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Lateral and vertical transfer in biology, linguistics and anthropology
An account of widely neglected ideas in the formation of evolutionary theories

Introduction

The purpose of this paper is to present a few selected research results of the joint project “Evolution and Classification in Biology, Linguistics, and the History of Sciences”. This project, generously funded by the Federal German Ministry of Research and Education (BMBF), was conducted by international research teams at the universities of Duesseldorf and Ulm, Germany in the years 2009-2012. Our paper is focused on findings from the history of the sciences section of this project that focused on reticulations between scholars of different academic disciplines in the formation of different theories of evolution from the 18th to the 20th centuries.

The Phylogenetic Visualization of Evolutionary Processes in Biology, Linguistics and Anthropology

Looking at models of biological and cultural evolution that developed from the 19th century onward, we can see clearly that they are characterized by two main features:

- They were mostly centered on the unilinear transmission of cultural and biological replicators (among others, languages)
- They were centered on phylogenetic images of descent, that means, specifically, the tree of life and the tree of languages metaphors.

This claim shall be testified by a look at the prevailing models of evolutionary descent in (1) linguistics, (2) biology, and (3) cultural and social anthropology.

Pedigrees in linguistics

As a remarkable fact, the image of the pedigree of languages is older than the tree of life image: In the late 18th century, Felix Gallet drew an early tree of languages, depicting their origin in a common ‘langue primitive. At this time, the typical imaging of relationships between biological species was network centered, as sketches drawn by the famous French naturalist George Buffon (1683–1775)¹ and the German botanist and physician August Batsch (1761-1802)² indicate.

With the development of comparative linguistics during the 19th century, and due to the works of William Jones (1746-1794), Franz Bopp (1791-1847), Kristian Rask (1787-1832), and Jacob Grimm (1785-1863),³ the idea that all Indo-European languages originated in a common proto-language (*Ursprache*) was established as a default theory.⁴ The development of the Indo-European languages was increasingly visualized in a pedigree fashion. Already in 1853, that means six years before Charles Darwin (1809-1882) published his *Origin of Species*, August Schleicher (1821-1868) presented an early language tree representation. This phylogenetic representation had probably been inspired by a quite similar image drawn by František Ladislav Čelakovský (1799-1852) which showed the branching of the Slavonic languages. Since then, the tree model has become the standard visualization of the development of Indo European languages and other language families⁵ – even in more recent attempts in mathematical modeling language evolution).⁶

The ‘tree of life’ Metaphor in Biology

In biology, the idea of unilinear descent of species by matters of natural selection in the struggle for life (Darwin 1853) gained increasing acceptance in the second half of the century and was also applied to human evolution (Darwin 1871).⁷ Although Charles Darwin himself drew hardly any image that can be identified as a true tree of descent,⁸ his followers did – especially the German zoologist Ernst Haeckel (1834-1919), the main popularizer of Darwin’s theory in Germany.⁹ Since then, the ‘tree of life’ image has become the standard visualization

¹ Le chien avec ses varieties, Buffon 1755.

² Tabula affinitatum regni vagitabilis. Copper engraving.

³ Jones, 1786; Bopp 1816, Rask 1818, Grimm 1819-34.

⁴ Schleicher 1853, 1861/62.

⁵ Gamkrelidze & Ivanov 1990.

⁶ E.g. Pagel 2009.

⁷ 1859, 1871.

⁸ Cf. his famous sketch of 1837 ‘I think’ which is only a very rudimentary phylogenetic image.

⁹ Among the followers of Darwinian thought in the German-speaking countries are also his translators Heinrich Georg Bronn (1800-1862) and Victor Julius Carus (1823-1903).

of biological evolution, even in those revised images that acknowledge vertical transfer as one among several factors in biological evolution.¹⁰

Evolutionary thought in cultural and social anthropology

Looking at evolutionary thought in cultural and social anthropology, we can see that the new discipline of culturally-oriented anthropology split from physical anthropology and was developed as an independent scholarly discipline under different labels such as *ethnologie*, *Völkerkunde*, social and cultural anthropology in the nineteenth century,¹¹ due to the works of Gustav Friedrich Klemm (1802-1867),¹² Adolf Bastian (1826-1905),¹³ Johann Jakob Bachofen (1815-1887),¹⁴ Theodor Waitz (1821-1864),¹⁵ Lewis Henry Morgan (1818-1881),¹⁶ Edward Burnett Tylor (1832-1917),¹⁷ and James George Frazer (1854-1941).¹⁸ All these early cultural and social anthropologists were stiff evolutionists, subscribing to a model of development from ‘lower’ to ‘higher’, more advanced stages of human development – a view that was clearly compatible with Enlightenment theories of cultural Evolution.

Conclusion

As a conclusion, we can claim that evolutionism had been firmly established as dominant school of thought in the second half of the nineteenth century in biology¹⁹ as well as in linguistics,²⁰ in social and cultural anthropology, and also influenced the emerging doctrine of Marxism.²¹

¹⁰ Doolittle 2000.

¹¹ Hann 2005.

¹² Klemm 1843.

¹³ Bastian 1860.

¹⁴ Bachofen 1861.

¹⁵ Waitz 1877.

¹⁶ Morgan 1877. Morgan had been heavenly influenced by the Swiss lawyer Johann Jakob Bachofen who had presented his view of an originally matriarchal society that anteceded later evolutionary stages of patriarchal societies; Bachofen, ‘Das Mutterrecht’ 1861, Rössler 2007, p. 5.

¹⁷ Tylor 1871.

¹⁸ Frazer 1890.

¹⁹ Darwin 1859, 1871; Haeckel 1874. In Darwin’s own works, occasional references to cultural and linguistic evolution can be found: In ‘Descent of Man’, Darwin points to technology, such as traps, snares or weapons, which might give one primitive human group a fitness advantage over another. In the ‘Origin of Species’, Darwin several times points to similarities between established theories of language change and his theory of descent with modification. And in ‘Descent of Man’ he writes: ‘A struggle for life is going on amongst the words and grammatical forms in each language. The better, the shorter, the easier forms are constantly gaining the upper hand,’ Darwin 1871, p. 113.

²⁰ Schleicher 1863, Bleek 1868.

²¹ Friedrich Engels’ (1820-1895) ‘The Origin of the Family, Private Property, and the State’ (1884) is subtitled ‘subsequent to Lewis Henry Morgan’s Research’; in German: ‘Der Ursprung der Familie, des Privateigentums und des Staats. Im Anschluss an Lewis H. Morgans Forschungen’.

'Antidotes' to Evolutionism

But not all biologists, linguistics and anthropologists of the 19th century subscribed to the idea of human development in the sole form of unilinear evolution in successive stages, leading from inferior to superior states. Apart from the fact that the idea of (Darwinian) evolution suffered a severe backlash in the beginning of the 20th century and was only later revived by the neo-Darwinian 'wedding of [Mendelian] genetics to evolutionary biology' in the 'new synthesis' of the 1930s and 1940s,²² the idea of the diffusion of words, grammatical features, cultural traits, and whole cellular organs had played a considerable role in the realms of biology, cultural anthropology, and linguistics already in the 19th century and did compete with the *Leitmotif* of evolutionism. The beginning of the 20th century saw a general anti-evolutionary turn in all three realms of biology, linguistics, and anthropology. Examples will be given here, starting with biology.

In 1883, the theory of endosymbiosis, claiming that eukaryotes developed through the merger of different prokaryotes, was introduced into biology by the German botanist Andreas Schimper (1856-1901).²³ He claimed that the chloroplasts to be found in the cells of plants originated from formerly independent cyanobacteria. This theory was then elaborated on by the Russian biologist Konstantin S. Merežkovskij (1855-1921) and only in the 1960s rediscovered by the American biologist Lynn Margulis (1938-2011) who further developed and publicized the endosymbiotic theory.²⁴

Alternatives to the phylogenetic model of languages origin

In linguistics, the phylogenetic model of language evolution that had been developed in the 19th century gained the status of a default theory and still forms the base of modern language classification.²⁵ The standard theory of a horizontal transmission of a language's words and grammar was, however, questioned by linguists like Johannes Schmidt (1843–1901). In 1872, Schmidt proposed his 'wave model' of language change. He claimed that a new language feature (innovation) will 'spread from a central region of origin in continuously weakening concentric circles'. The theory came into existence since the phylogenetic model of language change did not seem to be able to explain the development of some characters by descent from a proto-language.²⁶ Fifty years later, the Italian linguist Giuliano Bonfante presented

²² Hull 1988, p. 57, Dobzhansky 1937; Huxley 1942; Mayr 1942.

²³ Schimper 1883, Mereschkowsky 1905.

²⁴ Sagan, 1967, Margulis 1970, Geus & Höxtermann 2007.

²⁵ E.g. Gamkrelidze & Ivanov 2000, Greenberg 2000, 2002.

²⁶ Schmidt 1872, Spitzer 1922.

another approach emphasizing the role of horizontal reticulations between the subgroups of Indo-European.²⁷

More recent critique of the phylogenetic model of language origin emphasizes the fact that the origin of mixed languages – like Mbugu/Ma‘a in Tanzania – as well as of Pidgin and Creole languages is hard to explain by the historical-comparative standard model.²⁸ ‘Reconstructed phylogenetic networks that capture both vertical and horizontal components of evolutionary history reveal that, on average, eight per cent of the words of basic vocabulary in each Indo-European language were involved in borrowing during evolution [... the results of recent studies ...] indicate that the impact of borrowing is far more widespread than previously thought.’²⁹

Looking at the history of linguistics, it becomes evident that, coinciding with the dismissal of evolutionism in biology, the discipline’s attention shifted from the diachronic study of languages’ history and origin to the synchronic study of contemporary, ‘living’ idioms in the beginning of the 20th century. Backed by the new theoretical orientation of structuralism put forward by Ferdinand de Saussure(1857-1913),³⁰ a general turn toward the inner framework of languages was achieved within the ‘Prague School of Linguistics’ from the 1920ies onward. The members of the linguistic circle of Prague introduced the distinction between *language*, *langue* and *parole* to describe different functions of language and speech, and to analyze linguistic elements like phonemes and morphemes. Moreover, Nikolai Trubetzkoy (1890-1938) and Roman Jakobson (1896-1982) favored the concept of *Sprachbund*, i.e. the areal typology of languages,³¹ focusing on the lateral transfer of morphological features between languages, languages families, and their subgroups, instead of vertically transferred, inherited features.³²

The idea of areal typology can be traced back as far as to the 18th century when the Swedish scholar Johann Thunmann (1746-1778)³³ had noticed that certain morphological features - namely the absence of the infinitive, postponed articles and a ‘murmur’ vowel of similar quality - were shared between Romanian, Bulgarian, Greek and Albanian. These are all Indo-European languages, but they belong to four different subgroups.

In Thunmann’s succession, a number of linguists like Jernej Kopitar (1780-1844) and Franc Miklošič (1813-1891) identified geographical areas of shared features due to linguistic

²⁷ Bonfante 1931, Nelson-Sathi et al. 2011.

²⁸ Schuchardt 1979, Bickerton 1981, Mous 2003.

²⁹ Shijulal Nelson-Sathi et al. 2011.

³⁰ Saussure 1916.

³¹ Trubetzkoy 1930, Jakobson 1931, 1971.

³² Geisler & List 2013.

³³ Thunmann 1774.

convergence, and developed the paradigm of a 'Balkan linguistic area'.³⁴ This 'Sprachbund' model has then be extended to other areas of the world, e.g. the Indian subcontinent. Recently, the Altaic language family, encompassing Turkic, Mongolic, and Tungus languages in northern Eurasia, has been questioned as a language family and is regarded to represent a 'Sprachbund' rather than a stock of genetically related languages.

Turn of the century trends in cultural and social anthropology

Around the turn to the twentieth century, evolution was not only frequently dismissed in biology and linguistics, but also in socio-cultural anthropology.³⁵ Four main traditions of cultural anthropology emerged: *Social Anthropology* in Britain,³⁶ *Ethnologie* in France, *Völkerkunde* in the German-speaking countries, and *Cultural Anthropology* in North America. All 'four ways'³⁷ of cultural anthropology In the Anglo-Saxon, French and German-speaking countries expressed a strong anti-evolutionary perspective, guided by the theories of cultural relativism and particularism, diffusionism and structuralism.³⁸

Cultural and social evolutionism was equally dismissed within the British school of *Social Anthropology* which emerged shortly after World War I, with Bronisław Malinowski (1884-

³⁴ Kopitar 1829, 1945, Miklosich 1862.

³⁵ Bowler 1992, 2003.

³⁶ Malinowski 1915, 1922, Radcliff-Brown 1922, Evans-Pritchard 1937, Fortes & Evans-Pritchard 1940.

³⁷ Hann 2005.

³⁸ 'Die fruchtbarsten Einwände gegen die spekulativen Entwürfe der Evolutionisten kamen im 20. Jahrhundert von den Vertretern einer sich formierenden empirischen Ethnologie: Boas, Kroeber, Lowie, Malinowski, Radcliffe-Brown ...' (Streck 2000, p. 62). In the German-speaking countries, the discipline of *Völkerkunde* took a critical stand towards the question of cultural evolution in the shape of *Kulturkreislehre* (Gingrich 2005), elaborated on by the 'Vienna School' of historical ethnography (Streck 2000, p. 43). Leading figures in this turn to cultural diffusionism were Fritz Graeber (1877-1934), Bernhard Ankermann (1859 – 1943), Leo Frobenius (1873-1938), Wilhelm Koppers (1886-1961), and Wilhelm Schmidt (1868-1954) from the Catholic missionary order *Societas Verbi Divini* (SVD; Frobenius 1898, Ankermann 1905, Graebner 1905, 1911). Instead of cultural evolution in progressive stages, the lore of 'Kulturkreislehre' advocated the idea of cultural degeneration which was supposedly manifested in the supposed decline of monotheism to polytheism (Schmidt 1912-1955) or the historical development of 'Primärkultur' and 'Sekundärkultur' as degenerative process spoiling features like monogamy, monotheism, and patriarchal structures that were still abundant in the assumed 'Urkultur' (Rössler 2007, p. 13.) The idea of decay, so prominent in *fin de siècle* thought in the German-speaking countries of central Europe (Spengler 1918, 1922) proved to have a lasting influence on German and Austrian ethnography until the 1930 and 1940s (Rössler 2007). Diffusionist ethnography searched for 'pure forms of culture' instead of a development in hierarchical steps assuming that major technical and cultural inventions occurred only very rarely and were transmitted by cultural diffusion rather than by evolution – a view that prevailed in the works of Franz Boas and his early disciples as well (Wissler 1917, Kroeber 1939). The idea of world-wide diffusion of ideas and methods rooted in a 'Neo-Kantian' perception of history as an independent entity as well as in the romanticist research on language and mythology and the German movement of historicism which is closely connected with the person of Leopold von Ranke (1795-1886). Historicism emerged at a time when the idea of overall progress was increasingly questioned (Streck 2000, p. 42) and had been advocated by the geographers Georg Gerland (1833-1919) and Friedrich Ratzel (1844-1938) in their application of Moritz Wagner's (1813-1887) idea of diffusion. Wagner's field of interest covered natural history, zoology and geography as well as ethnography. The zoologist and geographer Friedrich Ratzel was mentioned by Boas as one of his most influential early mentors in 1911 (Voget 1970, p. 209).

1942), Alfred Radcliff-Brown (1881-1955), Edward E. Evans-Pritchard (1902-1973), and Meyer Fortes (1906 - 1983) being the main representatives. The emerging school of *Social Anthropology* in Britain advocated the method of participating observation in fieldwork, focusing on daily social interaction within a human community rather than on the classification of cultures by language, artefacts, and physical traits of its representatives. At roughly the same time, French *ethnologie* was coined by personalities like Emile Durkheim (1858- 1917) and Marcel Mauss (1872-1950) who shifted the discipline's focus to questions of social life.³⁹ The discipline was then shaped by Claude Lévi-Strauss (1908-2009) applying structuralist thought to ethnology and coining the term *anthropologie structurale*.⁴⁰ In North America, the nineteenth century view that populations were defined by an integrated complex of physical and cultural traits (including language and religion) met fierce opposition by the emerging cultural relativism and particularism of the Boasian school of cultural anthropology. Franz Boas (1858-1942) strongly rejected speculative ideas of cultural evolution and claimed that culture developed independently of biological characteristics of human populations, with culture, 'race' and language constituting mutually independent and unrelated determinants of human existence. In his succession, Clark Wissler (1870–1947) and Alfred Kroeber (1876-1960) established regional diffusionism as leading idea in their concept of 'cultural and natural areas'.⁴¹

The reintroduction of evolution (with unilinear horizontal descent) to anthropology

As the American anthropologist Marshall Sahlins shows, the evolutionary theoretical framework based on the idea of unilinear descent was largely reintroduced in the 1970s,⁴² especially since recent approaches in human genetics, evolutionary biology, and linguistics focus on the pedigree model and even tend to advocate a genetic-cultural-linguistic co-evolution in humans.⁴³ Therefore we would like to stress the fact that alternative models of lateral and vertical transfer between species, languages, and cultures are as grounded as the established phylogenetic models of evolution in all these three realms (biology, linguistics,

³⁹ Durkheim 1912, Mauss 1913.

⁴⁰ Lévi-Strauss 1958.

⁴¹ Wissler 1917, Kroeber 1939.

⁴² Sahlins 1977, 2000, Claessen 1996.

⁴³ Especially by the geneticist Luigi Luca Cavalli-Sforza, e.g. Cavalli-Sforza et al. 1981, 1988, 1991, 2005.

and anthropology),⁴⁴ and should be given more attention than before in an attempt to formulate an all encompassing theory of evolutionary epistemology. We also feel able to show that the emphasis that had been put on the that unilinear pedigree model of evolution in biology, linguistics and anthropology is to a certain degree biased and tends to neglect processes of vertical and/or lateral reticulation (networking and diffusion) that equally occur in the three scientific realms under consideration (biology, linguistics, anthropology).

As a conclusion, we can clearly see that theories of unilinear descent in biology, linguistics and anthropology represent just one among several approaches in explain evolutionary development in all three realms. ‘Antidotes’ to the pedigree and tree of life metaphors have been presented as early as phylogenetic models, but have been often neglected, suppressed or simply been ignored. Our aim was to draw your attention to these alternative models of lateral and vertical transfer of words, genes, and culture traits which form an indispensable part of an all-encompassing evolutionary epistemology.⁴⁵

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⁴⁴ Anthropology in the sense of the four field approach introduced by Franz Boas to U.S. American anthropology.

⁴⁵ In a very famous sketch, Alfred Kroeber tried to outline the main difference between biological and cultural evolution by a simple modification of the pedigree model. This famous sketch shows that the idea of unilinear evolution has to be extended to an overall model of evolutionary epistemology combining models of horizontal/lateral transfer with those of vertical transmission of words, genes, and culture traits.

References

- Ankermann, Kulturkreise und Kulturschichten in Afrika, *Zeitschrift für Ethnologie* 37, 1905, pp. 54-90.
- Bachofen, J.J., *Das Mutterrecht: eine Untersuchung über die Gynaikokratie der alten Welt nach ihrer religiösen und rechtlichen Natur*. Stuttgart: Kraus & Hoffmann 1861.
- Bastian, A., *Der Mensch in der Geschichte*. Leipzig: O. Wigand 1860, 3 vol.
- Bickerton, D., *Roots of Language*. Ann Arbor: Karoma 1981.
- Bleek, W.H.J., *Über den Ursprung der Sprache*, ed. Ernst Haeckel. Weimar: Böhlau 1868.
- Boas, F., *Kultur und Rasse*. Berlin: Gruyter 1913.
- Boas, F., *Race, Language, Culture*. New York: MacMillan 1940.
- Bonfante, G., *I dialetti indoeuropei*. *Annali del r. istituto orientale di Napoli* 4, 1931, pp. 69-185
- Bopp, F., *Über das Conjugationssystem der Sanskritsprache in Vergleichung mit jenem der griechischen, lateinischen, persischen und germanischen Sprache*. Frankfurt/Main: Andreäische Buchhandlung.
- Bowler, P., *Evolution: The History of an Idea*, third edition, completely revised and expanded. Berkeley: University of California Press 2003.
- Bowler, P., *The Eclipse of Darwinism: Anti-Darwinian Evolution Theories in the Decades around 1900*. Baltimore, Johns Hopkins University Press 1992.
- Buffon, G.-L.L., *Histoire naturelle générale et particulière*. Paris: Imprimeries royale, 36 vol. 1749-1788.
- Cavalli-Sforza, L.L., Feldman, M.W.; *Cultural Transmission and Evolution: A Quantitative Approach*. Princeton: Princeton University Press 1981
- Cavalli-Sforza, L.L., Piazza, A., Menozzi, P., Mountain, J., *Reconstruction of Human Evolution: Bringing together Genetic, Archaeological, and Linguistic Data*. *Proceedings of the National Academy of Sciences, USA* 85, 1988, pp. 6002-6006.
- Cavalli-Sforza, L.L., Wilson, A.C. et al., *Call for a Worldwide Survey of Human Genetic Diversity: A Vanishing Opportunity for the Human Genome Project*. *Genomics* 11, 1991, pp. 490-491.
- Cavalli-Sforza, L. : *Studying diversity*, *EMBO reports* 6/8, 2005, p. 713.
- Cavalli-Sforza, L.: *The Human Genome Diversity Project: past, present and future*, *Nature Reviews Genetics*. 6(4), 2005, pp. 333-340.
- Claessen, H.J.M., *Evolution and Evolutionism*. *Encyclopedia of Social and Cultural Anthropology*, eds. Alan Barnard, Jonathan Spencer. London, New York: Routledge, 1996, pp. 213-218.
- Darwin, C., *On the Origin of Species by Means of Natural Selection, or the Preservation of Favoured Races in the Struggle for Life*. London: John Murray, 5th ed. 1869.
- Darwin, C., *The Descent of Man, and Selection in Relation to Sex*. London: John Murray 1871.
- Dobzhansky, T., *Genetics and the Origin of Species*. New York: Columbia University Press 1937.
- Doolittle, W.F., *Uprooting the tree of life*. *Scientific American*, February 2000, pp. 90-95.
- Durkheim, E., *Les formes élémentaires de la vie religieuse*. Paris: F. Alcan 1912.
- Engels, F., *Der Ursprung der Familie, des Privateigentums und des Staats*. Im Anschluss an Lewis H. Morgan's Forschungen. Hottingen 1884.
- Evans-Pritchard, E. E., *Witchcraft, Oracles and Magic among the Azande*. Oxford: Oxford University Press 1937.
- Fortes, M., Evans Pritchard, E.E. (eds.), *African Political Systems*. London: Oxford University Press for the International African Institute, 1940.
- Frazer, J.G., *The Golden Bough: A Study in Magic and Religion*. London: Macmillan 1890.
- Frobenius, L., *Ursprung der afrikanischen Kulturen*. Berlin: Gebrüder Bornträger 1898.
- Gamkrelidze, T.V., Ivanov, V.V., *The Early History of Indo-European Languages*. In: *Scientific American*, March, March 1990, pp. 110-116.
- Geisler, H., List, J.-M., *Do Languages Grow on Trees? The Tree Metaphor in the History of Linguistics*. In: *Classification and Evolution in Biology, Linguistics and the History of Science. Concepts – Methods – Visualization*, eds. H. Fangerau, H. Geisler, Th. Halling, W. Martin. Stuttgart: Steiner, forthcoming.
- Geus, A., Höxtermann, E. (eds.), *Evolution durch Kooperation und Integration: Zur Entstehung der Endosymbiosetheorie in der Zellbiologie*. Marburg: Basiliken-Presse 2007.

- Gingrich, A., The German speaking countries. In: Chris Hann [ed.], *One Discipline, Four Ways: British, German, French, and American Anthropology. The Halle Lectures*. Chicago, London: University of Chicago Press, 2005, pp. 92-97
- Graebner, F. *Methoden der Ethnologie*. Heidelberg: Winter 1911.
- Graebner, F., *Kulturkreise und Kulturschichten in Ozeanien*. *Zeitschrift für Ethnologie* 37, 1905, pp. 28-53.
- Greenberg, J.H., *Indo-European and its Closest Relatives: The Eurasiatic Language Family*. Palo Alto: Stanford University Press, 2 vol. 2000, 2002.
- Grimm, J., *Deutsche Grammatik*. Göttingen: Diederich, 1819-34, 4 vol.
- Haeckel, E. *Anthropogenie oder Entwicklungsgeschichte des Menschen*. *Gemeinverständliche wissenschaftliche Vorträge über die Grundzüge der menschlichen Keimes- und Stammes-Geschichte*. Leipzig: Engelmann 1874.
- Hann, C. (ed.), *One Discipline, Four Ways: British, German, French, and American Anthropology. The Halle Lectures*. Chicago, London: University of Chicago Press, 2005.
- Hull, D.L., *Science as a Process. An Evolutionary Account of the Social and Conceptual Development of Science*. Chicago, London: University of Chicago Press 1988.
- Huxley, J., *Evolution: The Modern Synthesis*. London: Allen and Unwin 1942.
- Jakobson, R. *Über die phonologischen Sprachbünde*. *Travaux du Cercle linguistique de Prague* 4, 1931.
- Jakobson, R., *Selected Writings*. Paris, Den Haag: Mouton 1971.
- Jones, W. *The Third Anniversary Discourse, on the Hindus, delivered by the President, February 2, 1786*, *Asiatick Researches* 1, 1786, pp. 415-431.
- Klemm, G.F., *Allgemeine Culturgeschichte der Menschheit*. Leipzig: Teubner 1843.
- Kopitar, J., *Albanische, walachische u. bulgarische Sprache*, *Jahrbücher der Literatur* 46, Wien, 1829, pp. 59-106;
- Kroeber, A.L., *Cultural and Natural Areas of Native North America* Berkeley: University of California Press, 1939.
- Lévi-Strauss, C., *Anthropologie structural*. Paris : Plon 1958
- Malinowski, B., *Argonauts of the Western Pacific: An Account of Native Enterprise and adventure in the Archipelagoes of Melanesian New Guinea*. *Studies in Economics and Political Science* 65. London : Routledge and Kegan Paul 1922.
- Malinowski, B., *The Trobriand Islands*. London: Routledge 1915.
- Margulis, L., *Origin of Eukaryotic Cells*. New Haven: Yale University Press 1970.
- Mauss, M., *L'ethnographie en France et a l'étranger*, *Revue de Paris* 20 (5), 1913, pp. 537-560, 815-837.
- Mayr, E., *Systematics and the Origin of Species*. New York: Columbia University Press 1942.
- Mereschkowsky, C., *Über Natur und Ursprung der Chromatophoren im Pflanzenreiche*, *Biologisches Centralblatt* 25/18, ed. J. Rosenthal 1905, pp. 38-604.
- Miklosich, F., *Die slavischen Elemente im Rumänischen*. Wien: K.K. Hof- u. Staatsdruckerei 1862.
- Morgan, L.H., *Ancient Society, Or: Researches in the Lines of Human Progress from Savagery through Barbarism to Civilization*. London: MacMillan & Company 1877.
- Mous, M., *The making of a mixed language: The case of Ma'a/Mbugu*. Amsterdam: Benjamins 2003.
- Nelson-Sathi, S., List, J.M., Geisler, H., Fangerau, H., Gray, R.D., Martin, W., Dagan, T., *Networks uncover hidden lexical borrowing in Indo-European language evolution*. *Proceedings of the Royal Society – Biological sciences*, 2011, pp. 1794–1803.
- Pagel, M., *Human language as a culturally transmitted replicator*. *Nature Review Genetics* 10, June 2009, pp. 405-415.
- Radcliff-Brown, A. R., *The Andaman Islanders. A Study in Social Anthropology*. London: Cambridge University Press 1922.
- Rask, R.K., *Undersøgelse om det gamle nordiske eller islandske Sprogs Oprindelse*. Copenhagen: Gyldendal 1818.
- Rössler, M., *Die deutschsprachige Ethnologie bis ca. 1960: Ein historischer Abriss*, *Cologne Working Papers in Cultural and Social Anthropology* 1, 2007 <http://kups.ub.uni-koeln.de/volltexte/2007/1998/pdf/kae0001.pdf>, accessed March 11, p. 5.
- Sagan, L. *On the origin of mitosing cells*, *Journal of Theoretical Biology* 14/3, 1967, pp. 255–274;

- Sahlins, M., Ethnographic experience and sentimental pessimism: Why culture is not a disappearing object. In: *Biographies of Scientific Objects*, ed. Lorraine Daston. Chicago, London: University of Chicago Press, 2000, pp. 158-202.
- Sahlins, M., *The Use and Abuse of Biology. An Anthropological Critique of Sociobiology*. Ann Arbor: University of Michigan Press, 1977.
- Saussure, F. de, *Cours de linguistique générale*. Paris: Payot 1916.
- Schimper, A.F.W., Über die Entwicklung der Chlorophyllkörner und Farbkörper, *Botanische Zeitung* 41, 1883, pp. 105–120, 126–131, 137–160.
- Schleicher, A., *Compendium der vergleichenden Grammatik der indogermanischen Sprachen. Kurzer Abriss der indogermanischen Ursprache, des Altindischen, Altiranischen, Altgriechischen, Altitalischen, Altkeltischen, Altslawischen, Litauischen und Altdeutschen*, 2 vol., Weimar: Böhlau 1861/1862.
- Schleicher, A., *Die Darwinsche Theorie und die Sprachwissenschaft. Offenes Sendschreiben an Herrn Dr. Ernst Haeckel, o. Professor der Zoologie und Director des zoologischen Museums an der Universität Jena*. Weimer: Böhlau 1863.
- Schleicher, A., *Die ersten Spaltungen des indogermanischen Urvolkes*. *Allgemeine Monatsschrift für Wissenschaft und Literatur* 1853, pp. 786-787.
- Schmidt, J., *Die Verwandtschaftsverhältnisse der indogermanischen Sprachen*. Weimar: Böhlau 1872.
- Schmidt, W., *Der Ursprung der Gottesidee. Eine historisch-kritische und positive Studie*. Münster: Aschendorff, 1912-1955, 12 vol.
- Schuchardt, H., *The ethnography of variation: Selected writings on pidgins and creoles*. Ed.& translated by T.L. Markey, introd. Derek Bickerton. Ann Arbor: Karoma 1979.
- Spengler, O., *Der Untergang des Abendlandes. Umriss einer Morphologie der Weltgeschichte*, Wien 1918, München 1922.
- Spitzer, L., (ed.) *Hugo Schuchardt-Brevier: Ein Vademecum der allgemeinen Sprachwissenschaft*. Halle/Saale: Niemeyer 1922.
- Streck, B. 2000. *Kulturanthropologie*. In: *Wörterbuch der Völkerkunde*, ed. B. Streck. Wuppertal: Trickster 2000, pp. 141-144.
- Thunmann, J.E., *Über die Geschichte und Sprache der Albaner und Wlachen*. Leipzig: S. L. Crusius 1774.
- Trubetzkoy, N.S., Proposition 16. Über den Sprachbund. *Actes du premier congrès international de linguistes à la Haye*, du 10.-15. 1928. Leiden: Sijthoff, 1930, pp. 17-18.
- Tylor, E.B., *Primitive Culture: Researches into the Development of Mythology, Philosophy, Religion, Language, Art, and Custom*. London: John Murray 1871.
- Verkaar, E.L., Nijman, I.J., Beeke, M., Hanekamp, E., Lenstra J.A., *Maternal and paternal lineages in cross-breeding bovine species. Has wisent a hybrid origin?* *Molecular Biological Evolution* 21(7), July 2004, pp. 1165-70.
- Voget, W., Boas, Franz. *Dictionary of Scientific Biography*, ed. Charles Coulston Gillispie. New York: Charles Scribers Sons 1970, vol. 2, pp. 207-213, namely 209).
- Waitz, T., *Die Anthropologie der Naturvölker*. Leipzig: F. Fleischer 1877, 6 vol.
- Wissler, C., *The American Indian, An Introduction to the Anthropology of the New World*. New York: McMurrie, 1917.