



Styles of Scientific Thinking in Geography

Coğrafyada Bilimsel Düşünme Stilleri

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Makale Bilgisi

Bekaroğlu, E. & Anlı, Ö.F. (2019). Styles of Scientific Thinking in Geography. *Posseible Düşünme Dergisi*, Sayı: 15, s. 38-50.

Kategori: Araştırma Makalesi

Gönderildiği Tarih: 15.03.2019

Kabul Edildiği Tarih: 12.07.2019

Yayınlandığı Tarih: 29.07.2019

Article Info

Bekaroğlu, E. & Anlı, Ö.F. (2019). Styles of Scientific Thinking in Geography. *Posseible Journal of Thinking*, Issue: 15, pp. 38-50

Category: Research Article

Date submitted: 15th March 2019

Date accepted: 12th July 2019

Date published: 29th July 2019

Abstract

This study, which focuses on the styles of scientific thinking in the geographical praxis, claims that geography has been characterized historically by three different styles of scientific thinking. The styles that are created by revisiting geographical thinking in the light of the modern world-system analysis are called holistic one-cultural, systematic-empirical, and systematic-two cultural, respectively and provide the framework in which the Crombiean scientific thinking styles (Crombie, 1994) can be embedded and understood. It was concluded in this attempt at constructing geographical styles with an abductive reasoning that the Crombiean modernist macro-scale framework could only be meaningful and enhanced by a discipline-specific reconstruction of the styles exhibited by singular sciences historically.

Keywords: Styles of Scientific Thinking, Geography, A. Crombie, The two cultures.

Özet

Coğrafi pratiğin tarihsel olarak sergilediği bilimsel düşünce stillerine odaklanan bu çalışma, coğrafyanın tarihsel olarak üç farklı bilimsel düşünce stiliyle karakterize olduğunu öne sürmektedir. Coğrafi düşünün modern dünya-sistemi analizi ışığında yeniden okunması neticesinde oluşturulan stiller sırasıyla holistik-tek kültürcü, sistematik-empirik, sistematik-iki kültürcü olarak adlandırılmakta ve Crombieci bilimsel düşünce stillerinin (Crombie, 1994) içerisine yerleştirilip anlam bulabileceği çerçeveyi sağlamaktadır. Coğrafi stillerin abdaktif bir uslamlamayla inşa edildiği bu girişimde, Crombieci modernist makrocu çerçevenin, ancak tekil bilimlerin tarihsel olarak sergiledikleri stillerin disipliner-spesifik bir rekonstrüksiyonuyla anlam bulabileceği ve geliştirilebileceği sonucuna varılmıştır.

Anahtar Sözcükler: Bilimsel Düşünme Stilleri, Coğrafya, A. Crombie, İki Kültür



1 Introduction

In his *magnum opus* "Styles of Scientific Thinking in the European Tradition" published in 1994, A. C. Crombie distinguishes six styles, which have made their mark on the western image of science since antiquity to the 18th century (Kwa, 2011). These trans-disciplinary and trans-paradigmatic styles of thinking focus on the ways of reasoning that mostly crosscut fields of knowledge in terms of history of science. These styles of scientific thinking are postulational, experimental, hypothetical, taxonomic, statistical, and historical (Crombie, 1994).

Styles of thinking in the tradition of geography that go back to antiquity do not have a composition that can be directly understood by Crombie's abstractions. This does not mean that the geographical tradition does not have a style but rather it points to a challenge in the nature of Crombie's attempt. Indeed, Crombie's styles, apart from being macro-scale abstractions, focus on temporally and spatially dominant rituals. This reflects the importance attributed to both science and to regularity by the *ethos* of the enlightenment, thus the dominant rituals are generally promoted to the status of *truth*.

This article aims to investigate the styles of thinking in geography. Our argument is that the macro-scale styles of thinking in geographical thought cannot be understood by directly using the Crombiean framework as such an attempt necessitates a discipline-specific approach. It is argued that the abstraction we put forth in this study describes the styles of thinking in modern and contemporary geography, albeit diachronously: geographical thought has its own styles of thinking originated from its own historicity while it is still influenced by the Crombiean system at the theoretical level.

The rational reconstruction of scientific thinking in geography, by its nature, necessitates a theoretical reconstruction of the historical background. Because every scientific ritual -though not in linear context-gains its context by virtue of its historical inheritance, meaning is attained from such context. For this reason, this article will first focus on Crombie's historiography, and then the macro-scale external history of geographical thought will be reconstructed in the light of modern world-system analysis and finally, styles of thinking in geography will be distinguished.

2 The Styles

According to Crombie, a scientific style "*with its commitments, identified certain regularities in nature, which became the object of its inquiry, and defined its questions, methods and kinds of evidence appropriate to acceptable answers within that style*" (Crombie, 1995, 234). Crombie distinguishes six categories of thinking styles (Crombie, 1988; 1994; 1995):

a) *Simple postulation method* is best exemplified by Greek mathematics, geometry and logic. The postulation method represented by Plato, Aristotle, Euclid, Archimedes and Ptolemy, for example, reflects rational principles from which propositions are derived to give meaning to entities.

b) *Experimental style*, which reflects the effort to check the postulates by measurement and observation and to investigate the nature, comes into prominence with its role in the making of the modern scientific image especially in the 16th and 17th centuries. From this perspective, this style employed in almost all factual areas as seen by Galileo, Lavoisier, Newton and many other scientists' works and is still the basis of modern science.

c) The third style named *hypothetical modelling* by Crombie is developed as a model, which ensures that the unknown properties of a natural phenomenon are revealed by the known phenomena of a theoretical or physical artefact. Kepler's modelling of the human eye, Descartes' general physiology and Hobbes' political society exemplify this style, which systematically transferred into science and philosophy from the arts.



d) *The taxonomic style*, which reflects the logical organisation of the diversity in a subject matter by means of comparison and differentiation, despite its Greek origins, was the foundation of modern science. The taxonomic style, which developed with the discoveries (as seen in the classification of the organic and inorganic world), is still used, for example, in contemporary astronomy.

e) The style of *statistical and probabilistic analysis of expectation and chance* in some respects agrees with Ian Hacking's *The Taming of Chance* (1990). With this style, which describes the taming of uncertainty with reason and the calculus of probability especially after the 17th century, the search for regularity in big numbers of events gained prominence and this style of thinking found an area of implementation in physical and social domains. Such that, the studies of the neo-positivist movement, *sensu stricto*, on the probability theory are the indicator of the effect of this style on epistemological modelling, among others.

f) *The method of historical derivation or the analysis and synthesis of genetic development* is a style widely used in the areas of language, human culture, geological history and evolution. In this style, the subject matter of historical derivation is determined by diagnosis and the common properties of the varieties of beings are determined to reach a common origin in the past. The ritual continues with putting forward the postulates that can explain the diversity displayed by the common origin.

Even though Crombiean historiography points sometimes to a scientific reasoning (e.g. hypothetical), sometimes to a method (e.g. statistical) or to a ritual in history of science (e.g. taxonomy), it actually crosscuts various subject matters adopted by various disciplines since any single style operates in more than one scientific field. On the other hand, styles are supra-paradigmatic as, unlike theory generating paradigms, paradigms are produced within a given style in different fields. For instance, when two disciplines are taken into account such as economics and physics with different subject matters working under the influence of hypothetical and statistical styles, paradigms operating in those fields are not only being independent of each other, but also can change in one of the disciplines although the dominant style persists. Within this perspective, styles crosscut subject matter, theory and paradigm (or research programme) respectively and thus constitute a meta-building block of classical and modern scientific image.

At the same time, Crombie's styles are naïve as he has abstracted those styles from the history of science with an abductive reasoning but did hesitate to investigate them under the lenses of philosophy of science. Maybe for this reason, Crombie's styles of scientific *thinking* evolved into styles of scientific *reasoning* in the hands of Ian Hacking and gained ground for epistemological debates (e.g. Hacking, 1982; 1992; 2012; Vicedo, 1995; Kusch, 2010; Ruphy, 2011; Winther, 2012; Sciortino, 2017). Yet, apart from Hacking's addition of the artificial "laboratory style" (Hacking, 2009), which could easily be evaluated within the experimental style, Crombiean framework persisted with its historical dimension. For this reason, we shall be using the existing historical framework and leave the potential epistemological debates to another study.

3 The Cultures¹

We would like to turn the focus on the reconstruction of the institutional and intellectual external history of geography by considering two important attempts. The first of these attempts is the conceptualisation of "two cultures" by C. P. Snow (1959), and the second is the interpretation of this conceptualisation in a theoretical-historical framework by the modern world-system analysis (Gulbenkian Commission, 1996; Wallerstein, 2011). These two moves primarily suggest a unified structure of knowledge for pre-modernity where boundaries between cosmology, ethics, governmental doctrines and aesthetics did not exist (Collins, 2005). We name this unified structure of knowledge as "one culture" by rewinding Snow's

¹ In the third and fourth sections, the ideas put forward by Bekaroğlu (2016) were widely utilized.



conceptualisation (Bekaroğlu, 2016). One cultural structure of knowledge points to a practice of knowing where there is no separation between those who understand the language of the nature and those who understand the language of humanities.

However, a chasm came to appear in the unified structure of knowledge as of 17th century, and natural scientists declared themselves as the followers of that which can be objectively verified by repeatable methods, hence demolishing the one-cultural practice (Stremlin, 2004). According to Wallerstein (2011), this fragmentation was realized by the adoption of only one element (true) of the trio of true, good and beautiful. As a natural consequence, the humanities which endorsed the good and the beautiful declared their practices of knowing as different from those of the natural scientists, thus leading to a long term *methodenstreit* among the two groups.

In Windelband's words, the development that reflects the conflict between the nomothetic wing and the idiographic wing has split the one culturalist "faculty of philosophy" of the medieval university resulting in the birth of faculties of science and humanities respectively, which are the institutional manifestation of the concept of two cultures (Wallerstein, 2004). After the gestalt transformation created by the French Revolution, the six disciplines called the social sciences today (economics, sociology, political science, history, anthropology, orientalism) have joined this separation between the structure of knowledge. However, the social sciences, since they could not create a third epistemology, are split among the practice of two cultures as if a stagecoach pulled towards opposite directions by two horses. The result is the departmentalization of social sciences into nomothetic (economics, sociology, political science) and the idiographic (history, anthropology, and orientalism) camps in the framework of the two culturalist structures of knowledge institutionalised in the 19th century (Gulbenkian Commission, 1996).

This institutional structure, which has lasted until the end of World War II, suffered from erosion under the influence of three main developments, namely the USA becoming a hegemonic power, increase in population and economic growth in the world, and expansion of the university system.

One of the changes brought about by these developments in the organisation of the knowledge structure of the modern world-system was the emergence of multi-disciplinary area studies after 1950s. From then on, for hegemonic powers the political and economic potential of China, for instance, became more important rather than the art of novel during various Chinese dynasties, thus various regions of the non-modern world became the subject matter of the collaborative studies of historians, economists, sociologists, political scientists and to some extent geographers. This kind of working environment has led to the convergence of the three nomothetic social sciences to the others, while at the same time leading anthropologists and orientalists to "return home" (Wallerstein, 2006).

The expansion of the university system with economic growth and increase in population gradually reduced the quality of universities and created an environment favourable for "poaching" with the creation of sub-specialities under different disciplines. The transition from elite education to mass education increased the academic population who found themselves an exit in the form of theses written in the intersectional areas of various disciplines where an *original* thesis in a discipline would normally be expected in essence. In this direction, many sub-disciplinary fields were derived, all of which eroded the strict boundaries of the modern academic structure of the 19th century.

The impact of the 1968 world revolution in this environment of disciplinary abundance, in which the disciplinary complex before 1850 (the proto-disciplinary period) began to resurface, further shook the modern university structure. One consequence of the quake is related to the epistemological level and resulted in the questioning of the political positions of the existing disciplines in terms of their support to the *status quo*. Scientific disciplines have *a priori* bias that needs to be resolved. In parallel, critical voices were raised which stated that the researcher is part of the research processes, that the subject-object separation cannot be accepted and that the knowledge production process takes place in an open system. Awareness of neglected groups (women, minorities, indigenous peoples, people with oppressed gender identities, marginal groups) also increased during this period (Gulbenkian Commission, 1996).



Other important source of criticism after 1968, are complexity theory derived from the natural sciences (Prigogine, 1997) and cultural studies derived from humanities. Both critical attitudes created an *epistemological convergence* between the camps separated by a deep chasm by claiming that, both in the nature and the human world, -Newtonian- regularities are not absolute but transient (historical) realities that exist in certain situations, and that it is essential to understand the continuing complexity in the universe.

All those new developments as well as the world-system analysis that emerged in the 1970s have shaken the modern knowledge structures through both epistemological and temporal-spatial debates and debates conducted through analytical units and proclaimed that the current divided state that is experienced by the knowledge structures was the main obstacle to the act of knowing (especially, to the social sciences) (Wallerstein, 2001). Criticisms directed at this kind of knowing that separates the past and the present, the modern and the other, the nomothetic and the idiographic, or the political, economic and social aspects of social life, have protested the 19th century style of knowing, stating that it is an obstacle to knowledge in itself.

4 Geography in Focus

Wallerstein (1998) had also noted that the absence of geography in the modern knowledge structures so far:

It is now the moment to talk of geography as a discipline. Geography is of course taught in almost all the universities of the world. It is an honored name. But curiously, in terms of numbers of scholars, and centrality of attention, it has never quite attained the prominence of the six disciplines [he means the six social science disciplines mentioned above] I have been discussing. Yet it is the only other social science, along with history, that is taught in all the secondary schools of the world. This seems anomalous, and requires some explanation. I believe the key lies in the fact that geography did not fit in the neat pattern that I have described. It ignored the cleavages (Wallerstein, 1998: 78).

Wallerstein emphasises that the geographical practice excludes the division exhibited by knowledge structures divided into two cultures and by doing that it displays an anti-modernist development or, in a more concise expression, geography was institutionalised as a one-culture science. Yes, geography ignored the cleavages. Yet, this observation itself requires an explanation: Why?

Although geographical style of knowing exhibited a wide spectrum of diversity from ancient Greece to the first half of the 20th century (e.g. Cresswell, 2013), the most important characteristic of this pursuit is that, in the final analysis, geography positions itself as "the science of the earth as the home of men". With such positioning, geography developed within the framework of the spatial investigation of the relationship between human life and the physical world; the scope was always kept large while the focus was fixed on spatial variability (Hartshorne, 1939). The spatial differences of places have become the leitmotiv of the geographical style of knowing, and have led it to understand human life in the context of its environment. That is, geographical style of knowing is interested not in a specific research object but in the changing spatial context of physical/social phenomena and events. The key concepts of such a practice are relationality, difference, locality and wholeness. Thus, throughout much of its history geography has avoided certainty, orderliness, universality and fragmentedness that can be regarded as the key concepts of the modern (and dominant) knowledge structures. Undoubtedly, such holistic practice of knowing which sees both the natural and the social dynamics of spatial differences could have well been accepted in the context of one cultural style of knowing and it was accepted. Yet, the crystallisation of the divided knowledge structures of the modern world caused a fall from grace for the holistic and spatial knowing style of geography. It is important at this stage to investigate the reasons why geography continued to be a one-culture science ignoring the cleavages and yet could find a place in the modern university system.

The first argument to put forward here is related to the structuring of geography in Germany in the 19th century when modern knowledge structures were institutionalised. The modern period of geography developed around two basic figures; namely, Alexander von Humboldt and Carl Ritter. For



this reason, many historians of geography define the discipline as essentially a German science (Valkenburg, 1957; Dickinson, 1969; Fischer et al., 1969; Martin and James, 1993). This has led geography to be greatly influenced by romanticism that was dominant in Germany and its rejection of a mechanistic Newtonian understanding of science at a time when geography was being transformed from an intellectual occupation into an academic discipline in the modern-world system. This influence is of conjectural importance for the emerging discipline's refusal to integrate into one of the "two cultures" camps that were particularly strong in Britain and France (Mialents, 2004).

The second argument relates to the subject matter of geography, which in a sense constitutes its historical *raison d'être*. The holistic nature of geography, which brings together the physical, the social and the human, was the target of intense criticism from disciplines -especially geology and sociology- within the modern knowledge structures organised in faculties of science and humanities between 1850-1950. Because all sub-branches under systematic (general) geography (geomorphology, climatology, biogeography; social geography, economic geography, political geography and others) had a counterpart within the knowledge structures (geology, meteorology, biology; sociology, economics, political science and others) (Hartshorne, 1939). For this reason, geography has made its fundamental justification by positioning itself as a discipline that investigates areas that no other single discipline handles (Bekaroğlu, 2014). The basis of this epistemological justification whose origin extends back to Immanuel Kant is that geography is a science that investigates the spatial differences constituted by the combination of the physical and the social entities. That is, the justification is located at the intersection of the "two cultures" world, which no other disciplines can examine. Therefore, geography has tried to overcome the disadvantage created by the separation of "two cultures" by virtue of its being a one culture science; turning its disadvantage into an advantage.

The third argument relates to the development of the modern world system in a liberal geoculture based on nation-states, at least since the end of the 18th century. The idea of "the sovereignty of the people", which the French Revolution spread almost to the whole world, triggered the breakup of the empires and their restructuring based on the dominant national identity and thus the interest in nationalism was supported. In this environment, the function of geography has increased as well as that of the history in school education, which is the most important medium by which national consciousness is grafted onto new generations. In this context, the basic mission of history as a school education subject is to spread the knowledge of the existence of the nation in time; while that of geography is to reinforce the image of unity and integrity by placing that historical existence within the borders of the motherland (Durgun, 2011). Actually, geography's inclusion in the education system as a school subject in many places in the 19th century was in no way incidental. Later, it infiltrated into the university system with the aim of educating schoolteachers and by virtue of the outstanding efforts of the geographical associations (Unwin, 1992; Johnston, 2010). In our opinion, the second golden age of Western geography, which owes its first golden age to the imperialist practice of the discovery of *terra incognita*, corresponds to the period extending from 19th century to the first half of the 20th century when the image of the motherland was grafted onto the nation state.

The fourth argument is related to the social life form that made room for the *raison d'être* of geography which has ensured the discipline to find a place within the modern knowledge structures as a science with a "one culture" heritage. What is emphasized here is roughly the pastoral life form (Thrift, 1994) that could be found almost everywhere up until the first half of the 20th century. In a period when a large part of the world population lived in rural areas, agricultural activities still were an important sector and the acceleration of urbanisation/industrialisation did not have the same impact on social life as it does today, the pastoral character of the life style had created a suitable environment for investigating the causal connections between human life and its environment. For this reason, chorographic studies, which were, conducted systematically first in Germany and which corresponded to a practice of regional geography, later spread to France, Britain and to the New World. This practice aimed to investigate the harmonious relations between humans and their environment by understanding how differences within the unity of the earth created "regions". Since it was only possible within a pastoral life practice to study the humans, their relations with the natural environment and the culture they create in this framework,



the *raison d'être* put forward by geography was indirectly supported by the historically experienced life style.

These four basic arguments explain why the discipline of geography ignores the cleavages created by the knowledge structures divided into two cultures and why it must sustain the practice of one cultural praxis. Now, we will move on to the conceptual investigation as to how geography teared down its one cultural structure and adapted, albeit anachronistically, to the two cultural modern system.

4.1 Experiments

The first thirty years after the World War II was a period when the discipline of geography largely preserved its institutional structure but underwent prominent transformations in terms of its style of knowing unlike in any previous period. Undoubtedly, the revolutionary transformations of those three decades were mostly observed in Pan-European countries, especially in Anglo-American world (Taylor, 1977) and it took a while for these developments to reach other "geographies" in other parts of the world (Johnston and Claval, 2013).

The first remarkable transformation observed after 1950 in geography concerns the efforts to quantify the discipline (Barnes, 2004; Barnes and Farish, 2006). This was the first reaction of geography to the inferiority complex caused by the dominant style of knowing (nomothetic-positivist wing in a broad sense) within the two cultural structures of knowledge of the modern world system. In the previous period, the dominant practice of (regional) geography, which attempted to understand the internal unity of places (regions), the harmonious relations between the natural and the social, was largely abandoned and issues pertaining to systematic (general) geography gained importance. Thus, the idiographic and descriptive practice of geography that was largely based on interpretation evolved into a nomothetic or generalising practice based on "objective" data collection, testing and measurement. The most apparent manifestation of the quantitative transformation in physical geography -which started a decade earlier than the similar transformation in human geography- is the transition from the description of landforms to process analysis in geomorphology (Strahler, 1952; Gregory, 2000). The transformation in human geography studies manifested itself as the practice of discovering the spatial laws of social facts and events (Bird, 1993).

In this direction, it can be determined that the quantitative transformation that began to take place in the 1950-1960s disrupted the unity of geography and brought the discipline to a new experiment. This break in the traditional connection between the physical and the social / human has in fact brought about the ontological fragmentation of geography. The ontological fragmentation in this sense refers to the abandonment of the argument on the *raison d'être* of the discipline -as an intellectual project- and the disintegration of the geographical style of knowing into two basic practices of physical and human geography; i.e., the dissolution of the one cultural unity of geography.

Of course, the only reason for the ontological fragmentation in geography was not the inferiority complex created by the dominant knowledge structures. Undoubtedly, during the period in question, to become a respectable science and even to be accepted as science, a discipline was expected to have a theoretical dimension; use repeatable methods to provide highly accurate explanations and even predictions (e.g. Comte, 2000). It was possible for geography to join this nomothetic camp shared by the natural sciences and the social sciences in the same epistemological camp before. However, geography "waited" until after 1950s for the change. One fundamental reason for the delay is the hegemonic transformation in the modern world-system after the Second World War. The fact that the United States became the most prominent global power after the war changed the functioning of and expectations from the knowledge structures within the universities. In continental Europe, the priority of knowing was replaced with the priority of functionality; as the increasingly Americanized university system spread throughout the world, highly accurate, "objective", "reliable" and "functional" information gained importance. Secondly, rigid disciplinary borders were eroded over time as a consequence of both the convergence of various disciplines after the area studies of 1950s and the increase in the academic



population with the expanding university system. This, in turn, facilitated "poaching" at disciplinary boundaries, encouraging systematic areas of geography to converge with the mainstream systematic sciences to which they are related. The third reason is that the technologies and analysis techniques developed during the Second World War could be used in scientific studies in the post-war period. These developments supported the quantitative transformation by creating a leap in the measurement-analysis techniques employed by almost every scientific discipline. The fourth reason was that the pastoral way of life, whose influence had been felt until the first half of the 20th century, was replaced by a very crowded and cosmopolitan urban life style (Tekeli, 2010). Urbanization, by attracting the flow of people, goods, services and capital especially in the post-war period, has made increasingly insignificant the examination of *genre de vie* adapted to its natural environment in which the holistic geography practice can be anchored.

The second striking transformation in geography after 1950 relates to the intellectual re-shaping of knowledge structures after the 1968 world revolution and its remarkable effect on the portfolio of geography. Criticisms of the mainstream (human) geography, which began to adopt positivist philosophy with the quantitative transformation (e.g. Harvey, 1969), began to find their counterpart in human-centred geographical practices (Entrikin and Tepple, 2006; Johnston, 1983; 1986). On the other hand, the protests against the establishment and the dominant discourse in the atmosphere of 1968 paved the way for various structural schools to show up in geography (e.g. Harvey, 1973). The turbulence of 1970s and later developments enabled human geography to come increasingly closer to social theory by incorporating research practices with a wide range of philosophical positions. In this respect, while the positivist tradition continued, the practice of research has included semi-positivist behaviorists, hermeneutical humanists, historical materialist Marxists, critical realists and feminists as well as postmodern and poststructural geographies that joined in 1980 and thereafter (Johnston, 2010). Physical geography has come closer to the natural sciences that it is related to throughout this process and started to get a place in new multi-disciplinary fields (e.g. Quaternary Sciences). Hence, the discipline, which was ontologically fragmented in the 1960s started to fragment epistemologically from 1970s on. The epistemological fragmentation in this sense refers to the withering of the methodological (positivist) union shared by the two halves of the ontologically fragmented discipline (physical and human geography) before 1970s. Indeed, the post-positivist practices observed in the human geography as of 1970s have greatly weakened the methodological link between the two halves of the geography by infiltrating the diverse research programs (theories and methods) of social and human sciences; thus, the cleavages were revised after about a hundred years and the "two culture" experiment was completed in geography.

The post-war history of geography is in essence the history of the experiments in two cultural world. This experiment was completed in two stages: In the first stage, the holistic nature of the discipline was disrupted and fragmented into two parts (ontological fragmentation). In the second stage, the methodological links between the two fragments were broken (epistemological fragmentation). It is important to note that the fragmentation in question affected the geographical practices in different parts of the world non-synchronously; also, its effects were felt unequally in the wide spectrum of geographical practices ranging from mainstream systematic branches to the more holistic practices of human-environment studies.

5 Styles in Geography

It is self-evident when the Crombiean system and the evolution of the external history of geography were taken together that the discipline had different styles of thinking especially in the framework of its institutional history. At this stage, we propose to examine the styles of geographical thinking in three macro scale groups:



5.1 Holistic-One cultural style

Holistic-one cultural style is founded on the ontological premise on which it has built itself within the modern knowledge structures that were institutionalised in the 19th century. In the holistic one cultural style, which draws its source from the framework "theorised" by the 19th century German geography, observation precedes theory, subjective observation is dominant yet the objectivity problem created by this dominance is not problematized. An inductive reasoning reigns in this practice in which facts and events in space are described by naïve observation and the data gathered from observation is not generalised (or results obtained from one spatial unit are not used in another). Yet, reaching a general composition from specific spatial units is not an ultimate aim for this practice; it is an unnecessary endeavour trying to reach a general norm/pattern since the earth consists of parts/regions that are different from each other. Holistic one cultural style depends on the regional geography paradigm, which originated in Continental Europe and was exported later to the other parts of the world. This idiographic practice focuses on the relationality of the human-environment duality; thus, it harbours a determinist kernel in its constitution. In such studies where observational results obtained from units (from various scales) are purely described, not only is there no question of a research problem preceding or directing the research or a research hypothesis, but also the literature referred to is related only to their area of interest.

5.2 Systematic-Empirical Style

The most important feature of systematic-empirical style, which developed simultaneously with the holistic-one cultural style, is that it is in essence an explorative practice. This style is characterized by locational information produced in the sub-branches of physical and human geography (geomorphology, climatology, urban geography, economic geography etc.) Most of these studies lack an evident theoretical background, while some implicitly employ a theoretical framework. This practice methodologically depends on naïve empiricism (observation) to a large extent; and is semi-positivist in terms of dependence on data, especially where secondary data are used. Systematic empirical style, although having a descriptive tendency in general, is sometimes explanatory. In this context, idiographic studies dominate this practice. Studies in systematic-empirical style that completely depend on inductive reasoning have a semi-positivist background in terms of their dependence on facts/data. For instance, geomorphological studies, which have a certain prominence in this style, share a Davisian paradigm in general. In general, in this naïvely descriptive practice, which employs verification as its testing method, a research problem or a research hypothesis is absent. The justification for studies in this style is mostly the lack of studies on a specific location (for this reason, it is an explorative practice). Nevertheless, some examples of systematic-empirical style put forward a design based on a specific research problem. Studies in this practice mostly use local literature on a specific location.

The systematic-empirical style of geography constitutes the closest wing to modern knowledge structures (i.e., systematic sciences). Indeed, in this style, close links can be established between, for example, geomorphology and geology, climatology and meteorology, biogeography and biology; urban geography and sociology, economic geography and economics, political geography and political science. However, contrary to systematic sciences, the atheoretical structure, naïve empiricism and locational concentration of the systematic-empirical style, which is based on "distribution", "mapping" and "subjective-descriptive interpretation" in general, estranged it from systematic sciences.

5.3 Systematic-Two Cultural Style

The systematic-two cultural style emerged as a form of knowing with the ontological and epistemological fragmentation of the holistic structure of geography during and after the dazzling changes of the thirty-year period after the Second World War (Bekaroğlu, 2016). The style, in fact, refers to the adaptation of the discipline to modern knowledge structures. The systematic-two cultural style refers to the renunciation of geography's claim to understand the human-environment duality in its totality. The style emerged because of the process by which geographical practice, situated at the intersection point of



two cultural knowledge structures during a long period of its history, reorganised its style of knowing without problematizing its ontological status. In this respect, the social is explained by social processes and the physical, by physical processes. This practice is therefore the opposite of the "holistic-one cultural" style.

The systematic-two cultural style is dependent on the import of theory and method from systematic sciences and they are processed in a "spatial" context. In this respect, the style does not adopt the relational approach of the human-environment duality but rather deals with a specific research object by resorting to other systematic sciences. That is to say, the systematic-two cultural style adopts a horizontal, research-object-oriented approach, rather than a vertical and relational one. Due to the fragmented nature of the two cultural knowledge structures, there are two basic branches of the representation of this style in geography. One is the nomothetic / explanatory / positivist wing and the other is the idiographic / hermeneutical / post-positivist orientation. While the sub-branches of systematic physical geography adopt the first orientation in line with their epistemological inclination, those of human geography adopt the first or second one. Depending on the epistemological or paradigmatic position that is adopted, the form of knowing in question can be descriptive or explanatory, nomothetic or idiographic and the form of reasoning can be inductive or deductive. The systematic-two cultural style embraces a plurality of paradigms, especially in the context of human geography. In this respect, although the scene is plainer with the branches of physical geography as these areas generally adopt the theoretical-methodological background of natural sciences, composition in the sub-branches of human geography is more complex; because, depending on the paradigmatic form, thematic inclinations in human geography can be positivist or post-positivist (humanist, structuralist, feminist, post-structuralist, post-modern). Accordingly, the style in question can adopt verification or falsification as its testing method. Studies in this style, which are based on a research problem -that is theory precedes location in such studies-, may or may not harbour a research hypothesis according to their paradigmatic background. Studies carried out in the framework of such style of knowing refer not only to local literature but also to subject-based thematic literature.

6 Synthesis

Geographical practice, which dates back to ancient Greece just like Crombie's styles of scientific thought, has three styles that have been fed by its own epistemological history. These geographical styles in which Crombiean system can find its place are shown comparatively in Table 1.

As early periods of the geographical practice constitute an important part of the cosmographic tradition (Livingston, 1992), the postulation style comes to the fore as a style that characterizes early-period land measurements and cartography-mapping studies that are supported by mathematics and geometry. In this context, for example, the geodetic calculations of Eratosthenes or cartographic calculations of Ptolemy are characterized by postulation style.

Since the experimental style includes observation as well as experimentation, it is actually seen in all three geographical styles. Indeed, this style can find its place in all kinds of geographical studies, be it a behavioural study on spatial perception (systematic-two cultural style) or a classical regional study (holistic-one cultural style) or a geomorphological study based on the description of landforms (systematic-empirical style).

However, hypothetic and statistical styles can only be observed in a systematic-two cultural style within geographical practice, as it was possible for the style in question to be used in the discipline only after the quantitative revolution. The search for spatial order by the systematic-two cultural geographical style that emerged in human geography through the adaptation of the discipline to the modern knowledge structures after the World War II (Haggett, 1965) and the transition from description of landforms to process analysis that occurred in physical geography (Gregory, 2000; 2003) stand out as the essential elements that provided the visibility of the two styles in the geography practice.



Crombiean taxonomy style has made its mark on the first two geographical styles, whether in the functional classification of different regions or in the systematic classification of landforms, climate types or vegetation. The style in question has emerged and matured as a natural consequence of the descriptive scientific orientation over a very long period of the history of geography.

The historical derivation style, on the other hand, stands out as a style that is found in all geographical styles. In fact, modern geography practice is closely related to history and geology in this context. Historical evolution process in the idiographic analysis of regions and settlements, the uniformitarian context of the notion of erosional cycle (Davis, 1899) in Davisian geomorphology studies distinctly reflect this style. The style in question has also found its counterpart in the systematic-two culture style; contextuality or path dependency in modern economic geography, for example, reflect the influence of the historical derivation style, albeit differently.

As one can see, the Crombiean scientific thinking styles are unable to explain on their own even the intellectual tendencies in a practice with an old tradition like geography and have a meaning within the discipline-specific style categories set out here. For this reason, the macro-scale framework of Crombiean scientific thinking styles can become useful on a micro scale only through the consideration of the sciences' own epistemological histories. This demonstrates the necessity of observing analytical relationships between different levels of scale.

Table 1. The classification of the styles of geographical thought and their relation to the Crombiean framework.

	Holistic-one cultural style	Systematic-empirical style	Systematic-two cultural style
Theory	N/A	N/A or Implicit	Explicit
Method	Naive empiricism (observation)	Naive empiricism (observation)	Quantitative or Qualitative
Scientific Purpose	Description	Explanation or Description	Explanation or Understanding
Generalization	Idiographic	Nomothetic or Idiographic	Nomothetic or Idiographic
Reasoning	Induction	Induction	Induction or Deduction
Paradigm	Regionalism	Semi-positivism	Multi-paradigmatic
Testing	Naive description	Verification or description	Verification or Falsification
Research Problem	N/A	N/A or sometimes available	Available
Research Hypothesis	N/A	N/A	Available or sometimes N/A
Literature Review	Local	Local or sometimes Thematic	Local and Thematic
Postulation		x	
Experimental	x	x	x
Hypothetical			x
Taxonomy	x	x	
Statistical			x
Historical Derivation	x	x	x

Crombiean styles of scientific thought can find their place in the trio derived from the epistemological history of geographical practice. However, given the fact that the Crombiean system concluded in the 18th century, it is clear that the systematic two cultural practices proposed here, as the third style of geographical thought, should accommodate a much more diverse range of scientific thinking styles. The window is open because the post-positivist practices of science are not included and it points to the fact that there is a dimension to scientific styles of thinking in geography that is not exhausted yet, calling for contemplation.

7. Conclusion

This study investigates the six different categories of scientific thinking from ancient Greece to the 18th century as classified by A. Crombie in the context of geography and proposes that geographical practice displays three distinct styles: holistic-one cultural, systematic-empirical, systematic-two cultural.



The extent to which the Crombiean scientific thinking styles overlap with the historical practices in singular sciences depends, epistemologically and historically, on the individual reconstruction of the disciplinary forms or styles of knowing when the macro scale structure of the given frame is taken into account. Therefore, the original reconstruction of disciplinary styles can provide, even if incompletely, the framework in which the Crombiean styles can fit properly.

The styles that characterize geographical practice have a structure that is both historical, spatial and time-transgressive. Depending on the spatiality of the intellectual knowledge centers, produced knowledge originate from a specific place at a certain time, and then spread. Both holistic-one cultural and systematic-empirical geographical styles have come to life in the Old World (especially Asia Minor and Europe) and have spread over time to other parts of the world, including the New World, whereas, the systematic-two cultural style that characterizes contemporary geographical practices first developed in the Anglo-American World and then spread to different geographies of the world at different times. Accordingly, geographical practices in different geographies practiced different geographical styles at different times.

There is a temporal asymmetry between the current discipline-specific scientific thinking styles and Crombie's scientific thinking styles, as the latter concluded in the 18th century. Thus, there is need for convergence between philosophy and history of science and the studies that monitor new styles observed in single disciplines. A better understanding of scientific practice is necessary for better scientific practice, *vice versa*.

Acknowledgement

This study is supported by TUBITAK (The Scientific and Technological Research Council of Turkey). Project No: 114K063.

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