ genomes changed the pace and scale of biological research; the project marks the discipline’s transition from traditional to “Big Science”.³ At the HGP’s official launch in October 1990, James D. Watson, then director of the genome centre at the National Institutes of Health (NIH) announced that an international consortium was going to sequence the genome till 2005. All data would be made available to the scientific community free of charge. This principle was formalised at a meeting in Bermuda in 1996 where the participants agreed to integrate any new sequence data in public databases within 24 hours of acquisition.⁴

In May 1998, a former NIH-scientist, J. Craig Venter, announced the launch of a private firm whose goal was “to become the definitive source of genomic and related medical information” [3] by sequencing the human genome till 2001. As president and chief scientist of Celera Genomics⁵, Venter planned the sequencing as a money-making venture. In contrast to the HGP, he only gave his data to paying customers and aimed to patent “hundreds of genes” [4]. The academic endeavour, which had by then been ongoing for eight years, was already affronted by choosing the company’s name and motto “Speed matters, discovery can’t wait”.

¹ The genome is the entirety of the genetic information of an organism.

² All quotes in this paragraph are from the 26 June 2000 press release by The White House Office of the Press Secretary [1].

³ For a discussion of the HGP as strategic “Big Science” see [2].

⁴ Bermuda principles: Summary of principles agreed at the International Strategy Meeting on Human Genome Sequencing in 1996, at <http://www.gene.ucl.ac.uk/hugo/bermuda.htm>.

⁵ Celera is Latin for speed (as in acceleration). Venter stepped down as president of the firm in January 2002.

Celera's entrance in the sequencing of the human genome had a deep impact on the progression of the HGP.⁶ Worrying that the American Congress would cut down on the three billion US dollars that were allocated for the project, the international HGP took on the role of the advocate for the public release of genome data. But where was the appropriate arena to argue its case? "We were learning fast that we would have to play the public relations game if we were to survive", wrote one of the publicly funded scientists in his autobiographical approach to the story [7]. As the quote indicates, the competition between a publicly funded international project and a private firm triggered a media orientation on both sides. The human genome project therefore is a relevant case for an empirical study of the changing relationship between science and the media.

2. Orientation towards the Media

Attributing an increasing importance to the media is widely accepted amongst scholars, as is the adoption of a critical attitude towards this development. The concept of mediatization (*Medialisierung*) is used to describe a penetration of society with media content as well as the orientation of social systems towards the media [8, 9, 10, 11]. With regard to science, two aspects of the process have to be differentiated [11]. On the one hand, the crucial role of the media for the communication in society results in the permanent attention of the media for all social systems [12]. The inner world of science, practices of knowledge production such as quality assurance and the norms of science and scientific competition are made public by way of the media [11, p. 19].

On the other hand, the necessity of legitimation and acquisition of broad acceptance in a democratic society accounts for an increasing orientation of science towards a general public. Acknowledging the role of the media in a highly differentiated society, this public can be understood as a media public [13, 14]. The media therefore are the primary addressee for science communication efforts [11]. The media on their part need criteria for selecting news from the huge range of issues that they could possibly cover. The factors that determine the selection of news for coverage have been studied thoroughly.⁷ The list of news factors includes topicality, momentousness and relevance, prominence of personalities, unexpectedness, successes, conflicts, crises and catastrophes as well as human and local interest. Taken together, these factors generate the news value of any event, be it a royal wedding or a new transgenic mouse model of lung carcinoma.

That the media apply their own criteria to scientific news and issues has a far-reaching impact on the communication of science and may imply directing the communication to the rationalities of the media system. A metaphor and discourse analysis of the original speeches, the press releases and the British press coverage of the above mentioned White House Press conference by Nerlich *et al* [18] traced the origin of most of the metaphors and hyperboles used in the media to the artful discourse of scientists and politicians attempting to steer the discourse towards public euphoria. The authors state a "qualified success of these strategies in their reception and transmission by the UK national press" (cf. p. 464). Scientists learn about their colleagues' findings from the mass media [19, 20, 21]. The news value of personal prominence gives rise to attempts of *visible scientists* to exploit the media for their own purposes e.g. to ensure the priority for a finding or to gain public attention [9, p. 245].

Generally, the following phenomena may indicate an orientation towards the media [22]

- ① the intertwining of scientific, political and media discourses
- ① media events such as press conferences
- ① the publication of research results in the mass media prior to their scientific publication
- ① the occurrence of media stars or *visible scientists*⁸

3. Empirical Study

German and British print media coverage of the final phase of the human genome sequencing provided an empirical basis in looking for the above named indicators. Both countries were members of the international HGP consortium.⁹ Using a quantitative content analysis, 386 newspaper articles have been studied. The articles have been published in four German and four British daily newspapers. Two national and two regional daily papers were chosen for study in

⁶ For a scientist's point of view on the "permanent mark left on the public project" see [5]; for the consequences on sequence production cf. [6, p. 867, Fig. 4].

⁷ cf. [15]; for the theory see [12, 16]; for an overview [17].

⁸ The phenomenon of *visible scientists* is not new and can therefore not per se be regarded as a product of media orientation. It can be assumed, however, that in the course of increasing media attention, an individual scientist's mass media prominence has a different dimension than Pasteur's visibility for an assembled crowd in the 19th century.

⁹ About one third of the human genome has been sequenced in the British Wellcome Trust Sanger Institute; in Germany, three laboratories sequenced 1.8 percent of the genome altogether. For details on the selection of the two countries see [23].

each country.¹⁰ For Germany, the national newspapers are the *Frankfurter Allgemeine Zeitung* (FAZ) and the *Süddeutsche Zeitung* (SZ). The regional daily papers are represented by the *Berliner Zeitung* (BZ) and the *Mainzer Rhein-Zeitung* (MRZ). The selected British newspapers are the two nationals the *Times* and the *Guardian* and the regional papers the *Cambridge Evening News* (CEN) and the *Glasgow Herald*.

The period under study covers the twelve months between the 1st of March 2000 and the 28th of February 2001. A broad public discussion of the issue was initiated by a joint statement by politicians Tony Blair and Bill Clinton (15th of March 2000). The period includes the presentation of the first sequence drafts at the White House in June 2000 and the scientific publication of the draft sequences in February 2001. With the keywords “Venter” or “Celera” or “genome” or “decoding”, the online archives of these newspapers have been scanned. Subsequently, only articles that contained at least one concrete reference to the human genome sequencing have been selected. Composed in this way, the sample consists of 386 articles, derived from the eight newspapers under study as is shown in Table 1. The data were analysed statistically using SPSS version 10.0.

Table 1. Origin of Articles in the Sample

	GERMAN NEWSPAPERS				BRITISH NEWSPAPERS			
Total number of articles	250				136			
Share of the sample [%]	65				35			
Media	FAZ	SZ	BZ	MRZ	Times	Guardian	CEN	Herald
Articles per newspaper	107	72	51	20	42	54	24	16
Share of the sample [%]	28	19	13	5	11	14	6	4

4. Results

4.1. The Human Genome intertwined

The sequencing of the human genome was a controversial issue even within science [cf. 25]. With its far reaching medical, commercial and ethical consequences, human genome research is unsurprisingly one of the scientific issues under permanent media observation. How the scientific discourse is linked to other discourses in the media debate can be derived from the newspaper sections where the issue is covered (Fig. 1).

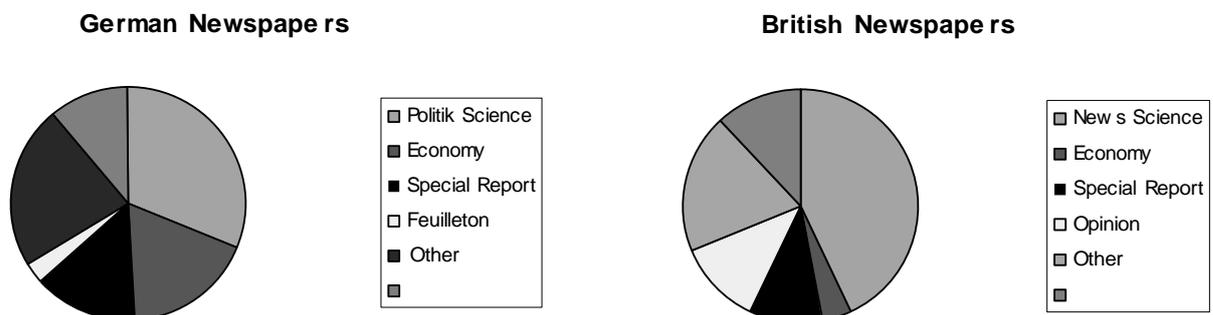


Figure 1a. and 1b. Articles in Newspaper Sections (in % of total articles in the respective country's sample)

¹⁰ A regionally distributed press is characteristic for Germany, a nationally distributed press for Britain [24, p. 132]. Because of their large circulations, widespread recognition of their titles and their influence on the national news agenda, the nationally distributed opinion leading papers guarantee a structural comparability of the two countries. The regional press was selected in order to assess the influence of proximity to a sequencing centre on the coverage (cf. [23]).

Most frequently, articles on the human genome sequencing appeared on the first pages of the newspapers, namely the *news* section of the British and the political section (*Politik*) of the German press. 43% of the articles in Britain and 31% of the articles in Germany were published in these sections, illustrating the importance editors in both countries attached to the issue. Relevant articles were published in all newspaper sections except sport and literature. The assessment that implications reach far beyond the scientific achievement itself also explains the many articles in the so called *Feuilleton* section of the German newspapers (23%).¹¹ The debate in the *Feuilleton* was a major and characteristic feature of the human genome coverage in the German quality press and is the most likely explanation for the higher quantity of articles compared to the British newspapers (cf. Tab.1).

On designated science pages, the sequencing of the human genome appeared more often in the German (18%) than in the British (4%) newspapers. In the latter, scientific “breakthroughs” such as the presentation of the sequence drafts frequently appeared on pages designated as *special reports* (12%). Such pages are less common in the German press (3%). In the British press editorials and comments are published on their own pages *opinion* or *analysis* and a considerable number of the British articles appeared on those pages (19%).

The scientific issue becomes a media event because it is of relevance to society as a whole: in the coverage of the human genome sequencing, the scientific discourse is intertwined with political, commercial and ethical discourses. Rather than presenting more science pages, there is more science in almost all sections of the newspapers.

4.2. The Human Genome as a pre-Publication News Story

In both countries, media reaction is closely tied to the scientific announcements and events between March 2000 and February 2001 (Fig. 2).

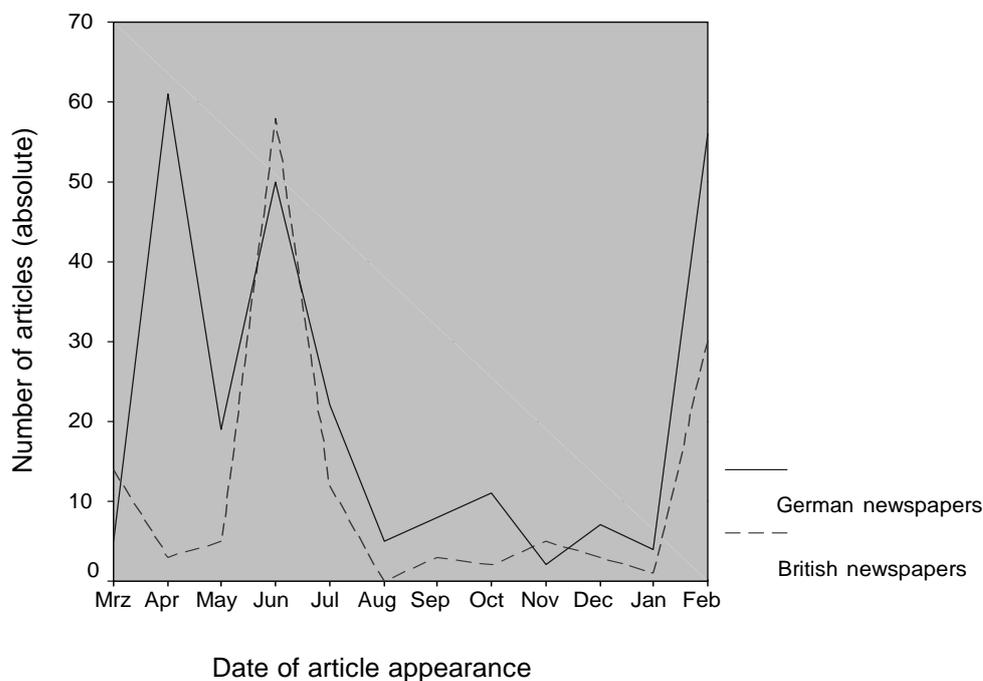


Figure 2. Media Attention to the Human Genome Sequencing between March 2000 and February 2001

The media attention clearly points to the presentation of the sequence drafts by privately and publicly funded scientists in June 2000 and the scientific publication of the data in February 2001. That the media are geared to international scientific triggers is consistent with the results of a study of biotechnology coverage in American opinion-leading publications [26] and explains the nearly parallel run of the British and German media attention curves over most of the period under study. The quantity of the coverage in the German press is consistently higher than in the British press. As already stated, this is probably due to the extensive debate in the German *Feuilleton*.

The graph shows only one major difference between the coverage in German and British media: the importance of

¹¹ The *Feuilleton* in the German press is traditionally the cultural section of a quality newspaper; it includes news and reports as well as comments, reviews and essays. Since several years, scientific and technological developments are increasingly discussed there as well.

the issue in spring 2000. The British press published only three articles in April whereas 61 articles, i.e. an average of two articles per day, appeared in the German media. This tendency continued throughout the month of May, albeit less pronounced. What causes this divergence is elucidated by looking more closely at the contents of the articles reflecting what happened in human genome research. On 6 April, Venter stated that his sequence data were complete and ready to be assembled. No one could verify the achievement because his data were not publicly available. The academic consortium promptly dismissed the claim as a PR campaign aimed at raising Celera's stock price [27]. They nonetheless engaged in the media dispute: a press conference on 8 May 2000 preceded the publication of the second completed human chromosome, chromosome 21, in the 18 May issue of *Nature* [28]. Whereas the German media pay close attention to the announcements, the British newspapers initially almost ignore the scientists' and their press offices' efforts.¹² Their attention increases, however, with the presumably most flamboyant media event in the history of science (see 4.3.).

On 15 and 16 February 2001, the two sequence drafts were published in *Science* [30] and *Nature* [6] respectively, again accompanied by press campaigns and resulting in another increase in media attention (Fig. 2). As the scientific publication occurred in February 2001 only, the whole period under study can be regarded as pre-publication.¹³

4.3. The Human Genome at the White House

According to a press release from the NIH, the state of research on the human genome in June 2000 reads as follows: „The assembly consists of overlapping fragments covering 97 percent of the human genome, of which sequence has already been assembled for approximately 85 percent of the genome“ [32]. To announce a finished draft at that point therefore seems to draw on anything but scientific reasons. So why the announcement? Was it because „the White House wanted something nice to happen about the human genome which was now getting such a lot of press attention“, as John Sulston, who led the British sequencing effort, wrote in his autobiography [7, p. 250]?¹⁴ Or rather, as a scientist who worked at Celera at the time, recalls, “the reason we had it was because the press was calling us at Celera fifty times a day and the pressure was getting so tense that we just needed to get rid of them, basically”?¹⁵ In any case, the carefully stage-managed media event has been a success: In the days following the announcement, news coverage of what was frequently called the “book of life” appeared on TV news and special reports and dominated the front pages of the press.¹⁶ The media attention curve in Figure 2 confirms quantitatively the success of this “PR version of the genome”.

4.4. The Human Genome's *Visible Scientists*

The final point that shall be dealt with here is the occurrence of media stars or *visible scientists*. With regard to the competition situation it is of special interest, how often both teams of scientists get a chance to publicly express their interpretations and points of view on the issue. Throughout the final phase of the sequencing, press releases of the HGP institutions (e.g. NIH, Whitehead Institute, Wellcome Trust Sanger Institute) are quoted just as often as Celera's press releases on an institutional level (both in 34% of articles). With regard to individual protagonists¹⁷ however, Celera's president and chief scientific officer J. Craig Venter is cited much more often than two of his antagonists from the publicly funded project, Francis Collins, the head of the NIH Genome Office and John Sulston, then director of the Wellcome Trust Sanger Institute (Fig. 3). Due to their respective positions, all three of them were prone to become public figures but the visibility *ex officio* appears to be constructed into media prominence by how well they meet the criteria of media interest. It therefore shows individual traits. Being “relevant, controversial, articulate, colourful and reputable as a scientist”, Venter seems to be the prototype of Rae Goodell's *Visible Scientist* [34]. Additionally, he “almost never said no to an interview opportunity”, according to the corporate communications vice president of PE Corporations, Celera's parent company [quoted in 29, p. 200].

¹² That the human genome finally ends up as „one of the biggest news stories of the year [is] due to the communications skills of each group's leading scientists as well as some diligent behind-the-scenes work by their respective PR teams” [29].

¹³ Pre-publication happened again with the finished sequence: The human genome was declared finished in April 2003, nicely matching the 50th anniversary of the discovery of the double helix by James Watson and Francis Crick. The official publication followed 18 months later [31].

¹⁴ That the then American President Bill Clinton called his science advisor in and told him to “make these guys work together” is reported by several authors [29, 33].

¹⁵ Personal communication, 26 April 2005.

¹⁶ In Germany, all five national quality newspapers (*Frankfurter Allgemeine Zeitung*, *Süddeutsche Zeitung*, *Welt*, *Frankfurter Rundschau* and *die tageszeitung*) chose the announcement of the sequence drafts as their lead story on 27 June 2000.

¹⁷ Protagonists are all external, non-journalistic sources of information who are mentioned explicitly in an article and who make a fundamental statement on aspects of the human genome sequencing.

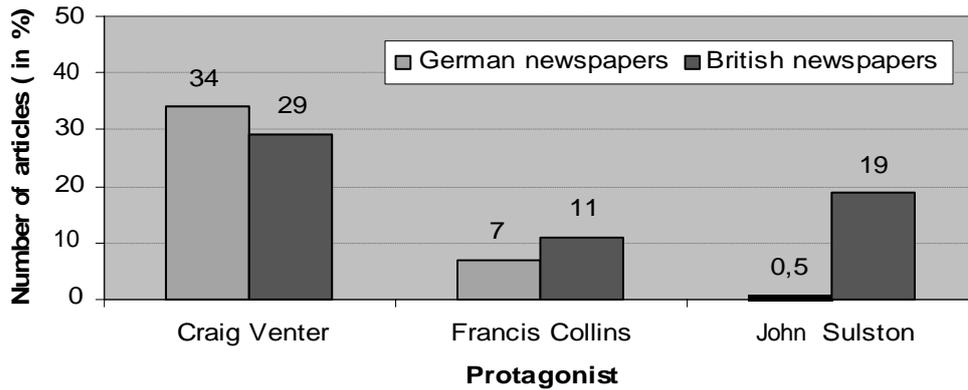


Figure 3. Media prominence of individual scientists

It is therefore not surprising that Venter is quoted in almost every third article in Germany and Britain, whereas John Sulston, who in his book wrote: “One thing was clear: I had no intention whatever of becoming a public face of the human genome” [7, p. 211], remains a British phenomenon only.

5. Conclusion

That science goes public via the media is an expected side phenomenon of modern mass democracies. It corresponds to their increased demands of legitimacy [22] as well as to the central role of the media for the communication in society. The need for legitimization is especially high with regard to “Big Science” projects with multiple implications such as the HGP. Additionally triggered by the competition of publicly and privately funded scientists to finish the first drafts of the human genome, human genome research is indicative of the so called medialization (*Medialisierung*) of science. Privately and publicly funded scientists held multiple press conferences to announce the completion of sequence data collection (April 2000), the publication of chromosome 21 (May 2000) and the presentation of the first sequence drafts (June 2000). German and British print media reaction is closely tied to these announcements. They understand the sequencing of the human genome as a newsworthy scientific issue with far-reaching medical, political, economic and ethical consequences. The appearance of articles in almost any newspaper section illustrates the intertwining of the scientific with political, economic and ethical discourses in the media debate. Science is contextualised according to the criteria of the media, not the ones of the science system.

But on their part, the scientists’ and their PR teams’ efforts to exploit the media leave their marks on the media coverage. The attention peaks show the agenda-building success of media events; Celera as well as the HGP get broad space to declare incremental results and to announce what could be called a “PR version of the genome”.¹⁸ This public presentation of sequence drafts occurred well prior to their scientific publication – and therefore their peer review. It needs further investigation to evaluate whether the announcement reflects a genuine influence of the mass media or whether it was in fact driven by politicians.¹⁹ However, attempts to exploit the media on the one hand and to dispose of the pressures of media attention on the other hand appear as two closely linked aspects of media orientation.

The media prominence of an individual scientist is exemplified in the coverage with regard to one of today’s most visible scientist’s, J. Craig Venter. The surfer, scientist and entrepreneur almost prototypically meets the criteria of media interest. This media prominence can in turn be used in the political and commercial realm, an aspect that gains importance with the increasing share of privately funded research in the generation of scientific knowledge.²⁰

The media attention towards the rivalry between publicly and privately funded scientists can be attributed to a combination and mutual amplification of the news value of the competition itself and Venter’s attention-generating breaks of scientific principles. In the years following Celera’s entrance into the sequencing of the human genome, the media became a major setting for a scientific competition. Even though this was due to the launch of Celera –

¹⁸ The frequent announcements are only commented on critically and ironically in the German national newspapers such as with the title “The chromosome of the week” [35].

¹⁹ The latter interpretation is supported by interviews with human genome researchers conducted by the author in 2005 and 2006 (unpub.).

²⁰ “If politics decides on research issues rather than the criteria of the scientific community, scientists’ and their disciplines’ reputation as it is mediated by the media can become a decisive factor in the public discussion.” [9, p. 124].

suggesting that media orientation in this case was instrumental rather than of a genuine interest in the media – this may well imply that the private firm’s impact on the work of the international consortium was mediated if not due to the extensive media coverage of the competition. As has already been shown in the case of Cold Fusion [21], the “surfeit of information” [21, p. 428] in the mass media led to confusion and instability, resulting in yet more and more public relations activities. The frequent announcements made in spring 2000 show that there was an increasing worry about claims for priority on both sides.²¹ The practice of “science by press release” [7, p. 261], initially more a corporate practice but then used by the public project as well, appears as an attempt to exploit the media in order to secure priority and, as this study suggests, occurs particularly in situations characterised by competition or controversy within science. These pre-publication activities do not yet imply an orientation towards the rationalities of the media system but rather a claim for priority and public attention [9, p. 245]. Weingart suggests that this indicates a quest for political support by way of the media [11, p.22] But even though public announcements of research results prior to their publication in peer reviewed journals are thought to serve the legitimization of public funding or the satisfaction of shareholders, they nonetheless show the crucial role of the media in science’s orientation towards new audiences. What has been called ‘expository science’ has been shown to be shaped by those audiences [36]. That science by press release means an adaptation to the news value criteria of the media is obvious from the study of Nerlich *et al* [18].

The processes and effects of media attention and media orientation are likely to work both ways. This is explicitly favoured in today’s “dialogue model” approaches to Public Engagement with Science and Technology, with the mass media providing the arena for a discourse that is in principle accessible to everybody: “The popular stage can in this sense provide an open space where stimuli, ideas and information are merged and exchanged among different actors and across disciplinary fields, in the absence of the constraints and conventions which bind scientific work and communication at the specialist level” [37, p. 21]).

An exchange “in the absence of constraints and conventions” implies, however, that the outcome of this process with regard to a certain issue or technology is open. The coverage cannot be controlled and conforms to the perception of the media rather than what someone wants to achieve by turning to the media.²² To announce the human genome finished four times may well comprise a danger that the public is left so confused that it loses trust in science.

The HGP certainly was a rare concurrence of concomitant newsworthy factors: The first “Big Science” project in Biology, the object under study itself, the human genome, its “hopes and fears” in terms of medical advances and ethical consequences, the competition between two groups of scientists working with different funding, methods and philosophies and the flamboyant personalities of some individual scientists involved. The final phase of the human genome sequencing therefore should be seen as an extreme case in the relationship between science and the media rather than the normality. But none of the individual factors is rare per se in fields such as biomedical research. The field as a whole relies on extensive funding resources and has the potential to influence everybody’s life. There is a permanent pressure for legitimization and an exposure to constant media attention, calling for an integration of rationalities external to the science system. It is therefore highly likely that the rationalities of the media system gain an influence on those research fields. The repercussions of a media orientation and their impact on the science system itself remain to be studied carefully.

6. References

- [1] The White House Office of the Press Secretary, Press Release, 26 June 2000, at: http://www.kentlaw.edu/islt/clinton_blair_announcement.htm.
- [2] G. Abels, *Strategische Forschung in den Biowissenschaften: Der Politikprozess zum europäischen Humangenomprojekt*, Sigma Rainer Bohn Verlag, Berlin, 2000.
- [3] Celera Genomics, Press Release, 6 April 2000, at: http://www.celera.com/celera/pr_1056640462.
- [4] E. Marshall, “Talks of public-private deal end in acrimony,” *Science*, Vol. 287, p. 1723, 2000.
- [5] L. D. Stein, “End of the beginning,” *Nature*, Vol. 431, pp. 915-916, 2004.
- [6] International Human Genome Sequencing Consortium, “Initial sequencing and analysis of the human genome,” *Nature*, Vol. 409, pp. 860-921, 2001.
- [7] J. Sulston and G. Ferry, *The common Thread. Science, politics, ethics and the Human Genome*, Transworld Publishers, London, 2002.
- [8] W. Schulz, “Reconstructing mediatization as an analytical concept”, *European Journal of Communication*, Vol. 19, pp. 87-101,

²¹ “More than on sequencing both sides focused on scoring points. It became a question of who could afford to wine and dine the press people, all very subtle though.” Personal communication, 26 June 2003.

²² Media effects are not restricted to how the media steer the process of public communication with their own rationality of selecting issues and opinions, but may as well affect whether and how this discussion impacts communication within science. According to Bucchi, a “continuity model” of gradual information flow from a narrow scientific to a broad public communication and vice versa should therefore be complemented by a „multi-level, multivariate perspective that can account for the mutual interactions and the permeable boundaries among different communicative practices“[37, p. 21]; cf. also [21].

2004.

- [9] P. Weingart, *Die Stunde der Wahrheit? Zum Verhältnis der Wissenschaft zu Politik, Wirtschaft und Medien in der Wissensgesellschaft*, Velbrück Verlag, Weilerswist, 2001.
- [10] P. Weingart, *Wissenschaftssoziologie*, transcript Verlag, Bielefeld, 2003.
- [11] P. Weingart, *Die Öffentlichkeit der Wissenschaft und die Wissenschaft der Öffentlichkeit*, Velbrück Verlag, Weilerswist, 2005.
- [12] N. Luhmann, *Die Realität der Massenmedien*, Westdeutscher Verlag, Opladen, 1996.
- [13] J. Gerhards and F. Neidhardt, "Strukturen und Funktionen moderner Öffentlichkeit: Fragestellungen und Ansätze," in S. Müller-Doohm and K. Neumann-Braun (Eds.), *Öffentlichkeit, Kultur, Massenkommunikation. Beiträge zur Medien- und Kommunikationssoziologie*. BIS, Oldenburg, pp. 31-89, 1991.
- [14] P. Donges and O. Jarren, "Öffentlichkeit im Wandel," in O. Jarren and H. Bonfadelli (Eds.) *Einführung in die Publizistikwissenschaft*. UtB, Bern, Stuttgart, Wien, pp. 101-133, 2001.
- [15] J. Galtung and M. H. Ruge, "The structure of foreign news," *Journal of Peace Research*, Vol. 2, pp. 64-91, 1965.
- [16] J. F. Staab, *Nachrichtenwert-Theorie. Formale Struktur und empirischer Gehalt*, Alber, Freiburg/München, 1990.
- [17] C. Eilders, *Nachrichtenfaktoren und Rezeption. Eine Empirische Analyse zur Auswahl und Verarbeitung politischer Information*, Westdeutscher Verlag, Opladen, 1997.
- [18] B. Nerlich et al., "The book of life: how the completion of the Human Genome Project was revealed to the public," *Health*, Vol. 6, No. 4, pp. 445-469, 2002.
- [19] V. Kiernan, "Diffusion of news about research," *Science Communication*, Vol. 25, No. 1, pp. 3-13, 2003.
- [20] D.P. Phillips et al., "Importance of the lay press in the transmission of medical knowledge to the scientific community," *The New England Journal of Medicine*, Vol. 325, No. 16, pp. 1180-1183, 1992.
- [21] B. Lewenstein, "From fax to facts: Communication in the cold fusion saga," *Social Studies of Science*, Vol. 25, pp. 403-436, 1995.
- [22] P. Weingart, "Science and the media," *Research Policy*, Vol. 27, pp. 869-879, 1998.
- [23] S. Rödder, *Das Buch des Lebens in der Presse. Die Darstellung der Entschlüsselung des menschlichen Erbguts in deutschen und britischen Medien*, Verlag Reinhard Fischer, München, 2005.
- [24] F. Esser, *Die Kräfte hinter den Schlagzeilen*, Alber, Freiburg/München, 1998.
- [25] S. Hilgartner, "The Human Genome Project," in S. Jasanoff et al (Eds.), *Handbook of Science and Technology Studies*, Sage, Thousand Oaks, pp. 302-315, 1995.
- [26] M. Nisbet and B. Lewenstein, "Biotechnology and the American Media: The Policy Process and the Elite Press, 1970 to 1999," *Science Communication*, Vol. 23, No. 4, pp. 259-391, 2002.
- [27] *Süddeutsche Zeitung*, 18 April 2000, "Craig Venter hat übertrieben".
- [28] *Deutsches Humangenomprojekt*, Press Release, 8 May 2000, at: <http://www.dhgp.de/deutsch/medien/press/archiv/2000-1999/pm-chr21.html>.
- [29] S. Sweet, "Communicating the Code," *PR Week*, 28 August 2000.
- [30] J. C. Venter et al., "The sequence of the human genome," *Science*, Vol. 291, pp. 1304-1351, 2001.
- [31] *International Human Genome Sequencing Consortium*, "Finishing the euchromatic sequence of the human genome", *Nature*, Vol. 431, pp. 931-945, 2004.
- [32] *National Institutes of Health*, Press Release, 26 June 2000, at: <http://www.nih.gov/news/pr/jun2000/nhgri-26.html>.
- [33] J. Shreeve, *The Genome War: How Craig Venter Tried to Capture the Code of Life and Save the World*, Knopf, New York, 2004.
- [34] R. Goodell, *The visible scientists*, Little, Brown and Co., Boston, 1977.
- [35] *Süddeutsche Zeitung*, 10 May 2000, "Das Chromosom der Woche".
- [36] T. Shinn and R. Whitley (Eds.) *Expository Science: Forms and Functions of Popularisation*, Reidel, Dordrecht, Lancaster and Boston, 1985.
- [37] M. Bucchi, *Science and the Media. Alternative Routes in Scientific Communication*, Routledge, London, 1998.

The Book of Life is a 2014 American 3D computer-animated adventure musical comedy film produced by Reel FX Creative Studios and distributed by 20th Century Fox. Co-written and directed by Jorge R. Gutierrez. The film stars the voices of Diego Luna, Zoe Saldana and Channing Tatum with supporting roles by Christina Applegate, Ice Cube, Ron Perlman and Kate del Castillo. The film received a Golden Globe nomination for Best Animated Feature Film. The Book of Life's story is nothing new but it is told and presented nicely. The characters are mostly likeable and the film doesn't slap villain on characters that it easily could have and the film really comes alive when we go to the Land of the Remembered. Here the gorgeous animationThe Book of Life's story is nothing new but it is told and presented nicely. The characters are mostly likeable and the film doesn't slap villain on characters that it easily could have and the film really comes alive when we go to the Land of the Remembered. The animation in this film alone makes this film a must watch. If you've heard this story a million times along with the occasional pop culture reference, you'll probably enjoy this film.