UDC 81.42

HOMO CYBERUS IN HYPERTEXTUAL REALITY: HEADING FOR PROSPERITY OR COLLAPSE?

E.A. Zaharchuk

PhD (Candidate) in Philology, Docent,
Associate Professor at the Department of Foreign Languages and Professional Communication
e-mail: elena_nezhura@mail.ru

Kursk State University

The human society is currently experiencing an information revolution which is associated with the transition to a new leading means of communication and, as a consequence, to a new type of culture. This transformation has given birth to Homo Cyberus – a human who socializes through cyberspace and encodes information, which is now seen as the greatest value, in hypertext. As collecting, storage and processing of data becomes the leading field of human activity, science tends to view personality through its virtual representation in the global communication space of the Internet. Cyber-socializing results in a totally novel way of organizing one's lifestyle, developing one's cognitive abilities and outlook. It takes more than simply mastering computer technology and learning to use various gadgets: what we see is a deep and profound change of the conceptual field, spiritual and cultural structures. Still this Pandora's Box of cyberspace has a double edge: on the one hand, communication and monitoring the behavior of others becomes easier; on the other hand, protecting personal information and sanctioning undesirable behavior becomes more difficult. Scholars take interest not only in how hypertext is produced, processed and evaluated by the reader, but in accessing the power of cyberspace and hypertext as a tool for social mediation and management. Researchers have revealed a number of system variables and user variables responsible of hypertext deciphering, and as for cyber-socializing in general, there is an even wider range of factors to be considered in the course of studying this process. Respectively, modern Linguistics has evolved from mere text study to a complex discipline embracing a much wider field of interest and linked both to humanitarian studies and exact sciences. Research in the field of hypertexting and cyber-socializing offers a powerful toolbox for exploring the human and the modern society.

Keywords: *hypertext, hypertextuality, virtual reality, internet-socialization, cyber-socialization, Homo Cyberus, Internet Linguistics, social transformations.*

Are we blessed or cursed to witness the dawn of an amazing era where our yesterday's selves often feel as strange and awkward as astronauts within our communication space? Aliens in our own creation, we explore the infinite possibilities it gives us together with its threats. At the dawn of the 21st century in the course of a tremendous breakthrough in information technology humanity has approached a new stage of evolution often referred to as *Homo Cyberus:* as information, i.e. databases, becomes the greatest value of production, and collecting, storage and processing of data is the leading field of human activity, science tends to view personality through its virtual representation in the global

communication space of the Internet. Thus *Homo Cyberus* is described as a human who socializes through cyberspace, which contains internet-socialization and media-socialization as well [Pleshakov 2012].

Cyber-socializing results in a totally novel way of organizing one's lifestyle, developing one's cognitive abilities and outlook. Researchers mention *disembodiment* (separating from the physical body or existing without it) and *deterritorialization* (separation of social, cultural and political practices from a location) as the milestones of the postmodern shift of the 21st century [Macfadyen 2006]. The matter is not only in mastering computer technology and learning to use various gadgets, but in deep and profound change of the conceptual field, spiritual and cultural structures. Personality formation is realized in virtual reality as well as in the material world. Social networks become the test ground for a person's social education.

As the digital age advances, the period of "real time" interaction is being increasingly encroached upon by technology: by the time most children face their preteen years, the bulk of their socialization occurs not in the street or at school, but on Facebook, Twitter, Instagram, and other social media outlets online [Kaminsky 2015]. We face the situation where production and distribution of information has to be immediate, with no space limits or time lags. On the one hand, the Internet gives us great possibilities; on the other hand, it generates new, unexplored problems in social transformations. For example, interest communities in social networks can contribute to a person's sociability, help one find and make friends, but at the same time the greater part of the modern "digital generation" prefers publicity only if it guarantees anonymity [Gabinskaya 2019] so that they feel protected and even invincible. Thus scientists conclude that humanity is currently experiencing an information revolution which is associated with the transition to a new leading means of communication and, as a consequence, to a new type of culture [Rubtsova 2019].

The general notion of "cyber-socializing" or "digital socializing" is usually seen as a complex of phenomena connected to the person's communion to the culture of electronic communication, as well as to values, norms and specific rules of communication in cyberspace; Russian explorers describe it as mastering and appropriation of social experience acquired in online contexts, reproduction of this experience in mixed offline/online reality and shaping a digital personality as part of a real-life one [Aysina, Nesterova 2019].

The amazing paradox is that the processes of cyber-socializing and traditional real-life socializing don't necessarily come together: a person can be very successful in digital social space, but at the same time fail to socialize outside the realm of virtual communication. An urgent problem is that, unlike traditional socialization agents like family and school that regulate the person's social development, the Internet makes socialization spontaneous and often uncontrollable. In an online environment young people are quick to absorb

values and norms which are accepted in the network community with its blurry rules and boundaries, lacking a solid cultural base and traditions. Another peculiarity of web-communication is that on the Internet almost every aspect of human behavior becomes "magnified" [Kaminsky 2015]: negative traits, beliefs, opinions may be rapidly spread around and blown out of proportion, and some normal facets of real-time interaction that are believed to be appropriate for many situations (e.g. sarcasm) may go over very poorly in an arena where there are no body language cues to make one's harmless intent clear. Likewise, very often trivial ranting, venting, and emoting may come off as needlessly harsh when expressed in text form, alienating friends just when one most needs their support. As a result online relationships can be dismantled just as easily and quickly as they are put together. The consequences of all this are now the focus of numerous studies in Sociology, Psychology and even Political science.

Yet let our reflection return from the social to the lingual. In accordance with the change brought into human communication by the technological advance of the recent years, modern Linguistics has evolved from mere text study to a complex discipline embracing a much wider field of interest. The theory of text has developed into the theory of hypertext linked both to humanitarian studies and exact sciences, which reflects the trend of interdisciplinary research. The interesting point is that not only in science, but in a lot of other spheres margins and boundaries blur, and there is a tendency of merging the notions or aspects that seemed very far apart not long ago. The idea of holism is that every object we study is much more than a mere sum of its constituent parts, which makes scholars take a wider perspective and go far beyond the safe and familiar framework of text. Thus we turn from the semiotic to the psycholinguistic, from the regular to the occasional.

The anthropocentricity of text has been emphasized in various fields of research. Hermeneutics that was at first more about the written word than about the human is nowadays referred to as "the methodology of interpretation… concerned with problems that arise when dealing with *meaningful human actions and the products of such actions, most importantly texts*" [Mantzavinos 2016: http]. Thus text studies (where text is considered wider than just the traditional written, vocalized or printed word) offer us an ultimate toolbox for efficient exploring human nature and treating various problems of interpreting people's actions. The 20th century's breakthrough in technology gave birth to an innovative way of data organization – hypertext – which revolutionized not only the way we work with information, but, most important, the way we communicate, learn and think. The concept of hyperspace civilization where human intelligence coexists with artificial intelligence, and mind transfer is about to become a reality involves ubiquitous access to knowledge with next to no limits.

The phenomenon of hypertext which is now much more than simply a technological invention has given rise to a series of publications in IT, Psychology, Cultural and Social Studies, and, naturally, Linguistics. What makes a difference between traditional text and hypertext is the presence of a developed system of hyperlinks in the latter. Those are transitions carried out by clicking on specially selected words and phrases. Such links turn reading into "navigation" and provide the basic characteristics of hypertext – *fragmentation* and *nonlinearity*. Since hypertext consists of fragments, by definition it does not have a fixed compositional structure and a single semantic center. Hypertext is impossible to read "from the beginning to the end", it its boundaries are subjective and determined individually by each specific user. In respect to that, another feature of hypertext is *infinitude* [Rubtsova 2019].

Naturally, processing hypertext and hypermedia structures is fundamentally different from reading traditional printed text. The question is: do we have a right to call this reading? The focus of contemporary research is how the human mind interacts with hypertext, and, conversely, how hypertext interacts with its user, how it self-organizes and develops as a multidimensional system with its own inner "life". The issues to be uncovered are the navigational complexity of hypertext structures, the perception of various elements of hypertext, the correlation between cognitive load during navigation through hypertext and the effectiveness of such reading. Upon closer inspection, the object of Internet Linguistics is web-communication, and its subject is the linguistically relevant features of Internet communication at various levels (morphological, lexical, syntactic, text level, communicative strategy level) [Goroshko 2007]. But in greater perspective, the study of hypertext meets the need in uncovering the communicative and pragmatic potential of virtual space in the anthropocentric framework of modern science. As the majority of people tend to use the Internet a lot nowadays, numerous economical, political, social processes can be defined and described if we take into account the influence of virtual media. Hypertextuality is understood as polysemy, poly-discursiveness, polyphony of virtual communication. This ensures intercultural interaction and cooperation as well as provides a unified communication space where many cultural practices are melted [Bazarova 2011].

A lot has been said about the structure of hypertext. So the focus of our scientific interest has moved "from the digital to the mental". The most exciting facet of studying hypertext is that it operates in a very similar way to how the human brain does – in a series of networks, or associations, as opposed to a linear path. The mind tends to organize information in nonlinear associations between chunks of information. Hypertextuality is viewed by modern science not only as a quality, but a state of being and a potential [Elmfeldt 2002]. Scholars consider that hypertextuality is much more than a feature of digital space: this is the way of existence for the society [Kalmykov 2009] and it

mediates communicative practices and the formation of the picture of the world (more and more knowledge originates from such communication channels but not from personal experience).

When it comes to exploring hypertext reading tactics, scientists claim that there must be *user variables* and *system variables* [Lopez 2010] that affect hypertext reading. User variables are, as the term itself hints, the factors which include prior knowledge, cognitive abilities, experience with computers [Lopez 2010], as well as traditional reading strategies developed by the person [Salmeron et al., 2005]: in this case reading strategies can be considered as the decision rule that a reader follows to navigate through the different nodes of a particular hypertext. For example, readers can read through the contents and select those nodes that contain interesting information or those related to the previous paragraphs they read [Salmeron et al. 2005]. Reading strategies in hypertext can as well determine the amount of information a reader accesses from the text: thus, readers following a strategy consisting of selecting the most interesting nodes could stop reading when they have read all the paragraphs considered interesting [Salmeron et al. 2005]. System variables are the formal features of hypertext itself: the number of links shown by the system, the provision of navigation support and the system structure [Lopez 2010]. All of these determine comprehension in general and the way in which readers process hypertext.

The majority of linguistic studies concerning hypertext comprehension are one way or another related to Walter Kintsch's theory of text comprehension and his Construction–Integration model. It is "a hybrid model, combining symbolic features with connectionist techniques, that emphasizes bottom-up, data-driven comprehension processes over more rigid top-down search strategies" [Wharton, Kintsch 1991: http]. This model distinguishes between two of the mental representations that a reader forms from the text: (1) *the textbase*, which can be described as a hierarchical propositional representation of the information within the text, and (2) *the situation model*, that is a representation in the mind of what the text is about that integrates the information with readers' prior knowledge. Prior knowledge and coherence are the main factors to be taken into account when analyzing text comprehension. Text coherence refers to the extent to which a reader is able to understand the relations between ideas in a particular text [Salmeron et al. 2005].

Studying hypertext reading in the framework of this theory, researchers have come to quite controversial conclusions. For example, in [Belyaeva 2007] the results of a series of experiments gave the author the ground to claim that hypertext (opposed to classical linear text) creates a very specific mental representation in the mind of its reader, which was deduced out of text reviews written by 2 groups of experiment participants. The researcher believes that the text summaries she got from liner text readers represent the text base of the processed passage, while the summaries created by hypertext readers are more

oriented on the situational models built in the readers' minds. Some experiments by [Moeller, Mueller-Kalthoff, 2000; Potelle, Rouet, 2003] show that hypertext benefits to textbase construction. Conversely, other studies could observe little to no effects [Puntambekar, Stylianou, Hübscher, 2003]. Thus, the issue of hypertext comprehension remains yet to be explored. Still the influence of hypertextual communication on modern socializing and education cannot be underestimated.

Researchers believe (and millions of users are the living proof of it) that the advantages of hypertext far outweigh the disadvantages. Thus, [Vora 2001] emphasizes the importance of ready-made "paths" in hyperlinked documents, which have been designed to foresee the needs and wants of the reader and suggest a "guided tour" through the giant array of information; purpose-oriented search tools like browsers and navigation ensure finding the necessary data successfully. Backtrack, bookmarks and history lists are believed to be greatly helpful facilities. Filtering allows readers to specify their interests, and modern intelligent navigation support mechanisms help one to construct or select a personalized path through hyperspace that is tailored for a particular purpose [Vora 2001]. Other strong points quite often mentioned are interactive pictures, reader response (feedback comments, likes/dislikes, sharing the information on one's personal webpage) and the possibility to track readers.

Studies in the field of hypertexting and cyber-socializing offer much more than a toolbox for exploring the human and the modern society. They can create a powerful framework for not only observing, but modifying and managing. The prospect itself was discovered quite early, but even in the end of the 20th century authorities realized that it was not an easy goal to achieve. In [Kollock, Smith 1996: http] we read that "cyberspace has a double edge: monitoring the behavior of others becomes easier while sanctioning undesirable behavior becomes more difficult; the costs of communication between members of a large group are decreased while the effects of defecting are often amplified… there is no simple conclusion to this story, and one-note predictions of either a utopian or dystopian future must be considered suspect".

The issue of "Freedom VS Regulation" in cyberspace is complicated. As [Resnick 1998: 68] emphasizes, "while those working on the cutting edge might still see the Internet as a wide-open frontier, it has taken on the characteristics of a settled territory. The utopian vision of a worldwide agora which would revitalize democracy has to confront the harsh reality of lawsuits and regulations, of commerce and entertainment, of political parties… and most importantly, of masses of bored and indifferent citizens." On the one hand, web-communication is a tremendous chance for every personality to be outspoken and to be heard. It gives equal possibilities to many people despite the age, race, gender, physical health and residence factors. The only requirement is to have access to the Internet. On the other hand, on the reverse of this huge potential for communication, learning and self-expression we face the problem

of greater vulnerability of people's privacy, which requires the authorities' intervention to be protected. As [Harv. L. Rev. 1680, 1999: http] puts it, "the Internet forces us to face anew the tension between pluralism and order. By placing ideas in contact with people, the Internet accentuates the diversity of perspectives that characterizes our world. Yet in so doing, it highlights the difficulties that arise as communities – both those delimited by jurisdictional borders and those defined by commonalties of interests – struggle to define themselves. In the context of Internet regulation, the law must recognize the role it plays in shaping the outcome of these struggles. The multitude of conflicts that can arise because of the Internet suggests that order might require national uniformity; only by imposing uniform rules will judges know how to resolve conflicts that arise between communities." The problem is that individuals tend to differentiate their normative orders according to their localities, race, gender, etc.

The most often reported dangers of cyberspace are cyber fraud and phishing (stealing people's money, credit card data, etc.), malware which can be accidentally downloaded, cyber bullying, posting private information that can ruin the person's reputation (which sometimes happens not instantly, but many years after the publication). The paper by [Quigley et al. 2015] also mentions cyber-terrorism, "hacktivism" (hacking a computer system or network for a socially or politically motivated reason) and even cyber-warfare. [Lessig 2006] emphasizes the importance of intellectual property protection.

In [Siboni 2019] the author surveys various strategies of cyber risk management adopted in leading countries and proposes a multilayered regulatory model with detailed recommendations for regulating the business-civilian sector in cyberspace. The study of cyber regulation demonstrates the high degree of variation in cyber regulation across countries; still, the countries surveyed devote large budgets to cyber security, and there are special institutions that supervise and influence developments in cyberspace, including its most threatened domains. The attention which the authorities give to the issue of cyberspace regulation confirms the importance of this sphere for the state. Siboni's regulatory model for cyber protection suggests defensive practices for organizations to prevent cyber crime. Such practices must be imposed and controlled by the state.

In most countries cyber crime results in real, but not virtual punishment. We will not examine this issue in detail, as the given paper is linguistic but not juridical. Nevertheless, the laws elaborated in the sphere of cyber-security prove the utter importance of the digital communication space for our civilization. The borders between the virtual and the real world become more and more blurred.

The meditating role of web communication space between the individual and the state cannot be underestimated. [Lessig 2006] ponders upon the change from a cyberspace of anarchy to a cyberspace of control. The author suggests

that much of the "liberty" present at the foundation of cyberspace will be removed in its future.

One of the novel branches of scientific research that focuses on human activities in the digital sphere is *socio-cognitive engineering*. It is described by scholars as "a framework for the human-centered design of technology-based systems to enhance human knowledge working, decision making, collaboration and learning" [Sharples 2006: http]. The actions of individual users and groups of people are analyzed: their use of technologies, social interactions, styles and strategies of working, and language and patterns of communication, to form a composite picture of that can help in developing and improving the design of digital communication space. This task involves two main parts: (1) *activity analysis* to interpret how people work and interact with their current tools and technologies, and (2) *socio-technical systems design* to build and implement a better interactive technology. The interesting point is that the works in socio-technical engineering prefer the term "actor" rather than "reader" or "user". This emphasizes the specificity of people's behavior in the digital communication space: individuals don't just "use" virtual reality, they "live" in it, modify it, create, express themselves in this realm. Socio-technical engineering is a way of not only studying and improving the digital world for the sake of people's convenience, but gently and implicitly influencing the human to cultivate the necessary outlook, preferences, behavior.

An example of influencing people's beliefs and political preferences through the Internet in Russia is an organization called the Internet Research Agency (also known as "Troll Factory" or "Trolls from Olgino"). This company based in St. Petersburg is engaged in *online influence* operations. The agency employs hundreds of fake accounts in social networks to post comments of political character which discredit some personalities or parties/institutions. The labour duties of the officially hired "trolls" include creating multiple posts and comments on the web, giving "likes" or "dislikes" to some content, which makes an impact on public opinion. As Internet-users tend to believe the information they read without checking the facts, such tactics is usually a success, and public attention (with a positive or negative effect depending on the situation) is quickly drawn to the necessary events or personalities. Moreover, there is evidence that a number of mass media are related to this organization. In the infinite vast of the digital communication space it becomes more and more difficult to filter the information that we consume.

The future of hypertextual communication technologies – utopian or dystopian, – as well as the position of the human in this space, remains yet to be unclear. But needless to say, the role of this communication sphere in the life of mankind is huge, and the prospects it gives us can be applied for the welfare of our civilization. Same as nuclear energy, virtual reality has a great power to create or to destroy. To apply this power for the greater good, we must explore it and tame it. Psycholinguistic research is one of the tools to carefully manage this

Pandora's Box, and the task of science is to explore its nature and find the best possible application to its capacities.

References

Aysina, R.M., Nesterova, A.A. (2019). Cyber Socialization of Youth in the Information and Communication Space of the Modern World: Effects and Risks. Social Psychology and Society, 2019. Vol. 10, N.4. Pp. 42–57.

Bazarova, A.A. (2011). Hypertextuality as a Basic Feature of Internet Mass-Media // Topical Issues of Philology: Proceedings of an International Conference (Chita, Nov. 2011). Chita: Young Scientist, 2011. Pp. 151–152. URL: https://moluch.ru/conf/phil/archive/25/1247/ (referred on: March 21, 2020).

Belyaeva, N.V. (2007). A Psycholinguistic Study of Text Comprehension // Izvestia: Herzen University Journal of Humanities & Sciences. Linguistics and Literature. Vol. 18/44. 2007. Pp. 83–87.

Gabinskaya, A.A. (2019). Cybersocialization: Sociocultural Development of the Digital Generation in the Framework of Internet Technology // Brest University Bulletin. 1st Series. Philosophy. Political Studies. Sociology. 2019. Vol. 2. Pp. 48–54.

Goroshko, E.I. (2007). Internet Linguistics: the Formation of a Disciplinary Paradigm // Genres and Types of Text in Scientific and Media Discourse. Orel. Kartush, 2007. Vol. 5. Pp. 223–237.

Elmfeldt, J. (2002). Mediacy – Exploring Hypertextuality. AoIR Internet Research 3.0: NET/WORK/THEORY, Maastricht NL. URL: https://www.researchgate.net/publication/265120308_Mediacy_-Exploring_Hypertextuality (referred on: Jan. 30, 2018).

Harv. L. Rev. 1680 (1999). Cyberspace Regulation and the Discourse of State Sovereignty. 112 Harvard Law Review 1680, 1685 (1999). URL: https://cyber.harvard.edu/property00/jurisdiction/hlr.html (referred on: Aug. 8, 2020).

Lessig, L. (2006). Code: And Other Laws of Cyberspace, Version 2.0 2nd Revised ed. Edition. Basic Books, 2006. 431 p. URL: http://codev2.cc/download+remix/Lessig-Codev2.pdf (referred on: Aug. 8, 2020).

Kalmykov, A.A. (2009). Interactive Hypertext Journalism in the System of Domestic Media. Moscow, Publishing House of Workers of TV and RV, 2009. 84 p.

Kaminsky, A. (2015). Socializing in Cyberspace: How to Balance the Influence of Virtual World on Children and Teens. Advanced Psychology Services. URL: https://www.psy-ed.com/wpblog/socializing-in-cyberspace/ (referred on: July 14, 2020).

Kollock, P. & Smith, Marc. (1996). Managing the Virtual Commons: Cooperation and Conflict in Computer Communities. Pragmatics and Beyond New Series. Pp. 109–128. URL: https://www.researchgate.net/publication/215643656_Managing_the_Virtual_Commons_Cooperation_and_Conflict_in_Computer_Communities (referred on: June 1, 2020).

Lopez, R.I. (2010). Towards a Hypertext Comprehension Model: the Role of Reading Strategies and Cognitive Load. PhD Thesis Resume. En la Universidad de Granada, Spain, 2010. URL: https://dialnet.unirioja.es/servlet/tesis?codigo=63443 (referred on: March 27, 2020).

Macfadyen, L.P. (2006). The Culture(s) of Cyberspace / Encyclopedia of Human Computer Interaction. Edited by Claude Ghaoui. Dec. 2006. 780 p. Pp. 143–149.

Mantzavinos, C. (2016). Hermeneutics / The Stanford Encyclopedia of Philosophy (Spring 2020 Edition), Edward N. Zalta (ed.), forthcoming. URL: https://plato.stanford.edu/archives/spr2020/entries/hermeneutics/ (referred on: March 17, 2020).

Moeller, J., Mueller-Kalthoff, T. (2000). Learning with Hypertext: The Impact of Navigational Aids and Prior Knowledge. Zeitschrift für Pädagogische Psychologie, 14, 2000. Pp. 116–123.

Pleshakov, V.A. (2012). Human Cybersocialization: from Homo Sapiens to Homo Cyberus. Monograph. Moscow State Pedagogical University, 2012. 270 p.

Potelle, H., Rouet, J.-F. (2003). Effects of Content Representation and Readers' Prior Knowledge on the Comprehension of Hypertext. International Journal of Human–Computer Studies, 58, Pp. 327–345.

Puntambekar, S., Stylianou, A., & Hübscher, R. (2003). Improving Navigation and Learning in Hypertext Environments with Navigable Concept maps. Human–Computer Interaction, 18, 2003. Pp. 395–428.

Quigley, K., Burns, C., Stallard, K. (2015). 'Cyber Gurus': A Rhetorical Analysis of the Language of Cybersecurity Specialists and the Implications for Security Policy and Critical Infrastructure Protection. Government Information Quarterly. Vol. 32, Issue 2, April 2015. Pp. 108–117.

Resnick, D. (1998). Politics on the Internet: the Normatization of Cyberspace / The Politics of Cyberspace. A New Political Science Reader. Edited by C. Toulouse & T.W. Luke. Routledge, New York, 1998. Pp. 48–68.

Rubtsova, O.V. (2019). Digital Media as a New Means of Mediation (Part Two). Cultural-Historical Psychology, 2019. Vol. 15, no. 4. Pp. 100–108.

Salmerón, L., Cañas, J., Kintsch, W., Fajardo, I. (2005). Reading Strategies and Hypertext Comprehension. Discourse Processes. Vol. 40. 2005. Pp. 171–191.

Siboni, G. (2019). Regulation in Cyberspace. The Institute for National Security Studies, Tel Aviv, 2019. URL:
https://www.inss.org.il/publication/regulation-in-cyberspace/ (referred on: Aug. 1, 2020).

Sharples, M. (2006). Socio-Cognitive Engineering. Encyclopedia of Human Computer Interaction. 10.4018/978-1-59140-562-7.ch080. URL: https://www.researchgate.net/publication/32231480_Socio-cognitive_Engineering (referred on: Aug. 8, 2020).

Vora, P.R. (2001). Hypertext and Hypermedia / International Encyclopedia for Ergonomics and Human Factors. Edited by W. Karwowski. Tailor and Francis Inc., 2001. Vol. 1. Pp. 691–694.

Wharton, C., Kintsch, W. (1991). An Overview of the Construction-Integration Model. Working Notes for the Symposium on integrated Intelligent Architectures, Stanford, March 1991. URL: http://digitalcollections.library.cmu.edu/awweb/awarchive?type=file&item=361947 (referred on: March 27, 2020).