MEASURING EMPIRE: THE EMERGENCE OF CLIMATE SCIENCE IN THE OTTOMAN EMPIRE

By

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Abstract

This thesis explores how the study of global climatology flourished in the Ottoman Empire and became a mutually-reinforcing metaphor of the rational order of nineteenth-century Ottoman society. In the first chapter of this thesis, I examine the reasons behind the Imperial Observatory's (*Raṣad-hâne-i Âmire)* initiation for the meticulous and precise observation of weather patterns in Istanbul and disparate geographies of the empire. In this chapter, I also explore how does this systematic recording of climate data had an impact on the emergence of climatology as a nascent popular science in the Ottoman Empire. Contra previous historiography on Ottoman science, this thesis attempts to show that the Ottoman Empire invested in this nascent science to delineate the climatic zones of the empire as well as to integrate its diverse populations. Moreover, one of the crucial departing points of my work is that it attempts to contextualize the proliferation of climate science in the Ottoman Empire as one of the ramifications of global scientific knowledge production.

In the second chapter of this thesis I explore the emergence of forest climatology and environmental protectionism in the late Ottoman Empire. Through the 1858 Land Code, and 1870 Forest Regulation as well as the implementation of scientific forestry the Ottoman government attempted to extend its control over the forests. Unlike the previous historiography, I offer a completely novel reading of the legal sources as well as the scientific treatises of imperial scientists, and I explore how this legal problem regarding the usufruct rights of forests was deeply interconnected with the emergence of climate science. In the second part of this chapter, I investigate the mutually constitutive relationship between climate science and agriculture. I explore how the attempts of imperial scientists to document plant geography, the implementation of phenology, and implementation of large-scale scientific agriculture led to a recognition of the miscellaneously diverse geography of difference in the late Ottoman period. I argue that this climatic difference was also a useful discourse for imperial elites to imagine multifarious geographies as part of one Ottoman universe as well as to consolidate its power on its subjects.

Linking history of science and environmental history, and drawing on a wide a range of overlooked sources in Ottoman-Turkish, French, German, and English, this thesis offers a novel reading of late Ottoman environmental history.

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The debts I have incurred in writing this thesis are immeasurable. Şebüsterî, a famous poet and sufi who lived in the thirteenth century, once eloquently reiterated the most existential question of this world long before Wittgenstein: "Why the meaning cannot be captured in words/language?" [Maʿnā niçin kelāma sığmaz?] In a different context, words could never do justice to Professor Tolga U. Esmer's meaning in my world. From the beginning of my studies at CEU, he always trusted me and supported me to pursue my diverse intellectual curiosities. Tolga Hoca's truly eye-opening comments, relentless but constructive criticisms on my every single written and verbal sentence have had the greatest impact on my intellectual development. I, therefore, feel extremely lucky for being his student. I also want to extend my gratitude to another Tolga, my dear Professor Yaşar Tolga Cora, from Boğaziçi University. Since I met him in front of the library at Boğaziçi, his shining mind and intellectual depth as well as his emotional support have always been a source of motivation for me. I also would like to thank my second reader Professor Mate Nikola Tokic for reading my thesis and for providing me with excellent comments and suggestions.

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This thesis is dedicated to the students, academics, workers, and alumni of Boğaziçi University who have been fighting for academic merit, freedom, and decent life. We won't give up, we won't look down! This thesis is also dedicated to people who eagerly work for environmental justice and sustainable life for all of us. Let me finish this part in the words of Bertolt Brecht;

(…) it takes a lot of things to change the world:
Anger and tenacity. Science and imagination,
The quick initiative, the long reflection,
The cold patience and the infinite perseverance,
The understanding of the particular case and the understanding of the ensemble:
Only the lessons of reality can teach us to transform reality.

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INTRODUCTION

"We got to know the *nature* of calculating by learning to calculate."

Ludwig Wittgenstein- *On Certainty*

"Scalability is not an ordinary feature of nature. Making projects scalable takes a lot of work. Even after that work, there will still be interactions between scalable and non-scalable project elements."

Anna L. Tsing- *The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins*

This thesis aims to examine the emergence of climate science and environmentalism in the Ottoman Empire along with its relation to agricultural science from the second half of the nineteenth century to the end of the empire. The first scientific observatory for weather forecasting in the Ottoman Empire, *Observatoire Impérial Météorologique (Raṣad-hâne-i Âmire)*, was established in 1868 as part of the larger comprehensive modernizing reforms of the *Tanzimat (Reformation)* era. Aristide Coumbary, who was initially commissioned by the Ottoman government to install crucial technological infrastructure like telegraph lines throughout the empire, also spearheaded the study of the climate and weather forecasting in empire and represented the empire at the first International Weather Congress in Vienna in 1873. The Ottoman imperial government even established weather observatories across the empire from Varna to Baghdad and Beirut by the 1880s to collect the data and use it for practical as well as informative purposes.[1] Private observatories built for weather prediction and climate analysis were concomitantly built and operated by foreigners as well as Muslim and non-Muslim Ottoman subjects alike.

[1] According to the weather information report from *Takvim-i Vekâyi* in 1869, the weather reports of these cities were available: Rusçuk, Sulina, Köstence, Varna, Bergos, Trabzon, Niş, Edirne, Tekfurdağı, Gelibolu, Çanakkale, Kavala, Thessaloniki, Manastır, Valona, Draç, Smyrna, Ankara, Diyarbakır, Baghdad, Beirut, Basra. (Takvim-i Vekâyi, nr: 1080, 25 Nisan 1869/ 13 Muharrem 1286).

Armenian experts in the Protestant School in the southeastern Anatolian town of Aintab, for instance, made regular observations of weather starting from the second half of the nineteenth century onwards. Moreover, an amateur observer on the Thomson Farm in Istanbul made invaluable observations on the humidity and precipitation of Istanbul from 1875 to 1892. Observations from across the empire were even compiled regularly and published in local newspapers as well as international journals such *as Observations Météorologiques du Réseau Oriental* and *Zeitschrift der Österreichischen Gesellschaft für Meteorologie (Journal of Austrian Meteorological Society)*. I therefore intend to examine why was it that foreigners as well as Ottoman subjects across the empire felt the need to record meticulously more precise knowledge of weather patterns and disseminate their work to larger audiences at home and abroad at the same time their contemporaries started doing so abroad? What distinguished observatory science from popular knowledge about weather conditions? What implications does this systematic recording of climate data have on the emergence of climatology as a nascent popular science in the Ottoman empire as well as pursuit of imperial scientists at the *Dâr al-Fünûn (House of Sciences) and Mekteb-i Erkân-ı Harbiye (Ottoman Military Academy)*? What does it say about Ottoman society that local collectors from disparate social, ethnic, and confessional groups across the empire shared this common pursuit and came together to compare data? I believe that my exploring these questions about science and its reception in Ottoman society will shed light on larger questions about: the nature of Ottoman society; how officials, subjects, and foreigners understood and valued its environmental and geographic diversity, and what viable scientific endeavours (or lack thereof) meant for the future of this ancient realm.

In recent years, historians of science have explored how overseas empires (British and French) invested in sciences to effectively rule as well as consolidate or extract the resources from their colonial territories. For instance, Helen Tilley in her study *Africa as a Living*

Laboratory: Empire, Development, and the Problem of Scientific Knowledge 1870- 1950 convincingly showed that British imperial scientists tested their nascent scientific methods on topics ranging from ecological models of development to ethnographic surveys primarily in colonial Africa from the second half of the nineteenth century onwards.[2] Likewise, Richard Grove in his seminal study *Green Imperialism Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860* has shown that modern environmentalism and environmental awareness as discourses in Europe arose directly from the environmental destruction that resulted from the systematic, irresponsible extraction of resources in European colonies during the modern era.[3] Inspired by Grove and Tilley's studies, I intend to explore the relationship between climate science, resource management, and scientific agriculture as part of my research. I intend to show how the proliferation of scientific knowledge transformed both physical environments as well as people's reception and experiences of their physical environments in the late Ottoman Empire. I will discuss how the increasing demand for resource extraction led to new forms of conceptualizations of nature and climate as well as environmental protectionism in the late Ottoman Empire.

In a more focused study on climate science, Katharine Anderson remarkably discussed how the science of meteorology and probabilistic reasoning proliferated among the Victorians in Britain to navigate their economic and political interests in the colonies as well as the mainland.[4] These studies on overseas empires have also accentuated the very crucial role of the cross-pollination of ideas and material exchange across the globe on different scales. Deborah Coen's *Climate in Motion: Science, Empire, and the Problem of Scale*, however, is the most

[2] Helen Tilley, *Africa as a Living Laboratory Empire, Development, and the Problem of Scientific Knowledge, 1879-1950*, Chicago: The University of Chicago Press, 2011.
[3] Richard Grove, *Green Imperialism Colonial Expansion, Tropical Island Edens and the Origins of Environmentalism, 1600-1860*, New York: Cambridge University Press, 1995.
[4] Katharine Anderson, *Predicting the Weather, Victorians and the Science of Meteorology*, Chicago: The University of Chicago Press, 2005.

inspiring study for the scope of this thesis[5]. Unlike the examples of overseas empires where the boundaries between the center and peripheries are more apparent, Coen brilliantly explores how the study of global climatology flourished in the Habsburg Empire and became a mutually-reinforcing metaphor of the rational order of nineteenth-century Habsburg society. The Habsburg Empire like other continental empires -the Ottoman Empire, Romanov Dynasty, Qing Dynasty- was a composite formation. It incorporated societies with different political, social, and cultural traditions through various arrangements and levels of submission. The monarchy also built and prevailed an enduring empire that spanned from Transylvania and Southeastern Europe to Moravia. Coen argues that the accommodation of difference (of communities and geographies, of institutional traditions) and the empire's goal of integrating "indigenous places" into "imperial space" was crucial in the emergence of a dynamic, nuanced understanding of climate that impacted in profound but overlooked ways modern climate science. Throughout the book, Coen convincingly explores the scientific, social, and bodily work of scaling in the Habsburg Empire. Even though she argues that the work of scaling was primarily a Central European phenomenon, it raises the question how and with what motivations did imperial scientists in other continental empires render their worlds legible in the age of global modernity.[6] Therefore, through a creative reading of disparate sources, I will show how the Ottomans operated similar human and material sources to scale their environments with the ultimate goal of enhancing their sovereignty and control over their vast empire. This study, therefore, aims to show the intimate interdependency of local, regional, imperial, and global scales.

The historiography regarding climate science in the late Ottoman Empire is still in its infancy. Alper Yalçınkaya in his study *Learned Patriots: Debating Science, State, and Society*

[5] Deborah R. Coen, *Climate in Motion: Science, Empire, and the Problem of Scale*, Chicago: The University of Chicago Press, 2018.
[6] Deborah Coen, *Ibid*, 339-363.

in the Nineteenth-Century Ottoman Empire argues that climate analysis was conducted only by Europeans and considered as European science in the Ottoman Empire. Yalçınkaya states that "while this observatory (*Raṣad-hâne-i Âmire)* is referred to as one of the important steps in the spread of European sciences in the Ottoman Empire, its benefits and purpose appear not to have been clear, at least to members of the Muslim community of Istanbul- in a way reminiscent of the reaction to lectures at the university."[7] To exemplify his argument, Yalçınkaya gives two mocking pieces which were published in contemporary newspapers. He concludes that the science of meteorology did not proliferate in the Ottoman Empire due to the financial difficulties and indifference of Muslims. In contrast to Yalçınkaya, I argue that both the Muslim and non-Muslim subjects of the empire as well as the imperial scientists and local observers in disparate geographies of the empire were very much interested in the science of meteorology. A case point is the *Raṣad-hâne-i Âmire*, which had both Muslim and non-Muslim imperial scientists, a topic I will explore at length in the first chapter of my thesis. Indeed, non-Muslim subjects of the empire such as Emile Lacoine Efendi, *Kâtip* Etienne, Monsieur Montani, Konstandi Efendi, and Pavli Efendi occupied prominent positions during Aristide Coumbary's directorship of the observatory from 1868 to 1896. However, after Salih Zeki Bey was appointed as the chief of the observatory in 1896, Muslims became salient figures in the administration of the observatory as well.[8] Likewise, ordinary subjects were also part and parcel of the recording of atmospheric phenomena in Istanbul as well as different geographies of the empire. For instance, Abbüllatif Efendi, the *Imam* of Kandilli Mosque, measured the heat of the Marmara Sea every morning with a thermometer and reported his measurements to the Observatory.[9] Other studies in the field are mostly descriptive and focus on the history of

[7] M. Alper Yalçınkaya, *Learned Patriots: Debating Science, State, and Society in the Nineteenth-Century Ottoman Empire*, (Chicago: The University of Chicago Press, 2014), 150.
[8] For instance, Receb Ferid Efendi, Said Efendi, Kazım Bey, Mehmed Fikri Efendi, Bediüddin Efendi, İsmail Hakkı Efendi were some of the administrative figures in the administration.
[9] *Raṣad-hâne-i Âmire'nin 1912- 1913- 1914 Senelerine Aid Hülâsa-i Rasadatı,* Matbaâ-i Âmire, Dersaadet, 1330, 15.

particular institutions.[10] For instance, Kübra Fettahoğlu's Master Thesis and Muammer Dizer's studies provide a coherent perspective on the history of *Raṣad-hâne-i Âmire* but overlook the work of scaling and networks of information across the empires.

Dipesh Chakrabarty in his recent study *The Climate of History in A Planetary Age* states that the ultimate givenness of the physical environments and our misperception of the uninterrupted continuity of life has been shaken by the immediate and observable changes in climate since the second half of the twentieth century.[11] Chakrabarty, therefore, argues that not only the scientists but the urban dwellers as well as the peasants have recognized our constant and fragile dependence on nature across the globe. For him, this idea of the interconnectedness of the planet under new circumstances is the manifestation of a new epoch, which is called Anthropocene. I argue that the imperial origins of climate science, and its global itineraries help us to parse the concept of the Anthropocene. I believe that this thesis therefore engages meaningfully with cutting-edge research in climate science, environmental history, and the Anthropocene in the context of the Ottoman Empire, Balkans, and the Near East.

Methodology

In the last three decades, Western historians, as well as historians of the Ottoman Empire and the Near East, have challenged the Eurocentric understanding of modernity and science.[12]

[10] for some examples see: Kübra Fettahoğlu, *Rasadhane-i Âmire'nin Kuruluşu ve Faaliyetleri (1868-1922),* Unpublished MA Thesis, 2012.; Muammer Dizer, *Türkiye'de Meteoroloji,* Bilim Tarihi, Sayı: 21, Istanbul 1993, 3-19. Feza Günergun, "Salih Zeki Bey ve Astronomi: Rasathâne-i Âmire Müdürlüğü'nden 1914 Tam Güneş Tutulmasına*", Osmanlı Bilimi Araştırmaları,* Istanbul 2005, VII/1, 97-121.

[11] Dipesh Chakrabarty *The Climate of History in a Planetary Age,* Chicago: The University of Chicago Press, 2021. Chakrabarty pointed out that the possibility of the extinction of the human planet became topic of discussion with the Great Acceleration after the World War II. However, I also argue that it is possible to see a similar anxiety among the nineteenth-century people. I will argue that the climate science emerged partly out of these coexistent feelings of curiosity and anxiety.

[12] for new approaches to the global history of science see: Lorraine Daston, "The History of Science and the History of Knowledge*",* Know: A Journal on the Formation of Knowledge, Volume:1 Number:1, Spring 2017, 131-154., Duygu Yıldırım, "Global Bilim Tarihi" [Global History of Science], Toplumsal Tarih, volume:331, 2021. Harun Küçük, *Science Without Leisure: Practical Naturalism in Istanbul, 1660- 1732,* Pittsburgh, University of Pittsburgh Press, 2020; Akif Yerlioglu, *Paracelsus Goes East:*

These new studies have postulated that scientific knowledge was produced as a result of a continuous -yet unequal- exchange of people and materials across the world as well as the cross-pollination of ideas both in the early modern era and the modern period. However, I argue that most of the existing literature on the history of science in the late Ottoman Empire either overlooked the polycentric and interdependent histories of imperial science or compared the Ottoman institutions with their contemporaries and alleged that modern science did not proliferate in the Ottoman Empire due to a paucity of scientific accumulation and innovation. Likewise, they mostly argued that the imperial authorities at the center of the Empire invested in sciences primarily to catch up with the West by importing technical materials as well as foreign scientists.[13] However, one of the crucial departing points of this thesis is that it attempts to contextualize the proliferation of climate science in the late Ottoman Empire as one of the ramifications of global scientific knowledge production. I contend that this contextualization will not only contribute to our understanding of the global and interdependent history of climate (science) but also challenge the reductionist but prevalent idea of importation. Therefore, I will discuss the emergence of climate science in the Ottoman Empire in line with developments in continental and overseas empires in the late nineteenth century.

Moreover, the nascent idea of global climate and scientific agriculture was also crucial for the recognition of local peculiarities and the integration of the localities to the imperial center. Deborah Coen argues that the constant oscillation between universal laws and local peculiarities throughout the nineteenth century inevitably led to the invention of an innovative

Ottoman "New Medicine" and Its Afterlife, Harvard University Unpublished Ph.D. Thesis, 2020; Helen Tilley, "Global Histories, Vernacular Science, and African Genealogies; or Is the History of Science Read for The World*" Isis*: 2010, 101: 110-119; Helen Tilley, "A Great (Scientific) Divergence: Synergies and Fault Lines in Global Histories", *Isis*: Volume 110, number 1, 2019: 129-136; Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900,* New York: Palgrave Macmillan, 2007.

[13] to see some examples: Ekmeleddin Ihsanoğlu, *Büyük Cihad'dan Frenk Fodulluğuna,* (Istanbul: Iletişim Yayınları), 1996., Ekmeleddin Ihsanoğlu, *Darülfünun: Osmanlı'da Kültürel Modernleşmenin Odağı,* (Istanbul: IRCICA), 2010.

understanding of climate in the Habsburg Empire.[14] In a similar vein, I will argue that this understanding of "dynamic climate" was also very much a product of the fertile internal tension between the center and the provincial parts of the empire. I believe that the scientific and social work of scaling was crucial for both scientific exploration and the social configuration of the empire. Therefore, I will discuss the local and imperial scales as well as the global scales to understand the proliferation of climate science in the late Ottoman Empire.

Historians tend to assume that unlike the European empires, it is hard to find systematic works on climate science in the Ottoman realms. However, throughout my research in the archives, I recognized that the systematic recording and prediction of weather was ubiquitous among the Ottoman subjects as well as the foreigners in the nineteenth and early twentieth century. Therefore, I will investigate what commensuration and statistical abstraction meant for people with an agricultural background as well as imperial scientists. Why would someone from Aleppo be interested in the volatile data of daily weather of Sofia in the nineteenth century? How can a historian measure this if the very revealing personal documents of individuals are not discovered yet? In a recent study on the history of environments, Etienne Benson suggests that "we need to remain open to moments when people are describing or encountering their surroundings in recognizably environmental terms even if they are not using the word environment itself.[15]" In our contemporary world, people do not write about how certain technologies such as the Internet changed their lives, but they experience and digest it. Likewise, it seems to me that the dissemination of very mundane enterprises such as thermometers, barometers, and fertilizers across the empire have certainly changed people's perception of their surroundings in the Ottoman Empire.

[14] Deborah Coen, *Ibid*, 144-171.

[15] Etienne S. Benson, *Surroundings A History of Environments and Environmentalisms*, (Chicago: The University of Chicago Press, 2020), 10.

Structure

This thesis will operationally use disparate and overlooked primary sources in each chapter. In the first chapter, I analyze the reports of weather forecasting which were published by the *Observatoire Impérial Météorologique (Raṣad-hâne-i Âmire).* Those reports were published as booklets under the title *Dersaadet Rasadhâne-i Âmiresi'nin Cevv-i Havaya Dair Yirmi Senelik Tarassudatı Neticesi,* (*The Results of the Observations Regarding Atmospheric Phenomena Between 1867- 1887)* and *Raṣad-hâne-i Âmire 1912-1913-1914 Senelerine Aid Hülâsa-i Rasadatı (Observations on the Atmospheric Phenomena in 1912- 1913- 1914)*. They include information from the mean annual temperature and precipitation of different cities to the atmospheric pressure and climatic conditions. In this thesis, I processed some of these quantitative data and transformed them into graphs to investigate the accuracy of the measurements of temperature, precipitation, atmospheric pressure, and winds which were meticulously done by the Ottoman imperial scientists. I also use contemporary journals and newspapers of the time (e.g., *Maarif, Malûmat, Tercümân-ı Hakîkat İkdam, Ceride-i Havâdis Takvim-i Vekâyî, Servet-i Fünûn),* which regularly published weather reports at the time. Interestingly, some of this weather data, which appeared in newspapers, contained information regarding the previous days and weeks rather than predicting the ensuing day. For instance, *Malûmat,* a daily newspaper published by Mehmed Tahir Bey, published regular reports of weather observations of disparate Ottoman cities as well as the foreign capitals such as Vienna, London, Paris, and Moscow from July 1898 to February 1901.[16]

I will analyze Aristide Coumbary's invaluable report M*émoire Sur La Nécessité De L'etablissement D'un Observartoire Météorologique a Constantinople* (*On the Necessity of Establishing a Meteorological Observatory in Constantinople)* that informed the Ottoman

[16] *Malûmât*, nr. 401, 9 Temmuz 1898/ 19 Safer 1316, p:1; *Malûmât*, nr: 1340, 9 Subat 1901/ 19 Sevval 1318, p:4.

imperial authorities regarding the necessity of scientific weather observatory in the empire. Besides, I will also work on another work by Aristide Coumbary *Lois des Tempêtes avec Dessins et Cartes des Tempêtes (The Law of Storms for the Mariners- Fırtınaların Kavanîni ve bunların denizlerde müstelzim olduğu mehalik ve muhatırattan ihtiraz için ittihazi iktiza eden suver ve tedâbîr-i fiiliyeden bâhis risâle*). In addition to Aristide Coumbary's writings, I will also investigate studies of foreigners as well as other prominent imperial scientists such as Emile Lacoine Efendi, Salih Zeki Bey, and Mehmet Fatin Gökmen. I recognized that the government correspondence regarding the collection of climate data in disparate geographies of the empire and the operations of the observatory reveal crucial information on the topic. Those open-access but overlooked materials which are in catalogs of the Presidential Ottoman Archives will be some other crucial sources in this study. The first chapter, therefore, aims to parse the scientific and social works of scaling the empire.

In the second chapter, I focus on two overlooked but extremely important journals and reports from the late nineteenth-century and early twentieth century. For instance, an overlooked journal called *Filāḥat* published by the Armenian intellectual Sebouh Istepanian in the early twentieth century contains several articles on climate, its impact on health, and scientific methods of agriculture on farms in disparate geographies of the empire. *Filāḥat (Agriculture), Halkalı Zirāʿat Mekteb-i ʿAlī̱ Mecmūʿası (Journal of Halkalı Agricultural School),* and Ahmet Tevfik's [Göymen] magnum opus Agricultural Meteorology (*Zirāʿī̱ Meteoroloji)* will be the core of primary sources in Chapter 2. Moreover, A. Bricogne, a French forest specialist who worked for the Ottoman government in the nineteenth century, also wrote invaluable reports (*Les fôrets de l'empire Ottoman*) about scientific forestry, and climate in the late Ottoman Empire. I will discuss the impact of Bricogne's reports on the new conceptualization of climate and environment in the late Ottoman Empire. My aim in the second chapter is to show how the legal problem regarding usufruct rights of the forests was intimately

interconnected with the emergence of climate science. The second chapter, therefore, shows how different techniques of measurement were applied to scale the empire in equilibrium-based ecosystems as well as non-equilibrium ecosystems across the empire.

Finally, even though beyond the scope of this thesis the bodily works of scaling in the late Ottoman Empire is a fertile topic for further explorations in the field. As historians of science have pointed out in their studies, the science of climate intersects with issues that run the gamut from planetary scales and agriculture to human health. As Vladimir Jankovic explicated in the context of eighteenth-century Britain "living well and feeling healthy was identified with the properties of one's existential coordinates. The locus of illness moved from the individual body to the space between bodies in the modern era."[17] Throughout my research, I recognized that the Presidential Ottoman archives include a myriad number of petitions and correspondence regarding the impact of climate on people's health. Those petitions exponentially increased in the second half of the nineteenth century with the increase of mobility as well as modern medicine. For instance, Legofet Bey who was a non-Muslim Ottoman subject of the empire could not live in Vienna due to its climate, and sent a petition to the Ottoman government to come back to Istanbul. The Ottoman government made all of the necessary arrangements to bring him back to provide him fresh weather and a heathy life.[18] Climate gradually became an important concern of the Ottoman government as well as the subjects of the empire. In this context, the climate science, therefore, opens us fertile fields to investigate how the body was placed vis-à-vis its surroundings.

Concluding Remarks

Meteorology is a science of observation and of arguments about observation. As Katherine Anderson explicates "it is hard to grasp its development as a discipline by an

[17] Vladimir Jankovic, *Confronting the Climate: British Airs and the Making of Environmental Medicine,* (New York: Palgrave Macmillan, 2010), 3.
[18] BOA, MKT. NZD. 116-80 / H20-12-1270 [13 September 1854].

exclusive focus on rival theories about atmospheric change."[19] John Frederick William Herschel, one of the leading men of science in the first half of nineteenth-century Britain, stated that "one of the marked peculiarities of this our science, that when we trace the forces of the atmosphere 'as exhibited in a specified time and place, theory affords us no assistance." The idea of laborious observation and meticulous recording of atmospheric phenomena continued to dominate the field throughout the second half of the nineteenth century. As a result, meteorology emerged as a practical and popular science in which regular observation without specialized knowledge could be useful to deal with the vagaries of nature. Moreover, with the proliferation of climate science, we see that observation and speculation, as well as prediction, were slowly distinguished from the traditionally dominant regimes of knowledge such as astrology, astronomy, or religious prophecy. Ottomans, like their contemporaries, were very much involved in the science of meteorology and climate on different scales in the age of global modernity. In the remaining chapters, I will investigate these different works of scaling.

[19] Katherine Anderson, *Ibid,* 6.

CHAPTER 1

THE SCIENCE OF WEATHER, THE SCIENCE OF EARTH

1.1 Global Science, Global Empire, Planetary Scales

"*We also demand from climatology that it furnish not merely a patchwork image of the varied climates of different locations, but rather that it satisfy our intellectual need for order and unity in the representation of diversity by means of a systematic representation, by grouping related climates together- further that it demonstrate the interaction and mutual determination of these climates. Only in this way does climatology become a scientific discipline."*

Julius von Ferdinand Hann- Handbook of Climatology

Climate science, today, is considered a proper scientific field with its use of tremendously complex computer models and satellite data. However, this was not the case before the last quarter of the nineteenth century. Previously, meteorology, as a field of natural philosophy was considered merely the application of the physical laws to the atmosphere.[1] The nascent conceptualization of dynamic and global climate required new sets of political and social arrangements, and technological improvements as well as epistemological categorizations throughout the last century. The first part of this chapter, therefore, explores the reasons as well as consequences of its emergence as a global phenomenon. Subsequently, the following part investigates its imperial itineraries in the context of the Ottoman Empire.

Scientists of the early nineteenth century were well aware that meteorology had unique problems of organization, communication, and data collection. Although recording the weather patterns were ubiquitous in Europe during the first half of the nineteenth century, the collected data was mostly unstandardized and uncoordinated across vast geographies. James D. Forbes,

[1] Garber, Elizabeth, *Thermodynamics and Meteorology (1850-1900),* Annals of Science, 33:1,1976, 51-65.

Scottish physicist, and inventor of seismograph, recognized in the 1840s that in order for it to be developed as a science a world-wide network of stations had to be established, where data could be recorded regularly in a standard form with standard methods of measurement.[2] The flourishing of atmospheric sciences on a global scale, therefore, coincides with the invention and development of certain technologies, and the adaptation of standard values of measurement during the second Industrial Revolution. Telegraph was perhaps the most revolutionary technological tool in the emergence of global climate science during the nineteenth century. The electric telegraph was developed as a working instrument in the 1830s by Samuel Morse and spread rapidly across the globe. In 1858, less than thirty years after its invention, an Anglo-American consortium of engineers, electricians and entrepreneurs succeeded in laying a telegraphic cable across the Atlantic though it functioned for only three weeks and transmitted only 271 messages. Yet, as Simone M. Muller explores in her study, communication technologies saw its breakthrough in 1866 with the successful operation of ocean telegraphy.[3] This was followed by the connection of India (1870), Australia (1872), and Southeast Asia (1870), as well as to the Caribbean (1873-74) and many other colonies and metropolitans.[4] The emergence of a global communication system based on electrical speed allowed weather observers to forward the volatile weather data faster than the weather itself. The telegraph, as Katharine Anderson states, introduced a new dynamic to meteorology.[5] Moreover, very much keen on creating a universal language of science, the

[2] Garber, Elizabeth, *Ibid*, 52.
[3] For the history of this ambitious enterprise of Transatlantic telegraphic line see: Simone M. Muller, *Wiring the World, The Social and Cultural Creation of Global Telegraph Networks,* New York: Columbia University Press, 2016. Simone M. Muller convincingly shows that even though telegraph has been considered by historians as tools of empires that aided the formation and consolidation of empires and nation-states, its history is much more complex, and different actors were involved in the development of the technology.
[4] Simone M. Muller, *Ibid*, 4.
[5] Katharine Anderson, *Ibid*, 2.

scientists during the First International Meteorological Congress of Vienna in 1873, diligently endeavored to set standard values of measurement to reconcile the problem of discordant values in the calculation. In fact two years before the signing of the International Treaty of Metre in 1875, which has been considered one of the most crucial steps for the international systems of standards, the International Meteorological Congress expressed its conviction that "among all the existing systems of measure, the Metric has the best prospect of universal adoption."[6] Therefore, the scientific endeavor of the meteorologists expedited the adaptation of standard values of measurement on a global scale and political internationalism in the nineteenth century.

Another indispensable factor in the efflorescence of the science of meteorology was the new discoveries in the realms of physical and atmospheric sciences in the nineteenth century. In the Aristotelian schema, the universe is mainly divided into two regions, namely terrestrial and celestial ones, which are the subjects of two distinct fields: meteorology and astronomy. In *Meteorologica,* Aristotle argues that the constant interchange of the four elements of nature -fire, water, air, earth- is the reason for the occurrence of weather events. Unlike the celestial worlds, which represent orderliness, the terrestrial world is made up of the chaotic co-existence of these elements, which hinders the predictability of any weather event. However, under its chaotic surface, even the sublunary world displays a certain order [cause-effect relationship] open to

[6] *Report of the Proceedings of the Meteorological Congress at Vienna Protocols and Appendices,* Published by the Authority of the Meteorological Committee, London: E. Stanford, Charing Cross, 1874.
Besides, Martin H. Geyer, in his article about the rise of internationalism in the second half of the nineteenth century, argues that the metric system was an ideology both of state- and nation-building in a universal setting. "This ideology appealed strongly to influential groups of scientists, civil servants, and businessmen who were reflecting on the possibilities for closer economic, political, and social integration of the nation-state within the broader setting of transnational exchange." Martin H. Geyer, "One Language for the World, The Metric System, International Coinage, Gold Standard, and the Rise of Internationalism, 1850-1900", in "*The Mechanisms of Internationalism, Culture, Society, and Politics from the 1840s to the First World War*," edited by; Martin H. Geyer and Johannes Paulmann, London: Oxford University Press, 2001. For further research see: M. Norton Wise edited by., *The Values of Precision,* Princeton: Princeton University Press, 1997.

rational investigation.[7] For Aristotle, therefore, "climate is determined by the angle of incidence of sunlight at different latitudes, *klima* being the Greek word for slope or incline."[8]

Aristotelian meteorology, a dominant paradigm until the late eighteenth century, focused on the explanation of causes rather than observation and prediction. However, this understanding of static climate and deductive reasoning was significantly altered with the discovery of the laws of thermodynamics by Herman von Helmholtz and other physicists in the nineteenth century. Especially Julius von Ferdinand Hann, an Austrian imperial scientist and the foundational figure for climate science and meteorology, elaborated the theory of dynamic climate that the accidental factors, such as the shape of the Earth and the rotation of the earth have also an impact on the local and global climates. "These efforts originated only in the 1860s with the investigation of mountain winds by Julius Hann and Herman von Helmholtz in the eastern and Western Alps."[9] In the framework of dynamic climatology, winds were interpreted as products of encounters between contrasting air masses.[10] Thus, unlike the deductive method of the Aristotelian paradigm of climate, Hann, Wladimir Köppen, and other meteorologists across the empires proposed the idea that the systematic and conscientious observation of the weather patterns of scattered geographies is imperative to make inductive inferences about the local and global climates.

[7] Ivano Dal Prete, "Climate and Meteorology: From Aristotelian Natural Philosophy to the Eighteenth Century", Springer Encyclopedia of Early Modern Philosophy and the Sciences, 2019: 2.
[8] Deborah R. Coen, *Ibid*, 171.
[9] Deborah R. Coen, "The Advent of Climate Science", *Oxford Research Encylopedia*, Climate Science, 2020, 10. Also see: Julius von Hann, *Handbuch der Klimatologie,* Stuttgart: Germany, Engelhorn, 1883.
[10] Deborah R. Coen, *Ibid*, 173. Herman von Helmholtz in his seminal essay *On the Interaction of the Natural Forces* discusses the preservation and conversion of the wind energy, and the text includes the idea of the dynamic climatology: "(…) I remind you of the windmill, which derives its force from the moving air. It may appear as surprising that motion, which we are accustomed to regard as a non-essential and transitory endowment of bodies, can produce such great effects. But the fact is, that motion appears to us, under ordinary circumstances, transitory, because the movement of all terrestrial bodies is resisted by perpetually by other forces, friction, resistance of the air, (…)*"* Herman von Helmholtz, *Science and Culture Popular and Philosophical Essays,* edited by: David Cahan, Chicago: The University of Chicago Press.

So, scientific observation emerged and flourished as a fundamental component of both the science of meteorology and dynamic climatology under specific historical conditions in the nineteenth century. The very word "observation", however, is suggestively ambiguous, yet necessary to explicate the emergence of the science of meteorology and climate science as a separate category of knowledge as well as practical field of science. As a way of life, observation has been pursued by farmers in fields, scientists in the laboratory, and nomads in the mountains. As Loraine Daston and Elizabeth Lunbeck affirm that even though the act of observation is so central to science as well as everyday life, it is rarely the focus of attention and almost never as an object of historical inquiry in its own right.[11] Daston and Lunbeck convincingly show that while observation and experiment were understood to work hand in hand throughout the eighteenth and early nineteenth centuries, the latter gradually degraded the value of the former from 1820s onwards with the gradual separation of technique and sciences. This understanding became crystallized in the words of French philosopher Claude Bernard who stated that "the observer no longer reasons; he registers."[12] People who advocated the complexity and superiority of experiment and innovation fervently argued that while the experiment requires certain methodological steps, observation could be done by lay people who do not have proper scientific training. This debate over the value of observation challenged the legitimacy of meteorology as a scientific discipline, but it also helped its efflorescence as a popular and practical science in the nineteenth century.

[11] Lorraine Daston, and Elizabeth Lunbeck (edited by), *Histories of Scientific Observation,* Chicago: The University of Chicago Press, 2011. Even though the book gives a broad survey of observation as a cultivated form of scientific experience, it overlooks the histories of observation in non- European contexts.
[12] Claude Bernard, *Introduction à l'étude de la médecine expérimentale*, ed. Francois Dagognet, Paris: Garnier-Flammorion, 1966, 55.

I argue that climate science grew out of the politico-economic context of empire-building during the third quarter of the nineteenth century across the world. Even though colonial empires had already been systematically observing the weather patterns in the continent in the first half of the nineteenth-century, only the political conditions of the period from the 1870s to 1914 allowed its emergence as a global science. This period, the *Age of Empires* as it is coined by Eric Hobsbawm, witnessed a novel type of imperialism across the world. The unfavorable impacts of the 1873 economic crisis on Britain's economy and the voracious imperial ambitions of the newly unified imperial states, such as Germany and Italy in 1871 as well as Japan with the Meiji Restoration in 1868, created a much more interdependent and interconnected through extremely contentious political environment. For instance, "between 1876 and 1915 about one-quarter of the globe's land surface was distributed or redistributed as colonies among a half-dozen states. Britain increased its territories by some 4 million square miles, France by some 3.5 million, Germany acquired more than 1 million, Belgium and Italy just under 1 million each."[13] As a direct consequence of this geographic and economic expansion, according to Hobsbawm, peripheral parts of the world were integrated into the single global economy. In this context, day-to-day weather knowledge of trade routes and climatic variabilities of disparate geographies became much more important for informational and governmental as well as economic reasons. This fact was reiterated by Alexander von Danckelman, German colonial geographer and meteorologist, during the Third International Meteorological Congress in Paris in 1885:

"The knowledge of climatic conditions of the regions of the Upper Congo, acquired by carefully-made meteorological observations, would undoubtedly be of essential utility, from an economic point of view, such as cultivation and plantations. The organization of meteorological systems at

[13] Eric J. Hobsbawm, *The Age of Empire 1875- 1914*, New York: Vintage Books, 1989, 58.

great expense by the English in India, and in Barbados for instance has certainly not been due to theoretical reasons solely."[14]

Alexander von Danckelman's statement plainly reveals that the economic motivations in the scramble for Africa and other geographies were also a motivation to invest in the science of meteorology in the nineteenth century. For instance, natural rubber, an essential raw material to produce hoses, tires, industrial bands, shoes and so many other industrial products, was extracted by the exploitation of natives in the rainforests of the Congo and the Amazon in the nineteenth century. Likewise, the extremely fertile basin of the Congo River was also a great food basket for the colonialists who inhabited the continent.[15] The rapacious demand for consumption expedited the developments in scientific methods of agriculture, and agricultural meteorology both in the colonies and on the continent. However, Richard Grove has shown that colonial science, including the science of climate, was deeply indebted to local epistemologies and practices.[16] Therefore, it can be deduced that imperial politics and the imperial science of meteorology were mutually constitutive factors in the nineteenth century. Even more interestingly, the imperial scientists from different empires that were potentially rivals to each other in the business of exploitation, gathered

[14] *Report of the Third Meeting of the International Meteorological Committee*, London: Majesty's Stationery Office, 1887, 26. In the same report Danckelman also states that the meteorological stations are absolutely necessary for the colonization of Africa: "As far as concerns meteorology and physical geography, the benefit which would be derived from these stations would obviously be invaluable, and the debated question of the colonization of tropical Africa might be discussed from the standpoint of actual information, which at present is entirely wanting. The question possesses, therefore, here a practical side of great importance."

[15] Scholars have shown that the mass consumption also exponentially increased in the overseas empires from 1860s onwards. For instance, "Britons who had consumed 1.5 lb. of tea per head in the 1840s and 3.25 lb. in the 1860s, were consuming 5.7 lb in the 1890s -but this represented an average annual impart of 224 lb. compared with less than 98 million in the 1860s and about 40 million in the 1840s." Eric Hobsbawm, *Ibid,* 64.

[16] Richard Grove, *Ibid.* Grove examines the institutionalization of the ecology and botany as scientific disciplines and shows that the colonial scientists who were key figures both in the making of colonial policies and scientific epistemologies, inherited the traditional knowledge of natives that have sustained them in disparate ecologies.

in these international congresses and worked for the creation of an international network of knowledge.

Concurring with Lorraine Daston's apt but cautious argument, I also argue that even though there was a situation where science was already global in its scale and cosmopolitan in its networks, its governance was at best national and even precarious before the last-quarter of the nineteenth-century.[17] The truly global -climate- science emerged only during this period in conjunction with the developments in theoretical and practical fields of sciences and political economy, "similarly to the confluence of different streams at different stages in a large riverbed, which then carries these waters along collectively."[18] Finally, all these different streams of the river, on the one hand repeats the narrative of modern man's ultimate victory over nature. However, the other side of the story also shows that the nineteenth-century people had a keen appreciation of their vulnerability to the vagaries of the atmosphere. This sense of vulnerability was not simply a potential to be harmed but also an anticipation of new experiences and new connections on different scales. The rest of this chapter surveys this elusive anxiety and its palpable consequences in the context of the Ottoman Empire.

1.2 The Ottoman Empire, The Science of Meteorology, and the Problem of Scale

L'etablissement d'un Observatoire météorologique a Constantinople, vu la position geographique de cette ville et ses communications directes avec les stations météorologiques de l'Asie, comme celles de Beyrouth, Alep, Baghdad, Bassorah, et relie aux stations des Indes, ne tardera pas a devenir le depot central des avis météorologiques du reseau asiatique, pour les transmettre a l'Observatoire de Paris, centre du reseau europeen.

(The establishment of a Meteorological Observatory at Constantinople, given the geographical position of this city and its direct communications with the meteorological stations

[17] Lorraine Daston, *Science Goes Global*, NHC Scholar-to-Scholar Talk, https://www.youtube.com/watch?v=d1CpC5Usd0g, 2021.
[18] Deborah Coen, *Ibid*, 185.

of Asia, such as those of Beirut, Aleppo, Baghdad, Basra, and linked to the stations of India, will soon become the central repository for meteorological warnings of the Asian network, to transmit them to the Paris Observatory, the center of the European network.)

Aristide Coumbary- M*émoire Sur La Nécessité De L'etablissement D'un Observartoire Météorologique a Constantinople*

As I showed in the first part of this chapter, the science of meteorology has been mostly discussed by scholars in the context of overseas empires. This approach, however, devotes attention to the dialogic nature of scientific knowledge production between the center and colonies. It underestimates the contiguous empire's significant contribution to the production and circulation of knowledge, and their utilization of science to consolidate their hegemony over diverse populations in vast geographies. This part of my chapter, first and foremost, aims to reiterate the Ottoman Empire's overlooked role in the global history of climate science. Secondly, it also shows how the Ottomans perceived and utilized this new science of meteorology to render legible their landscapes as well as to consolidate their power in different geographies in the Age of Empire.

Like its imperial neighbors, large-scale meteorological observations in the Ottoman Empire became possible with the introduction of the telegraph to the empire when the technology was still in its infancy. The very first telegraphic line in the empire was set up by American scientist John Lawrence Smith who introduced the Morse system to the Sultan Abdülmecid in 1847.[19] In less than a decade, the telegraph line for communication started to operate in the empire with the assistance of the British and French empires during the Crimean War. Even though the technical know-how for the construction of telegraph lines was imported from the West, the Ottoman imperial government was keen on expanding telegraphic networks across their vast empire.[20]

[19] Sultan Abdülmecid was so excited by the new technology and awarded Samuel Morse a *berāt* in 1847. Yakup Bektaş, "The Sultan's Messenger: Cultural Constructions of Ottoman Telegraphy, 1847-1880*",* *Technology and Culture*, Oct. 200, Vol. 41, 669-696.

[20] for a broad survey of the history of telegraph in the Ottoman Empire, see: Roderic H. Davison, "The Advent of the Electric Telegraph in the Ottoman Empire", *in Essays in Ottoman and Turkish History 1774-*

During the reign of Sultan Abdülaziz (1861-1876) and Sultan Abdülhamid II (1876-1909), telegraphic networks expanded miscellaneous geographies of the empire. According to the information given by Roderic H. Davison, while the empire had 6,490 km of telegraphic lines in 1863, the networks expanded to 13, 750 km in 1866, and even to 25, 137 km in 1869.[21] The Ottoman imperial government also established hundreds of telegraph offices even at the edges of the empire to connect localities to the center as well as to each other. This network of information kept growing until the end of the empire.

In fact, both the subjects of the empire and the foreigners had been observing and recording the weather before the introduction of the telegraph technology and the initiation of the state for the establishment of the imperial observatory (*Raṣad-hâne-i Âmire).* Even though there is no rigorous study on this topic so far, I recognized that especially scholars at missionary schools were keen observers of weather and the climate of the empire across different geographies. For instance, Priest Dalmas, a man of letter at the missionary School of Saint Benoît in Galata in Istanbul, made the first weather observations between 1839 and 1847 in the empire.[22] His observations did not indicate the precipitation level, or the directions of winds, however, he regularly recorded the daily temperatures of Istanbul. Likewise, William Lane also made weather observations from 1865 to 1886 with his own equipment in his house, which was located near the British Cemetery in the Asian side of Istanbul.[23] One of the overlooked sources regarding Istanbul's climate was, however,

1923 The Impact of the West, Texas: University of Texas Austin Press, 1990.; Bahri Ata, *The Transfer of Telegraph Technology to the Ottoman Empire in the XIXth Century*, Istanbul: Bogazici University Unpublished MA Thesis, 1997.; Yakup Bektas, "The Sultan's Messenger: Cultural Constructions of Ottoman Telegraphy, 1847-1880", *Technology and Culture*, Oct. 200, Vol. 41, 669-696.

[21] Roderic H. Davison, "The Advent of the Electric Telegraph in the Ottoman Empire", in *Essays in Ottoman and Turkish History 1774- 1923 The Impact of the West*, Texas: University of Texas Austin Press, 1990, 133-166.

[22] Kübra Fettahoğlu, *Ibid,* pp: 1-8.

[23] Kübra Fettahoğlu, *Ibid, 1-8.*, Muammer Dizer, *Ibid.*

Eugéne Grellois's *Studies on the Climate of Istanbul (Etudes sur le climat de Constantinople).* Grellois meticulously observed and measured the air pressure, winds, and rain in Istanbul between 1848-1855.[24] According to the information given in the *Zeitschrift der Österreichischen Gesellschaft für Meteorologie (Journal of Austrian Meteorological Society),* which was edited by famous Julius Hann and Carl Jelinek, Grellois recorded the temperature and the air pressure of Istanbul with a mercury barometer at 4 a.m., 1 p.m., and 8 p.m. every day between those years. Besides, he also pointed out that the wind directions in Istanbul were greatly influenced by the configuration of the coasts.[25] As I discussed before, the appreciation of the dynamic relationship between the atmospheric phenomena and the landscape was a new discovery in the nineteenth century.

Moreover, Grellois also compiled observation records of rain, which were done in different schools and hospitals in Istanbul such as at American College [Robert College] in Bebek and at French Hospital in Pera. These and other multifarious examples show the eagerness of the lay observers as well as the experts to measure the weather and climate for multiple purposes from agriculture to scientific curiosities. Yet, I discuss the science of meteorology with the establishment of the imperial observatory for two reasons: First, since all these intriguing weather observation reports are mostly fragmented and dispersed, it is not possible to reach a comprehensive picture at this stage. I postulate, rather, that these observations were ubiquitous across the empire in the second half of the nineteenth-century. For a moment, it is quite interesting to ponder about the meaning of a such dedication to quantifying nature. The semantics of these diligent observations can be rendered by looking at the personal writings of people or by

[24] Zeitschrift der Österreichischen Gesellschaft für Meteorologie, Dr. Julius Han, Wien: Selbstverlag Der Gesellschaft, XIII. Band, 1878, 60-62.
[25] *Ibid*, 61.

investigating the official records of institutions if the historian reads them along the grain.[26] As Ann Laura Stoler luminously shows in the context of the colonial Dutch empire, this reading might allow us to grasp the emotional reverberations and epistemic anxieties behind these conscientious observations and diligent recordings.[27] Secondly, the Ottoman state had a monopoly in regards to infrastructural investments and enhancements in the empire; therefore, its history was inextricably tied to the imperial government.

The first attempt at the establishment of an imperial observatory in the Ottoman Empire was Aristide Coumbary's report regarding the necessity of a weather observatory in 1867. According to the Ottoman population censuses, Aristide Coumbary was born in Istanbul in 1827. After receiving his primary education in Istanbul, he moved to Athens to pursue his studies there.[28] Later, he received his diploma in Paris and returned back to the empire to augment telegraph lines in the empire. In his *Memoire sur la necessite de l'etablissement d'un Observatoire Météorologique a Constantinople (On the Necessity of Establishing an Imperial Observatory in Istanbul),* Coumbary points out to imperial authorities that all the civilized nations of Europe have applied the nascent science of meteorology to fields ranging from agricultural science to navigation.[29] Throughout the text, Coumbary mentions the studies of numerous European imperial scientists and alleges that thanks to the developments in communication technologies and atmospheric sciences, the nations of the civilized world are now able even to foresee the dangerous storms at seas. Even though Coumbary's discourse on civilization was predictable, he nevertheless fashioned the new science of meteorology as a science that benefitted the well-being of all

[26] Ann Laura Stoler, *Along the Archival Grain: Epistemic Anxieties and Colonial Common Sense*, Princeton: Princeton University Press, 2010.
[27] Ann Laura Stoler, *Ibid,* 1-55.
[28] Presidential Ottoman Archives (hereafter to be cited as BOA) BOA (DH. SAID.d) 42/7.
[29] BOA, Irade, Dahiliye, *578-40243,* Aristide Coumbary, M*émoire Sur La Nécessité De L'etablissement D'un Observartoire Météorologique a Constantinople,* H. 21.03.1285/ 12 Temmuz 1868.

humanity. In recent years historians have shown that the concept of "civilized nations" was invented to justify the hierarchical and exclusionary international order of the Western nations solidified through various colonial arrangements in the nineteenth century.[30] While Coumbary expressed the concept of civilized nations to convince Ottoman imperial elites for the establishment of an imperial observatory, he also elucidated that this nascent and practical science, which needed the collaborated work of different groups across the empire might transgress national and confessional boundaries and serve all humanity.[31]

Coumbary stated that the establishment of an observatory in Istanbul was so crucial in this age of new internationalism as the empire's vast geography made it so central in the analysis of atmospheric phenomena in Asia and the Black Sea.[32] Coumbary apparently envisioned the imperial observatory in Istanbul as the center of an Asian meteorological network, much like the Meteorological Observatory in Paris served as the center of the European network. The Ottoman Empire's paramount importance in the science of meteorology was also emphasized in correspondence between Aristide Coumbary and French Meteorologist Marié-Davy who was the deputy-director of the Paris Observatory at the time. Marie- Davy noted: "Your project is excellent, and science will thank you for it. We would be delighted to see Turkey take the lead in the meteorological movement of the East: and its vast territory can furnish precious documents on the circulation of the atmosphere on the surface of the great continent in which we inhabit.*"*[33] So we

[30] Selim Deringil, *"*They Live in a State of Nomadism and Savagery": The Late Ottoman Empire and the Post-Colonial Debate", *Comparative Studies in Society and History*, April 2003, Vol. 45 No.2, 311-342., Boris Barth and Rolf Hobson, "Civilizing Missions from the 19th to the 21st Centuries, or from Uplifting to Democratization", in *Civilizing Missions in the Twentieth Century*, https://doi.org/10.1163/9789004438125_002

[31] BOA, I. DH, 578- 40243, *Ibid*, 4-7.

[32] BOA, I. DH, 578- 40243, *Ibid*, 10.

[33]BOA, I. DH, 578- 40243: 13.

"votre projet est excellent, et la science vous en sera reconnaissance. Nous verrions avex le plus grand plaisir la Turquie prendre la tête du movement météorologiqu*e* de l'Orient: et son vaste territoire peut fournir

can infer from this correspondence that Western scientists and Ottoman imperial scientists were in dialogue discussing the merit of large-scale data even before the establishment of the Imperial Observatory. Coumbary's other correspondence in regards to the new developments in the science of meteorology in the empire as well as the empire's geographical importance for this nascent science on a global scale was published in the *Zeitschrift der Österreichischen Gesellschaft für Meteorologie (Journal of Austrian Meteorological Society)* in 1869.[34] Coumbary accentuated the unique geographical position of Istanbul for the transmission of knowledge as well as the inevitable importance of Ottoman landscapes for the discovery of laws of nature. Contra previous

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de précieux documents sur la circulation de l'atmosphère à la surface du grand continent que nous habitons." cited by Aristide Coumbary in his M*émoire Sur La Nécessité De L'etablissement D'un Observartoire Météorologique a Constantinople.*

[34] Dr. C. Jelinek and Dr. Julius Hann, *Zeitschrift Der Österreichischen GesellSchaft Für Meteorologie*, Wien: Selbstverlag der Gesellschaft, 1869, 64-65.

[To my knowledge this correspondence and Eugéne Grellois's weather observation records have been completely overlooked by historians. I think that further investigations will reveal new networks as well.]

We know that Aristide Coumbary could speak French, Turkish, Greek, and Italian. Considering some tiny errors in the text, his letter was either translated by non-native speaker of German language - probably an Ottoman subject- or he himself attempted to write his text in German. I am unable to give the full text here as it is longer than a page, but a short excerpt from his correspondence is necessary to understand the imperial and global networks of scientists:

(…) "Von nun an aber wird das new begründete meteorologische Beobachtungsnetz der Türkei, welches sich vom adriatischen, dem schwarzen Meere, dem Archipel und dem östlichen Theile des Mittelmeeres über das ganze Innere des türkischen Reiches bis zum persichen Meerbusen erstrecktm die Bewegung der atmosphärischen Erscheinungen über einem grösseren Raume als bisher zu verfolgen gestatten, was gewiss zur Auffindung der Gesetze dieser atmosphäarischen Bewegung beitragen muss.(...) Das Observatorium zu Constontinopel wird daher durch seine ausnahmsweise Lage in den Stand gesetz sein, täglich den Zustand der Atmosphäre über ganz Europa und einem grossen Theile Asiens zu kennen. Eine tägliche Uebersicht dieser Witterungs- Depeschen kann durch seine Vermittlung allen Observatorien Europa's und Ostindiens, mit welchen wir in Verbindung stehen, mitgetheilt werden."

"(…)From now on, however, *the newly founded meteorological observation network of Turkey, which extends from the Adriatic, the Black Sea, the archipelago and the eastern part of the Mediterranean Sea over the whole interior of the Turkish Empire to the Persian Gulf,* the movement of atmospheric phenomena over one larger space than before, which must certainly contribute to the discovery of the laws of these atmospheric movements.(…) The observatory at Constantinople, by its exceptional position, will be in a position to know daily the condition of the atmosphere over the whole of Europe and a large part of Asia. A daily survey of these weather dispatches can be given through his agency to all the observatories of Europe and the East Indies with which we are in communication."

literature on Ottoman science, I argue that *the* Ottomans were indeed considered an important part of this international network of knowledge.

After Coumbary's detailed report, grand-vizier Âli Paşa (d. 1871) asked the permission of Sultan Abdülaziz (r. 1861-76) for the establishment of an Imperial Observatory that would play a key role in global science data collection and analysis.[35] The Imperial Observatory (*Raṣad-hâne-i Âmire)* for weather forecasting was established in Istanbul with the patronage of Sultan Abdülaziz in 1868. Aristide Coumbary was duly appointed as the director of the observatory with the recommendation of Monsieur Le Verrier who was the founder and the head of the imperial observatory in Paris since 1863.[36] Montani Efendi and Emile Lacoine Efendi, two important and versatile scholars in the Empire, were appointed as Aristide Coumbary's assistants.

The personal backgrounds of these imperial scientists are also important to trace the proliferation of the science of meteorology in the empire. Montani Efendi was born in Trieste in 1829 and migrated to Istanbul when he was a child. He attended World Expeditions in Paris in 1867, and in Vienna in 1873, and he represented the empire in these exhibitions as one of the leading architects of the empire.[37] Likewise, Emile Lacoine Efendi was born in France in 1836 and settled in the Ottoman Empire in his early twenties, and later he became one of the most crucial imperial scientists in the enhancement of telegraph technology across the empire. He was the head of the telegraphy center in Istanbul for many years and he taught electricity courses to the students at Darüşşafaka.[38]

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[35] BOA, I, DH, 578- 40243.
[36] Kübra Fettahoğlu, *Ibid*, 6.
[37] Nurcan Yazıcı, "Bilinmeyen Yönleriyle Mimar Montani Efendi", *Arkitekt*, Mart-Nisan 2003/ 02, 42- 47.
[38]Emile Lacoine Efendi's overlooked source *Mebahis-i Telgraf* is an invaluable source in the global history of technology. His book contains theoretical formulations as well as many practical knowledges. During his lifetime, the French government praised him due to his inventions and immense contributions to science. Yet, his work has been intentionally or unintentionally overlooked by the Western historians of science. Emile Lacoine Efendi, *Mebahis-i Telgraf*, Istanbul: 1300/ 1883.

The Imperial Observatory started to operate in a temporary place near the Russian Embassy, and shortly after that it moved into its new headquarters in Pera Street in 1868.[39] The correspondence between Aristide Coumbary and imperial elites reveals that the observatory had difficulties in operation as there was no proper building for scientific activities.[40] Another recurring problem was that Coumbary's requests for new instruments such as thermometers and barometers occasionally created uneasiness among Ottoman imperial elites, as the empire suffered a serious budget deficit at the time.[41] Scholars have alleged that underinvestment in science due to economic crisis was an impediment to the development of science in the empire.[42] Indeed, the Imperial Observatory (*Raṣad-hâne-i Âmire)* did not have a separate building dedicated to scientific observation from its establishment until 1911. This was primarily because of Sultan Abdülhamid II's (r. 1877- 1909) compulsive obsession with conspiracies against him. He did not give permission for the construction of a new observatory on the outskirts of the city, because he worried that such an establishment could be used as a meeting place for the Young Turks or other opponents of the regime.[43]

Tanju Demir, "Osmanlı Haberleşme Kurumunda Yabancı Uzmanlar ve Emil Locaine Efendi", *Kebikeç Dergi* 19/ 2005, 35-53.

[39] Kübra Fettahoğlu, *Ibid,* 1-8.

[40] Kübra Fettahoğlu, *Ibid,* 8-17.

[41] For a broad overview of the Ottoman economy in the nineteenth century see: Şevket Pamuk, *Osmanlı-Türkiye Ekonomik Tarihi 1500-1914*, Istanbul: İletişim Yayınları, 2005., Şevket Pamuk, *A Monetary History of the Ottoman Empire*, New York: Cambridge University Press, 2000.

[42] In my opinion this alleged idea of underinvestment in science is one of the most crucial problems in the historiography of the Ottoman Empire and Near East. Most of the scholars so far have argued that the Ottoman Empire did not invest in sciences either because of monetary problems or lack of interest. As Lorraine Daston stated in her talk that these international projects were always underfunded and underprivileged across the world at least until the second half of the nineteenth-century. So far there is no quantitative study that compares the amount of money invested in sciences by the Ottomans and the European empires throughout the nineteenth-century. Since my quantitative data collection on this topic has not finished yet, I eschew from making groundless postulations.

[43]Kübra Fettahoğlu, *Ibid, 21.*

However, this did not necessarily mean that the Sultan was against the science of meteorology. On the contrary, he was an ardent follower of various technologies, and he attempted to take control of them to consolidate his power throughout his reign.[44] For instance, contemporary newspapers reported that Sultan held responsible the Imperial Observatory for reporting daily weather data of miscellaneous geographies of the empire to the Palace every day.[45] Through this incessant exchange of knowledge, the empire aimed to connect the localities as source of information to the imperial center. In 1881, Sultan Abdülhamid II even decided to establish another imperial observatory in the courtyard of Yıldız Palace, and Coumbary was commissioned for this mission as well.[46] The construction of the observatory was completed in 1884, and the weather observations concomitantly started at the new observatory (*Raṣad-hâne-i Şahâne*).[47] Unlike the initial Imperial Observatory (*Raṣad-hâne-i Âmire),* the new observatory at Yıldız Palace mainly concentrated on the observation of daily weather in Istanbul, seismic forces, and to some extent astronomical observations.[48] Indeed, the construction of the new observatory in the vicinity of the Palace was symbolically important as for the first time in the history of the empire an observatory for the analysis of the atmospheric phenomena was built and funded by the Sultan himself. Selim Deringil has convincingly shown that symbolic actions of the Sultan as well as symbolic values attributed to institutions and causes he sponsored created a palpable image of the sultan and empire

[44] For further research on Sultan Abdülhamid II's and the imperial elite's utilization of various technologies and science to consolidate its power in the late nineteenth-century see: Ahmet Ersoy, "The Sultan and His Tribe: Documenting Ottoman Roots in the Abdülhamid II Photographic Albums", in *Otttoman Arcadia, the Hamidian Expedition to the Land of Tribal Roots (1886)*, Istanbul: Koç University Research Center for Anatolian Civilizations (ANAMED): 31-65.
[45] *Vakit,* 10 March 1977/ 24 Safer 1294.
[46] *Vakit,* 5 January 1881/ 3 Safer 1298.
[47] *Tercümân-ı Hakîkat,* 5 Zilhicce 1301/ 26 September 1884.
[48] Abdülhamid II had a keen interest in observing the stars as well. Kübra Fettahoğlu shows that Aristide Coumbary repaired Sultan's telescope in Vienna and ordered new technical material for weather observation to enhance the technical capacity of the *Rasadhâne-i Şahâne*. Kübra Fettahoğlu, *Ibid,* 69.

abroad, and buttressed his legitimacy in the eyes of his subjects.[49] Therefore, I argue that scientific observation and rational prediction rather than prophecy became sources of legitimacy in the empire. The following section, therefore, discusses how this scientific and political endeavor resulted in sophisticated analysis of atmospheric phenomena by the Imperial Scientists in the Ottoman Empire.

1.3 Weather Reports of the *Raṣad-hâne-i Âmire (Observatoire Impérial Météorologique)* and the Imperial Scales

"*Meteorology gave an exceptional illustration of the mental proximity of many geographically distant possessions*"

Katharine Anderson- Predicting the Weather: Victorians and the Science of Meteorology

Since its establishment, the Imperial Observatory made regular observations in the capital and administered the weather observations in distant geographies of the empire for political, economic, and practical reasons. As an imperial institution, the Imperial Observatory also served a crucial, completely overlooked role in connecting the Ottoman state with other states as well as the people through science. This part, therefore, first and foremost examines the international connections of the Observatory. Then, I examine and evaluate the nature of its weather and climate observations. Finally, I briefly discuss how these data were collected and shared with the public in Istanbul as well as other parts of the empire.

As I mentioned before Aristide Coumbary attended and represented the empire at the First International Meteorological Congress in Vienna in 1873.[50] During the Congress, Coumbary worked with Habsburg scientist Julius von Hann and Swiss meteorologist M. Plantomour under

[49] Selim Deringil, *The Well-Protected Domains: Ideology and the Legitimation of Power in the Ottoman Empire, 1875- 1909,* London, New York: I.B. Tauris, 1999.

[50] For the discussions at the Congress see: *Report of the Proceedings of the Meteorological Congress at Vienna Protocols and Appendices,* Published by the Authority of the Meteorological Committee, London: E. Stanford, Charing Cross, 1874.

the sub-committee of 'Hours of Observation,' which aimed to determine the most suitable time-slots to reach the most accurate measurement results of weather across different geographies.[51] The Ottoman imperial scientists had already started analyzing disparate climates across the empire before the Congress, but the Congress immediately improved and expanded the development of climate science in the empire. Even though the Ottoman Empire did not attend the subsequent International Meteorological Congresses due to economic hardships, imperial scientists continued to follow new developments in the science of climate and broadened their networks until the very end of the empire in 1923. For instance, Petro II, the monarch of Brazil, visited the Imperial Observatory (*Raṣad-hâne-i Âmire*), scrutinized the technical equipment of the observatory, and exchanged knowledge with the imperial scientists during his visit to Istanbul in 1876. Petro II also expressed his desire to share the daily weather data between Istanbul and Rio de Janerio.[52] Moreover, the connection between the Imperial Observatory and other observatories significantly increased in the last decade of the nineteenth century. The imperial observatory started to share daily weather data with the Observatory of Sofia Observatory in 1891 and the National Observatory of Athens in 1892.[53] In Egypt, at the other edge of the empire, the British imperial scientists shared their analysis of water drainage on the Nile River according to the seasonal and climatic changes across the Nile Delta with the Imperial Observatory in 1901.[54] These multifarious webs of connections demonstrate that the Imperial Observatory played a paramount role in the production and dissemination of weather data across different scales in the empire.

[51] *Ibid*, 15.
[52] *Vakit*, 16 June 1876/ 23 Cemaziyelevvel 1293, 3. Kübra Fettahoğlu, *Ibid,* 62.
[53] BOA, Y. MTV, 60/30, 10 March 1892.
[54] Kübra Fettahoğlu, *Ibid,* 66. Fettahoğlu diligently lists the empire's various international connections during the era. However, her study does not examine the meaning of the creation of international network of science.

It is necessary to accentuate that even though the empire had a limited budget at the time, the Observatory could garner technical equipment to measure and predict the weather. According to the inventories of the Imperial Observatory in Istanbul, the Observatory had already accumulated the best quality of barometers, thermometers, pluviometers, hygrometers, flow meters [a device that measures the flow-rate of a river], and various other technical materials of measurement in 1887.[55] Because the Ottomans were in such close contact with the French Empire in almost every sphere in the nineteenth-century, most of the equipment of measurement for the Observatory was ordered from Paris.[56] Indeed, Aristide Coumbary's close contact with M. Le Verrier had an impact on the exchange of knowledge as well as materials between empires at the time. The international connections of Aristide Coumbary and other imperial scientists allowed them to improve the technical conditions of the observatory. Hence, when it comes to the technical equipment, the Imperial Observatory in Istanbul was not less qualified than its counterparts in Europe.

A practical organization of everyday life without any distraction was, indeed, a precipitating factor behind the act of observation and transmission of weather data. However, the Imperial scientists had also a scientific endeavor to map out the climatic characteristics of Istanbul and other miscellaneous geographies of the empire. This noble venture resulted in different treatises produced by Imperial scientists. The Imperial Observatory published its first comprehensive book under the title *Dersaadet Raṣad-hâne-i Âmiresi'nin Cevv-i Havaya Dair Yirmi Senelik Tarassudatı Neticesi,* (*The Results of the Observations Regarding Atmospheric*

[55] *Dersaadet Rasadhane-i Âmiresi'nin Cevv-i Havaya Dair Yirmi Senelik Tarassudatı Neticesi*, Dersaadet: Matbaa-i Osmaniyye, 1304 (1887).

[56] According to inventories of the Observatory, one of the Fortin Barometers, a device to measure the atmospheric pressure, had a seal from the Paris Observatory. Moreover, I haven't seen the document but Kübra Fettahoğlu argues that the Observatory also ordered a mercury barometer, two electrical anemometers, two thermometers, a Fortin Barometer, and some other materials from Paris in 1889.

Phenomena Between 1867- 1887) in 1887.[57] The book includes the measurements of all the daily weather phenomena from temperature and precipitation to atmospheric pressure and humidity between 1867 and 1887 in the capital of the empire. The report was not only a compilation of raw data but it also included some inferences about the impact of geography and other relational factors on the climate of Istanbul. Therefore, authors aimed to discern broader characteristics of nature by diligently observing the recurring patterns of volatile weather and turning them into statistical data. I will now explain the nature of this quantitative data, as they were crucial for the study of meteorology and climatology in the empire.

[57] *Dersaadet Raṣad-hâne-i Âmiresi'nin Cevv-i Havaya Dair Yirmi Senelik Tarassudatı Neticesi*, Dersaadet: Matbʿa-i Osmaniyye, 1304 (1887).

Average Monthly and Yearly Rain Between 1868-1887 (mm)

YEAR	January	February	March	April	May	June	July	August	September	October	November	December	Total Yearly Rain
1868	88,6	64,3	54,8	35,7	1,6	0	26,1	187	9,2	144,6	153	32	798
1869	29,8	8	59	18,8	6,1	18,5	16,6	39,7	44,1	94,2	132,9	65	532,7
1870	45,5	52,6	101,7	95,7	4,6	67,6	21,7	22,1	58,9	177,8	6,1	101,5	756,1
1871	100	20	50,4	11,6	89,3	42,5	1,9	101,2	72,6	47,7	47,9	128,3	712,4
1872	38,9	98,5	17,3	28,6	28,3	40,7	47,9	60,8	27,1	4,2	105,9	108,4	606,2
1873	43,5	45,5	27,8	30,3	55,5	45	47	56	132,3	5,7	113,9	127,2	729,7
1874	37,5	67,3	37,8	37	39,8	31,6	0	0	5,1	69,1	90,3	91,8	507,3
1875	141,2	67,3	141,4	41,8	12	4,7	130,5	30,2	95,4	126,4	78	155,5	1024,5
1876	29	44,7	52,4	13,3	57	26,9	95	69,8	34,6	36,6	158,7	104,3	722,3
1877	119,3	89,9	69	34,2	64,1	71,8	35,6	29	106,5	119,1	226,6	101,6	1066,7
1878	102,9	38,3	116,9	97,8	12,9	64,8	51,7	64	51	13,5	45,2	217	876
1879	66,9	52,2	103,1	19	52,5	2,1	0	0,8	69,2	117,6	173,3	112	768,2
1880	83	13	59	10,6	43,4	45,2	3,5	55,3	49	74,7	37,4	32,1	507,2
1881	148,6	78,4	49,6	15	64,5	31,6	57,3	0	8,9	40,4	49,7	58	602
1882	56,6	47,8	1	23,1	37,8	20,9	0	56,7	0,8	54,5	118,9	65,1	482,2
1883	66,1	43,5	116,1	60,8	25,3	67	7,4	20,4	56,4	33,1	64,4	271,9	832,4
1884	158,3	38,2	37,3	24,9	8	66,5	35,8	70,6	97,1	53,1	132,6	39,5	761,9
1885	80,9	68	44,6	37	17,5	10,6	20,9	0	48,2	88,5	83,7	116,5	616,4
1886	44	90,3	105,5	36,1	37,8	38,7	35,3	71,1	37,7	52	39,6	29,8	617,9
1887	62,5	69,4	77,3	77,1	2,4	29,7	11	49,4	70,3	87,6	142,8	172,7	852,2
Monthly Average	77,2	54,7	66,1	37	33,2	36,2	32,3	49,2	53,7	72	100	106,5	718,6

Dersaadet Rasadhâne Âmiresinin Cevv-i Havâya Dair 20 Senelik Tarassudatı Neticesi, Dersaadet: Matbaa-î Osmâniye, 1304 (1887).

Table 1.

Monthly and Yearly Mean Temperatures Between 1868-1887 (°C)

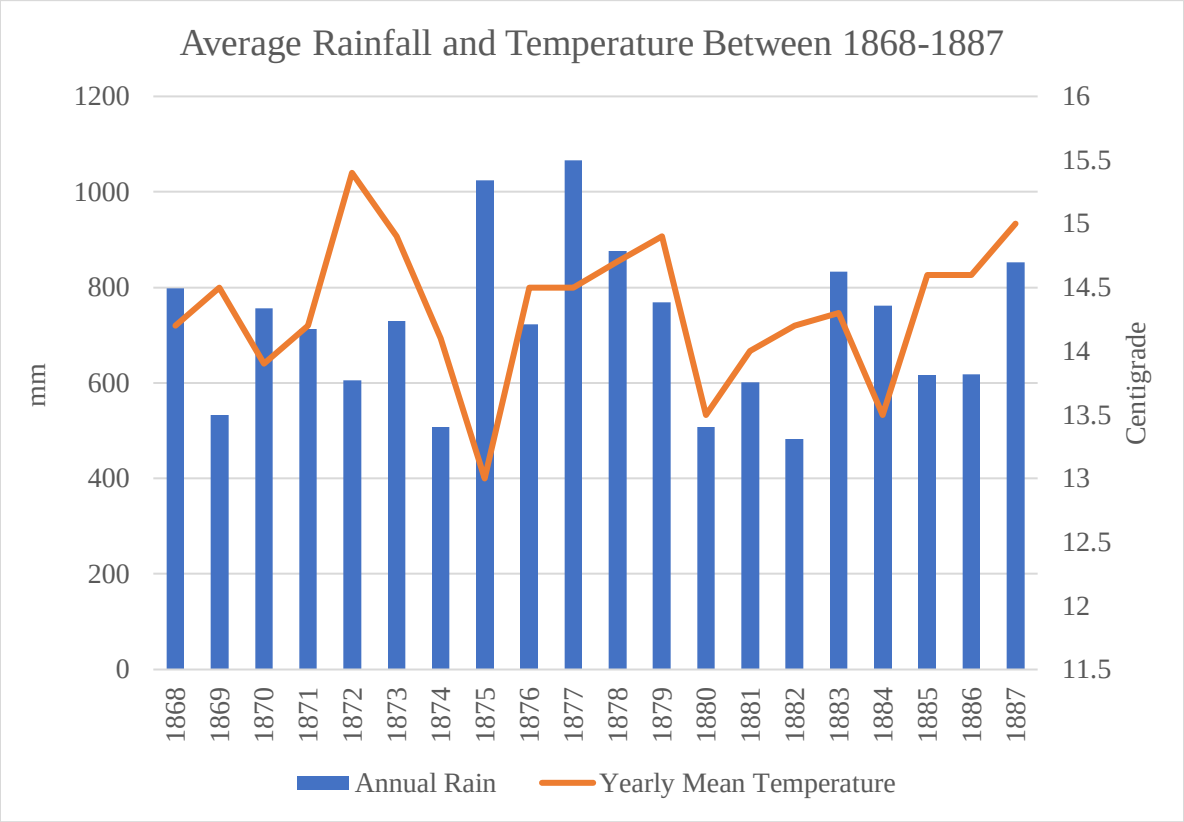
YEAR	January	February	March	April	May	June	July	August	September	October	November	December	Yearly Average
1868	6,2	3,2	2,1	10,9	16,8	21,5	23,4	23,3	21,2	18,1	10,4	8,6	14,2
1869	2,7	6,7	10,7	11,1	17,3	22,1	22,4	24,8	20	16,7	10,4	8,9	14,5
1870	7,4	3,7	7,3	8,4	18,7	20,8	22,7	23,3	17,2	13,7	14,1	10	13,9
1871	7,3	4,9	6,8	11,7	15,6	21,7	23,9	23,3	19,5	15,2	13,6	5,9	14,2
1872	7	4,5	7,1	14	19	21,5	12,5	22,8	21,1	18	14,5	10,6	15,4
1873	8,9	6,9	8,9	14,4	17,8	19,2	23,4	24,1	19,4	17,5	11,9	7	14,9
1874	4,3	3,1	4,1	13,1	16,6	20,4	22,6	23,7	20,5	16,7	12,3	11,9	14,1
1875	4,4	3,9	3,8	10,8	15,6	22,5	23,7	22,6	16,7	16,3	11,1	5,2	13
1876	3,2	6,6	10,5	11,6	16,7	22,2	22,9	23,2	20,6	16,5	8,7	10,7	14,5
1877	7	6,2	10	13,1	16,4	19,7	21,8	23,2	21,3	15,6	11,1	8	14,5
1878	4,6	8,2	7,7	12,4	16,8	20,8	23,4	22,2	21,9	16,7	14,6	10,4	14,7
1879	6,5	10,3	7,7	15,8	16,3	22,5	23,8	22,1	20,9	16	10,2	5,1	14,9
1880	5,8	4,6	4,5	9,9	15,7	22,5	23,9	23,7	18,7	17,4	12,8	7,2	13,5
1881	5,8	4,3	8,4	12,3	15,7	20,6	23,1	23,5	21,2	16,2	10,4	6,8	14
1882	4,7	3	9,4	11,4	16	19,5	24,8	23,6	20,6	15,3	12,7	9,5	14,2
1883	4,3	2,6	7,2	11,2	17,4	21,8	24,1	23,7	22,2	18	13,3	6,5	14,3
1884	4,7	5,1	7,8	13,3	15	20,6	22,2	21,3	18	15,7	8,6	9,5	13,5
1885	4,7	5,9	7,5	12,5	18,6	22	22,2	23	20,4	18,4	12,9	7,6	14,6
1886	9,4	5,9	7,5	12,5	18,6	22	22,2	23	20,3	18,4	12,9	7,6	14,6
1887	6,4	4,8	9,3	11,3	19,6	20,4	23	23,9	21,5	17,6	13,3	9,8	15
Monthly Average	5,7	5,2	7,4	12	17	21,2	22,6	23,2	20,1	16,7	11,9	8,3	14,3

Dersaadet Rasadhâne Âmiresinin Cevv-i Havâya Dair 20 Senelik Tarassudatı Neticesi, Dersaadet: Matbaa-î Osmâniye, 1304 (1887).

Table 2.

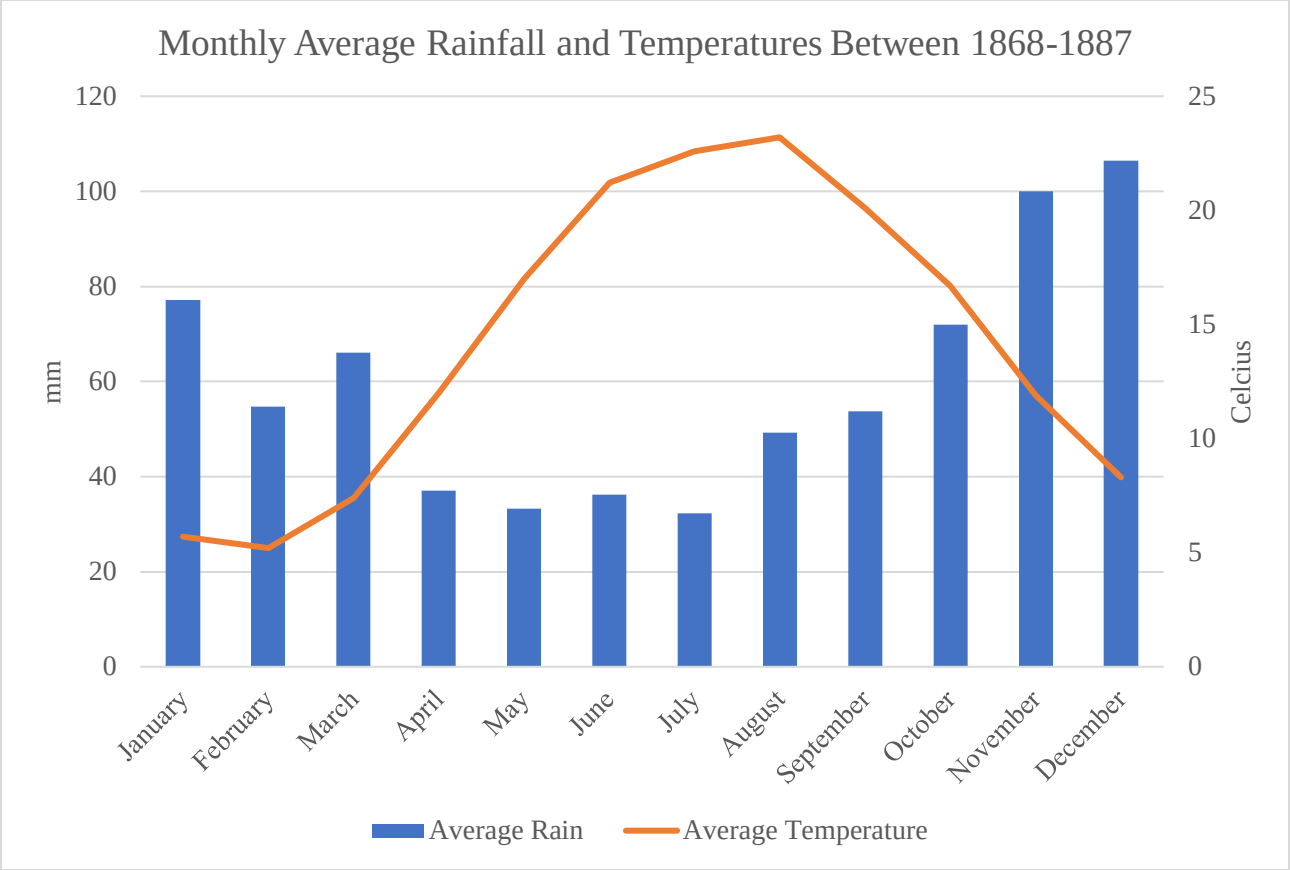
For instance, the first and second tables were produced by the imperial scientists to show the yearly and monthly average temperature and rainfall between 1867 and 1887 in Istanbul. They measured the daily temperature and precipitation every day from 1867 to 1887 and shared these data with their international partners as well as with scientists and enthusiasts across the empire. The main reason behind providing mean temperature and rain was to reach the climatic characteristics of Istanbul in the long run. This was the first systematic and scientific attempt to

delineate the climatic characteristics of Istanbul by utilizing the statistical data.[58] Concomitant to their contemporaries in other empires, the imperial scientists had an idea that they could explore the rules of nature by collecting more and more numbers in the age of statistics. Furthermore, since this booklet was published only in Ottoman Turkish, I postulate that the main audience of the Imperial Observatory was ordinary residents of the city. The Imperial Observatory apparently had a public mission to share its findings with the people and disseminate this popular science to a larger population.



Graphic 1.

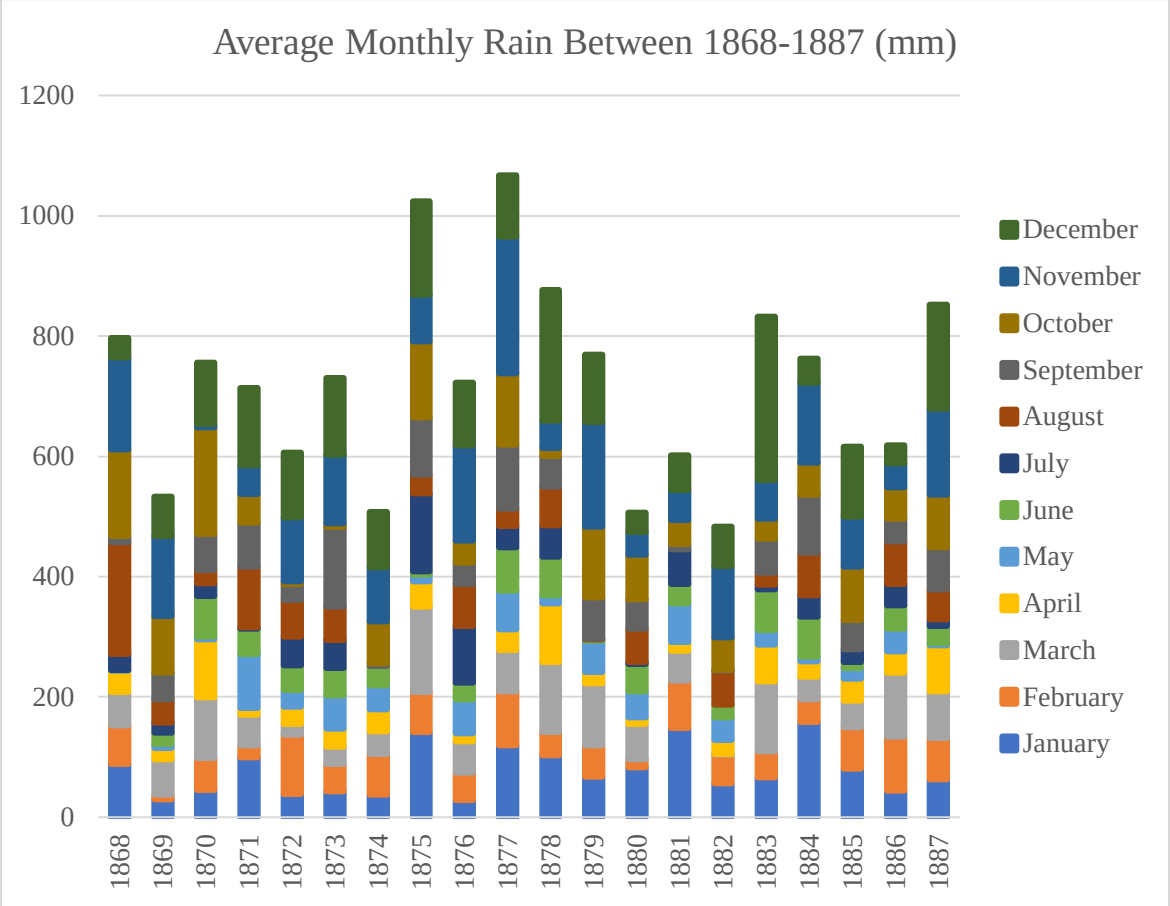
[58] For further research on the growing authority of the statistics in the nineteenth century see: Ian Hacking, *The Taming of Chance*, Cambridge: Cambridge University Press, 1992. Ian Hacking, T*he Social Construction of What?*, Massachusetts: Harvard University Press, 1999., Ian Hacking, *The Emergence of Probability: A Philosophical Study of Early Ideas About Probability, Induction and Statistical Inference*, Cambridge: Cambridge University Press, 1993., Michael Donnely, "From Political Arithmetic to Social Statistics: How Some Nineteenth-Century Roots of the Social Sciences Were Implanted", in Johan Heilbron et al., eds., *The Rise of the Social Sciences and the Formation of Modernity*, (1998), 225- 239.



Graphic 2.

Moreover, I verified the accuracy of measurements and the calculations of the imperial scientists and found that their calculations were mostly accurate in this booklet. As the tables and my graphics reveal, Istanbul had regular rain patterns according to the seasons. Likewise, the city had a more temperate climate compared to inland territories of the empire which exhibited the characteristics of the terrestrial climate. As the Graphic 2. And Graphic 3. show that the precipitation level dramatically increases from October to December in Istanbul. This data was useful for imperial scientists, the ruling elite, and the people of the empire to take necessary precautions in regard to floods and other natural disasters in these months. It was also useful data for agricultural ventures in the hinterland of the capital. The Graphic 1. reveals that the dramatic decrease in rainfall in 1874 intersected with the extreme drought in Central and Eastern Anatolia

in 1874.[59] In 1874, the annual precipitation was 507,3 mm, which was a critical threshold for further precautions in times of droughts.[60]



Graphic 3.

[59] For further information regarding the drought in 1894 see: Mehmet Yavuz Erler, *Osmanlı Devleti'nde Kuraklık ve Kıtlık Olayları (1800-1880),* Libra Kitapçılık ve Yayıncılık, Istanbul: 2010. Kübra Fettahoğlu, *Ibid,* 125.

[60] The imperial scientists and the people of Istanbul were aware that this was not the general pattern in Istanbul but rather an exceptional drought. However, they were also aware about the different techniques of farming in times of droughts, especially in drylands. "Dryland farming is frequently defined as crop production in areas with less than 500 mm of annual precipitation, but this definition omits a critical component of the equation, evaporation potential." Garry A. Peterson, *Reference Module in Earth Systems and Environmental Sciences,* 2018. https://www.sciencedirect.com/topics/agricultural-and-biological-sciences/dryland-farming

The Ottoman meteorologists and agriculturalists were well aware about the Dryland Farming as they discuss it in the traditional manuals of Agriculture, namely *Al-Filāḥa* manuals (Books on Agriculture).

More importantly, even though the booklet did not explicitly discuss the connection between the drought in Anatolia in 1874 and the dramatic decrease in rainfall in Istanbul, I argue that Aristide Coumbary and other imperial scientists were cognizant of the impact of weather anomalies and climatic changes in one geography on other distant geographies. Therefore, I argue that these weather observations were crucial for the recognition of the reciprocity and interdependency of different climatic regions. This was an entirely new conceptualization of climate in the late nineteenth century. Thus, the imperial scientists aimed to discern the dynamic relationship between different localities and to delineate the climatic zones of the empire by observing the weather patterns of miscellaneous geographies across their vast empire. Katharine Anderson's argument in the context of Victorian Britain can well be applied to the Ottoman Empire as well: "meteorology gave an exceptional illustration of the mental proximity of many geographically distant possessions."[61]

Our knowledge about the observation records of the weather in Istanbul is unsurprisingly more abundant and systematic than in the other geographies of the empire. However, Ottoman imperial scientists in the capital attempted to establish observatories for weather analysis in disparate geographies of the empire. For instance, according to the *Annual Booklet* [*salnâme*] of 1887, the Imperial Observatory in Istanbul was in contact with observatories in Sulina, Köstence [Konstanza], Varna, Rusçuk, Bergos, Trabzon, Gelibolu, Çanakkale, Kavala, Selanik, Izmir, Manastır, Valona, Draç, Beirut, Baghdad, and Fav.[62] Likewise, contemporary newspapers such as *Vakit (Time)* and *Tercümân-ı Hakîkat (Interpreter of Truth)* often published the weather reports of disparate cities ranging from the Balkans and Anatolia to the Near East. Interestingly, these newspapers included the weather data of European cities as well. These data also show the partners

[61] Katharine Anderson, *Ibid*, 253.
[62] Kübra Fettahoğlu, *Ibid*, 46.

of the Imperial Observatory at the time. For instance, an illustrated journal *Malûmat (Information)* published the weather reports of Moscow, Paris, Vienna, Sofia, Athens, and many other European cities in its pages.[63]

The number of observatories that were in constant communication with the Imperial Observatory changes in different registers due to the economic expenses of telegraphic communication. In reality, the imperial scientists at the International Meteorological Congress of Vienna reached a consensus regarding the free transmission of weather data all over the world.[64] However, the economic hardships of the empire and the conflicting interests of companies and state officials occasionally hindered the transmission of data. Even though the exchange of data between the Imperial Observatory and other observatories across the empire was intermittent, I postulate that the local observatories and boarding schools continued to observe the weather and atmospheric phenomena in different geographies of the empire. This can be discerned in Salih Zeki Bey's attempt to utilize the high schools (*Idâdî)* as information providers for the Imperial Observatory in disparate geographies of the empire.[65] Salih Zeki Bey [1864- 1921], a famous mathematician and versatile scientist in the empire, was appointed as the Head of the Imperial Observatory after Aristide Coumbary's death in 1895. Before his appointment to the Imperial Observatory, he helped Emile Lacoine in the preparation of *Takvim-i Cedīd (New Calendar)* in 1894.[66] Apart from his treatises on mathematics, geometry, and the science of probability, Salih Zeki also translated books from French about cosmography.[67]

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[63] *Malûmat (Information)*, 23 Saban 1317/ 27 December 1899, Kübra Fettahoğlu, *Ibid*, 58.
[64] *Report of the Proceedings of the Meteorological Congress at Vienna Protocols and Appendices*, Published by the Authority of the Meteorological Committee, London: E. Stanford, Charing Cross, 1874.
[65] BOA, MF. MKT. 312/42. 12/11/1313, (25 April 1896).
[66] Feza Günergun, "Salih Zeki ve Astronomi: Rasathâne-i Âmire Müdürlüğünden 1914 Tam Güneş Tutulmasına", *Osmanlı Bilimi Araştırmaları*, Cilt:7 Sayı:1, 2005: 97-122.
[67] Feza Günergun, *Ibid.*

As his report indicates, Salih Zeki Bey had a plan to broaden the information network of the empire to have more accurate and uninterrupted data on weather across the empire. As a result of this policy, the empire also provided technical materials to the schools and imperial farms for the measurement of weather data in sundry geographies of the empire. For instance, the empire provided one Fortin Barometer, one thermometer, and some other materials of measurement for the High School in Jerusalem (Kudüs) and reimbursed all the expenses of these materials in 1896.[68] The Imperial Observatory continued its studies and tried to map out the climatic zones of the empire by integrating different institutions and groups under Salih Zeki Bey's directorship from 1895 to 1909. However, the Imperial Observatory and some of the studies of the Observatory were destroyed by counter-revolutionary groups during the 31 March Incident in 1909.[69] The studies of the observatory were interrupted until the construction of a new and fully-fledged observatory on the hills of Kandilli outside the capital in 1911. Mehmet Fatin [Gökmen] was appointed as the new director of the Kandilli Observatory as Salih Zeki Bey became the head of *Mekteb-i Sultanī (Galatasaray Lisesi)* in 1910. The imperial observatory prepared a considerably detailed analysis of the weather and climate of Istanbul and published them under the title ***Raṣad-hâne-i Âmire'nin 1912-1913-1914 Senelerine Aid Hülâsa-i Rasadatı (Observations on the Atmospheric Phenomena in 1912- 1913- 1914)***.[70] These reports include the level of temperature, precipitation, atmospheric pressure, directions of winds, and many other atmospheric phenomena in Istanbul. The imperial scientists also used the observation records from 1867 to 1908 and analyzed the precipitation level

[68] BOA, MF. MKT, 312/42, 11 November 1896, p:17. We need to work on the private archives of these schools and various other institutions to reach their observation records. This is not possible at this state of this research, but further studies will reveal further and more comprehensive data across different geographies.
[69] Kübra Fettahoğlu, *Ibid*, 29-41.
[70] *Raṣad-hâne-i Âmire'nin 1912-1913-1914 Senelerine Aid Hülâsa-i Rasadatı,* Istanbul: Matbʿa-i ʿĀmire, 1330, [1915].

of Istanbul from 1867 to 1914.[71] These reports show that both the imperial scientists and lay observers had a keen interest in observing the weather and mapping out the climatic zones of the empire in miscellaneous geographies from the second half of the nineteenth century onwards.

Concluding Remarks:

In this chapter, I explored the emergence of climate science as a global phenomenon from the last quarter of the nineteenth century to the World War I both in the overseas empires and the Ottoman Empire. I showed that the confluence of political, economic, technological, and scientific factors gave rise to its proliferation on a global scale at the time. The imperial scientists at the Imperial Observatory meticulously observed the atmospheric phenomena both in Istanbul and in other geographies, and spearheaded climatic studies in the empire. As the treatises and correspondence of the imperial scientists reveal, Ottoman scientists envisioned the empire as one of the centers of global networks of knowledge exchange. The empire invested in this new science to map out its miscellaneous climatic zones as well as to integrate its diverse population on an imperial scale. The Ottoman state's own role in sponsoring the systematic research of natural laws also reflected its own sense of political order. Therefore, it was an efficacious enterprise for the political authority. On the other hand, the authority of modern science also shaped the empire's environmental policies as well as the flow and texture of every day life in the nineteenth century. In the next chapter, I will explore the climatic analysis of miscellaneous geographies of the empire by examining treatises of the Imperial Scientists at the School of Forestry and Agriculture.

[71] *Ibid*, 16-17.

CHAPTER 2

CLIMATE AND THE SCALES OF EMPIRE

2.1. Scientific Forestry and the Local Climates

During the First International Congress of Agriculturalists and Foresters, which also met in Vienna in 1873, the participants of the congress issued a call for a unified international observation system to study the impact of forests on the climate.[1] Climate scientists, nowadays, concur that deforestation can impact climates on the local and global scale. "Vegetation cover controls soil water recharge by protecting the soil surface from erosion and by contributing the organic matter that maintains soil structure and drainage."[2] Vegetation is also the main link for water transfer to the atmosphere through evapotranspiration. Therefore, land-use change is one of the dominant drivers of global atmospheric change and thus, climate change. At first glance, this cycle is perspicacious for the twenty-first-century reader. But discerning the complex relations among the atmosphere, plants, and soil was a complex task and required sets of arrangements across different scales in the nineteenth century.[3] The ambitious proposal of the committee to measure the forest's impact on the atmospheric events at such an early date was significant for the development of forest climatology.

[1] Deborah R. Coen, *Climate in Motion, Science, Empire, and the Problem of Scale,* Chicago: The University of Chicago Press, 2018, 245.
[2] W.G. Ernst (editor), *Earth Systems Processes and Issues,* Cambridge: Cambridge University Press, 2000, 451.
[3] Vaclav, Smil, *Enriching the Earth Fritz Haber, Carl Bosch, and the Transformation of World Food Production,* Massachusetts: The MIT Press, 2001.

Historians of the late Ottoman Empire so far have formulated the forest question only as a legal problem and discussed it in the context of property relations.[4] Through the 1858 Land Code, and 1870 Forest Regulation as well as the implementation of scientific forestry the Ottoman government attempted to extend its control over the forests. These legal promulgations mostly resulted in the capture of the lands by large landowners, the restrictions on the traditional usufruct rights of peasants, and the forced sedentarization of the nomads as well as the drastic change of ecologies across the empire.

However, my attempt here is to reformulate this dilemma as a climate question. The climate question means here the contradiction between the overarching imperial policy of resource extraction and the regional interests of the local people. This divergence of interests between the imperial policies and the local actors became apparent through discussions regarding the impact of the forests on local climates. The empire started to implement scientific forestry from the second half of the nineteenth century onwards to reconcile this dilemma by articulating the importance of expert opinion regarding the forests. I argue that the legal problem regarding forests inevitably incited a research agenda for scientific forestry and forest climatology. Therefore, in the first part of this chapter, I answer how this legal problem regarding the usufruct rights of forests was deeply interconnected with the emergence of climate science. However, nineteenth-century Ottoman imperial scientists and forest experts did not problematize the forest's capability of modifying the

[4] Even though historians have discussed the Land Code in the context of the property rights and the tragedy of commons, there has been no detailed study on its effect on the environmental change in disparate geographies of the empire. For its effect on the property rights and the development of capitalism in the late Ottoman Empire, see: Yücel Terzibaşoğlu, "The Ottoman Agrarian Question and the Making of Property and Crime in the Nineteenth Century*,"* in "*Ottoman Rural Societies and Economies*, ed. By Elias Kolovos, Institute of Mediterranean Studies, Crete: Crete University Press, 2015.; Yücel Terzibaşoğlu, "Privatisation of Land, Criminalisation of Custom, and Land Disputes in 19th-Century Anatolia*", Les acteurs des transformations fonciéres autour de la Méditerranée au XIXe siècle*, ed. by V. Guéno et D. Guignard, Karthala and Maison Méditerranéenne des Sciences de l'Homme, 2013.

surrounding atmosphere beyond regional boundaries. Hence, the scale of the forest-climate problem rarely exceeds specific localities. In the second part of the chapter, however, I discuss the proliferation of scientific agriculture and its relation to climate science, whose scale was much more global.

The increasing demand for energy in the nineteenth century was the foremost reason to accentuate the importance of scientific forestry and agriculture both in industrial and agricultural economies.[5] Land area was the standard measure of agrarian societies because energy was collected on the surface of the land. For instance, three basic types of agrarian habitat -arable, pasture, and wood- constituted more than 85% of the land structure in England and Wales in 1700, which was similar to the structure of land usage in the Ottoman Empire at the time. In agrarian energy systems, forests were the main sources of energy.[6] Wood in all agrarian economies was utilized as construction material, raw chemical material, and heat production.[7] Although agrarian energy systems are eminently sophisticated and innovative, the utilization of energy sources, and

[5] Historians have recently shown that the effective and abundant usage of coal was the main factor in the transformation from an agrarian society to Industrial society. It is highly likely that, as Rolf Peter Sieferle states, without coal, European societies of the 18th and 19th centuries would have remained agrarian societies, even if they had utilized the innovation potential fundamentally embodied in agrarian societies to a much greater extent. This rapid and revolutionary transformation, first in Britain, and concomitantly in Europe and US, was neither because of the voluptuous entrepreneurship of the European bourgeoisie nor their unique culture of innovation. As recent researchers have explained, such as Kenneth Pomeranz's *The Great Divergence* and Giovanni Arrighi's *Adam Smith in Beijing*, non-Western economies, (e.g. the Chinese economy) was as complex and innovative as the Western economies, until the second half of the nineteenth century. However, the conducive location of fossil fuels for extraction and utilization as well as distribution ultimately resulted in the proliferation of Industrial Revolution in Britain. For further research on this topic see: Kenneth Pomeranz, *The Great Divergence, China, Europe, and the Making of the Modern World Economy,* Princeton: Princeton University Press, 2000. Giovanni Arrighi, *Adam Smith in Beijing, Lineages of the Twenty-First Century,* London: Verso Books, 2007.

[6] It is important to keep in mind that "the complete transformation of the forest into a controlled site of exclusive wood production was associated with a functional decoupling of agriculture and forestry, with the displacement of traditional rights usufruct by peasants, which in the older perspective were inseparable from the peasant economy." Rolf Peter Sieferle, *The Subterranean Forest, Energy Systems and the Industrial Revolution*, London: The White House Press, 2010.

[7] Rolf Peter Sieferle, *The Subterranean Forest, Energy Systems and the Industrial Revolution*, London: The White House Press, 2010, 51.

the sustainability of life are conditioned to contingent factors of the land and vagaries of weather. Moreover, even though wood is a renewable energy source, the energy capacity of agrarian energy systems is not compatible with fossil economies. Even in the most-equilibrium-based ecosystems surplus is relatively small and highly dispersed. [8] If we make a comparison between the energy capacity of coal and wood we can easily see that they are not incompatible in terms of energy utilization. For instance, coal production in England and Wales already amounted to about 15 million tons around 1810, which was hypothetically equivalent to the area of England and Wales (150,000 km^2 .)[9] British coal production reached 181.6 million tons in 1890, and the possible substitution of this amount of energy would require 2, 252, 000 km^2 of woodlands. Unlike the industrial economies of Europe, which started to utilize fossil fuels as a primary source of energy in many domains of industry and everyday life in the nineteenth century, the Ottoman empire was still an agrarian economy and heavily dependent on the consumption of wood in the nineteenth century.[10] Therefore, congenial factors of nature and the global market in the nineteenth century were an imperative in the application of scientific forestry and agriculture for subsistence reasons as well as economic and political realities.

[8] It is necessary to accentuate the difference between equilibrium-based and non-equilibrium ecologies as I will discuss them in this chapter. Conventional ecological thinkers assumed that ecosystems have their patterns and human beings were considered destructive outsiders of this harmonic evolution of nature. However, new ecological thinking accentuates the instability, and chaotic fluctuations of ecosystems as well. This distinction is important for this thesis as I will examine how Ottoman intellectuals and scientists developed different policies for both non-equilibrium -arid land- ecosystems and relatively equilibrium-based ecosystems in the nineteenth century. For further research see: Davis, Diana K., *The Arid Lands, History, Power, Knowledge*, Massachusetts: The MIT Press, 2016.; J. Terrence, McCabe, *Cattle Bring Us to Our Enemies: Turkana Ecology, Politics, and Raiding in a Disequilibrium System*, Michigan: The University of Michigan Press, 2004.; Douglas G. Sprugel, "Disturbance, Equilibrium, and Environmental Variability: What is 'Natural' Vegetation in a Changing Environment?", *Biological Conservation*, 58, no.1 (1991), 1-18.

[9] Rolf Peter Sieferle, *Ibid*, 104.

[10] For the history of fossil fuels in the Ottoman Empire see: *Miners and the State in the Ottoman Empire: the Zonguldak Coalfield, 1820- 1920*, New York: Berghahn Books, 2006., Volkan Ş. Ediger, *Osmanlı'da Neft ve Petrol,* Istanbul, Dergah Yayınları, 2022.

The beginning of scientific forestry in the Ottoman Empire is a debated topic. While some historians tend to see its beginning only with the modernity ushered in by the Turkish Republic, others argue that the immediate and excessive need for wood to rebuild the navy after the Crimean War necessitated the documentation and scientific management of forests in the Ottoman Empire. Selcuk Dursun, however, in his study on the history of forestry and forest administration in the Ottoman Empire, convincingly argues that the implementation of scientific forestry started with the collaboration of French experts and Ottoman students of forestry in the 1850s.[11] The first School of Scientific Forestry was established in the empire in 1858 under the directorship of French forest expert Louis Tassy who was initially head of the French Mission for forestry and commissioned by the Ottoman imperial government to document the flora and fauna of the empire. Tassy, in *Études Sur l'aménagement des Forêts*, discusses the fundamentals of scientific forestry, modern methods to improve productivity as well as the significance of forest preservation.[12] The book was translated into Ottoman Turkish in 1861 by Osman and Artin Efendis, students of the Forestry School at the time, and was used many years as a textbook in the empire.[13] Likewise, the students at the School of Forestry had a versatile curriculum ranging from physics, chemistry, and geography to agriculture and agricultural meteorology as well as botany. As the curriculum reveals, the empire aimed to train imperial scientists and experts who could combine their theoretical knowledge of natural sciences with the applied sciences. The Ottoman School of Forestry was combined with the school of mining -*Orman ve Maadin Mektebi*- in 1880, and these

[11] Selçuk Dursun, *Forests and the State: History of Forestry and Forest Administration in the Ottoman Empire*, Istanbul: Sabancı University unpublished PhD Thesis, 2007.
[12] Louis Tassy, *Études Sur l'amenagement des Forêts,* Paris: Libraire de la *Société* Botanique de France, *Deuxième edition*, 1872. Tassy's book is extremely detailed and covers topics ranging from insects to the impact of climate on the material quality of forests.
[13] Selçuk Dursun, *ibid,* 181.

two schools had 113 graduates between 1857 to 1893.[14] In 1892, the Halkalı School of Agriculture (*Halkalı Ziraat Mekteb-i Âlîsi)* was founded for scientific agriculture and replaced the Ottoman School of Forestry. So far, no research has been conducted on the scientific and scholarly networks of the experts in agriculture and forestry; their social and confessional backgrounds, and the conceptualization and imagination of the imperial ecologies by these imperial scientists. In fact, in the final years of the nineteenth century, 60 officials from disparate geographies in the forest service were already assigned to the province of Konya, 46 in Adana, and 17 in Syria to develop sustainable models of silviculture and agriculture by considering the climatic characteristic of the provinces.[15] For instance, Bedros Kuyumcuyan, an Armenian subject of the empire, became the first General Director of Forests in the empire. Likewise, Osman Efendi, one of the first graduates of the Forestry School, was nominated to be the first inspector of the forests of Istanbul and its environs.[16] Those appointed imperial officials in collaboration with the local observers scaled the local climates of the empire and turned them into statistical data. After a decade of service in the Ottoman Empire, Tassy returned to France in 1869, and Louis Adolphe Ambroise Bricogne (1825-1905) replaced him in his position. Bricogne left extensive reports on the conditions of forests and the local climates based on the information and statistical data provided by the Ottoman officials. These reports offer us unique lens to study the forest-climate question in the late Ottoman Empire.

Bricogne's purportedly crafted *Les fôrets de l'empire Ottoman* is a valiant attempt at scientific and emotional scaling of the infinite diversity of nature by experts, and it shows the entangled relationship between humans, ecology, and the climate across the vast geographies of

[14] Metin Özdönmez, and Abdi Ekzioğlu, "Türkiye'de Ormancılık Yüksek Öğretiminin Başlangıcından Bu Yana Mezunlara Verilen Ünvanlar ve Diplomalar", İstanbul Üniversitesi Orman Fakültesi Dergisi, Seri B, Cilt:46, Sayı 1-2-3-4, 1996.
[15] Andrea E. Duffy, *Ibid*, 221.
[16] Selçuk Dursun, *Ibid,* 203.

the empire. The reports include systematic surveys of forests from the Balkans and the coastal regions of the Black Sea where the vegetation is diversely lush on fertile land to the desert-like landscapes where the forests are depleted and vegetations is sparse such as the Central Anatolian city of Konya and some parts of the Taurus mountains.[17]

Bricogne's account verifies that the Ottoman forest experts were able to pinpoint the ratio of forests on the surface by using mapping, sketching, and other methods of scaling. According to the calculations of the Ottoman foresters, for instance, the total surface of state forests in Asia Minor, the Aegean Islands, and the Balkans were 4, 434, 000 hectares. Of these 2, 299, 000 hectares of forests (%67) were found in in Anatolia and the Aegean Islands, whereas, of 1, 435, 000 of the remaining hectares of forests (% 32.4) were in the Balkans, including the Thrace.[18] Even though the statistical data of state *(mīrī)* lands presented by Bricogne did not include the communal, private, and *vaḳf* forests, the earliest survey to commensurate the quantity as well as the quality of nature was a milestone in the recognition of the imperial paradigm of climate.

Unlike the previous administrative divisions of the empire, Bricogne's classification was based on the characteristics of the flora and fauna of the forests as well as the social organization of life as a result of the entangled relationship between the human and feral world. For instance, the scale he used to denominate the boundaries of Bosnia in his reports were the physical features of geography and the types of species on land. Bricogne states that while the vast forests of lower Bosnia existed along with the scattered meadows and marshes, the forests of upper Bosnia were monolithic and located in the higher altitudes.[19] As forestry and agriculture were inseparable in

[17] Bricogne's reports include the systematic reports of these cities in Europe: Bosnia; Upper Bosnia, Lower Bosnia, Herzegovina, The Danube, Edirne, Thessaloniki, Prizren, Istanbul in Asia Minor and Aegean Islands: Trabzon, Canik, Kastamonu, Istanbul (İzmid), Hüdavendigar, Biga, Aegean Islands, Aydın, Konya, Adana, Cyprus, Aleppo, Damascus (Syria), and Erzurum.
[18] Selcuk Dursun, *Ibid,* 195.
[19] Bricogne, *Ibid,*

agrarian energy systems, the agricultural societies in upper Bosnia either settled near forests to make use of them as much as possible in agriculture or developed different subsistence economies such as pastoral nomadism. Climate, according to Bricogne, had also an impact on the types of forests in lower and upper Bosnia. For instance, lower Bosnia was primarily dominated by oak trees, which is a highly valuable material for the construction of navy as well as other economic purposes. Therefore, the local climates had an impact on the formation of ecology, the organization of the social life as well as the uneven economic development of geographies. The peculiar characteristics of local climates also became imperative to scale the imperial geographies with the application of scientific forestry.

Bricogne's reports also include one of the earliest accounts of the relationship between human-induced deforestation and the anthropogenic climate change in the entire region of Mediterranean and the Middle East in the nineteenth century. For instance, the environs of the vilayet of Kastamonu, inhabited by 500.000 people, were completely deforested because of the excessive exploitation of forests by the local population.[20] Yet, thanks to the afforestation policies of the empire, northern parts of the province were covered by complete forests. Similar to Europe, mining, heating, construction, timber extraction for military and commercial shipbuilding, clearing for agriculture and pasture, fires, wars, as well as urbanization all caused the depletion of Ottoman forests in the nineteenth century.[21] Apart from them, the nomadic pastoralists -*yürüks and Türkmens*- who had lived around the Taurus mountains for centuries were held responsible for destroying the forests, hence for the climate change on a local scale. Bricogne noted: fires set by the nomads on the Taurus mountains caused not only the depletion of the forests but also the

[20] Bricogne, *Ibid*, 327.
[21] Andrea E. Duffy, *Nomad's Land, Pastoralism and French Environmental Policy in the Nineteenth-Century Mediterranean World,* Lincoln: University of Nebraska Press, 2019, 268.

excessive droughts in the region.[22] Moreover, the nomads' livestock allegedly prevented trees from regenerating by grazing on saplings. The story told by Ottoman forest experts was common among nineteenth-century imperial scientists across the world. For instance, Peter Simon Pallas, a famous Prussian botanist and naturalist, noted in 1793 that "the [Russian] steppes are frequently fired, either by the negligence of travelers, or willfully by the herdsmen [nomads], in order to forward the crops of grass."[23] The implication of both Pallas's and Bricogne's arguments, which were repeated by many other scientists as well, was that the environment of semi-arid mountains of Anatolia or Russian steppes, including the soil and climate, was conducive for trees to grow and flourish, and that the treeless landscape had been created by the irresponsible peasants or the nomads.[24] The growing authority of the expert opinion on the anthropogenic dimensions of climate change shaped the environmental policy of the empire, which aimed to carefully monitor the mutually constitutive relationship between human and climate.

The connection between deforestation and diminished rainfalls, more interestingly, was a pertinent example of the desiccation theory in the nineteenth century. Desiccation theory was initially produced and propagated by colonial scientists who asserted that dryland peoples have deforested their own landscapes, which ultimately led to reduced rainfalls and the creation of deserts. Diana K. Davis, in her recent study brilliantly shows that the development of desiccation theory was inextricably linked to the intensification of colonization and the expansion of capitalism in the nineteenth century.[25] Likewise, scientists in the nineteenth century aptly recognized that

[22] Bricogne, *Ibid*, 419.
[23]David Moon, *The Plough that Broke the Steppes: Agriculture and Environment on Russia's Grasslands, 1700- 1914*, Oxford: Oxford University Press, 2013, 60.
[24] David Moon, *Ibid*, 61.
[25] Davis, Diana K., *The Arid Lands, History, Power, Knowledge*, Massachusetts: The MIT Press, 2016. For further research on colonial scientists' perception of nomads, and the relationship between the forestry preservation and colonialism see: Diana K. Davis, *Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa*, Ohio: Ohio University Press, 2007., Diana K.

changes in vegetation could cause weather anomalies. The imperial authorities in collaboration with the imperial scientists propagated the idea that the unsystematic destruction of forests might cause excessive droughts around the Taurus Mountains, or devastating floods in Central Anatolia and the European territories of the empire.[26] For instance, the Adana region, one of the depleted frontiers of the empire according to the reports of Bricogne, was shaken by the recurring floods due to weather anomalies in the late nineteenth century. As discussed by Chris Gratien in a recent study, the flooding of the Seyhan in Çukurova and resultant damage to bridges, barrages, roads, and adjacent property appears in the archival records roughly every three years over subsequent decades.[27] Likewise, the Ottoman imperial government implemented several policies to deal with the vagaries of weather by building new canals and dams, resettling local people in different regions against their will as well as afforesting the depleted areas. All questions about the modification of forests for practical precautions led to the larger question of the dynamic climate in the empire. However, imperial scientists in the nineteenth century were very much concerned with local climates in the context of scientific forestry. Neither Bricogne nor other Ottoman forest experts problematized the forest-climate question on a global scale at the time. The excessive droughts as a result of deforestation in the fertile lands of Iraq and the accelerating floods around Çukurova were not considered interrelated to each other. Yet, I argue that the scientific understanding of climate had an impact on the formulation of the early environmentalist policies of the empire: The afforestation of the depleted areas as well as the conservation of the existing forests was beneficial for the local climates, and ecologies.

Davis, "Of Deserts and Decolonization: Dispelling Myths About Drylands", The MIT Press Reader, https://thereader.mitpress.mit.edu/dispelling-myths-about-drylands/

[26] Bricogne, *Ibid.*, Filāḥat, *Irak*, 15 Eylül 1329 (28 September 1913) vol: 11. Filāḥat 4, *Ormancılık İktisād-ı Usūl-u Idārenin Fevâidi*, 1 Mayıs 1329 (1 May 1913), vol: 4.

[27] Chris Gratien, *The Unsettled Plain: An Environmental History of the Late Ottoman Frontier*, Stanford: Stanford University Press, 2022, 117.

The recognition of the relationship between the local climates and forests, however, contradicted the extractive policies of the empire, which aimed to maximize the utilization of the primary energy sources of the empire. The empire aimed to reconcile this paradigmatic dilemma between the local climates and extractive imperial policies by promulgating laws such as The Forest Regulation Code (*Orman Nîzamnâmesi)* in 1870 and by applying scientific methods of forestry and agriculture in the interest of public good (*maṣlaḥat)*. The Forest Regulation Code divided the forests of the empire into four categories: state (*mīrī)*, pious endowments (*evḳāf)*, communal, and private forests. One of the principal goals of the Code was to restrict the use of forests as pasture, hence protect them.[28] Likewise, even though herders, nomads, and peasants argued that the forests should be open to the public and be free like the air, the imperial foresters advocated the idea that deforestation ruined the regional ecologies.[29]

Today, we widely acknowledge the devastating impact of deforestation on climate on a much more global scale. But what makes this scale global? Its scale is global, because climate science has shown us that the changes in local ecologies or climates have global impacts or have been impacted by changes in other geographies. Our conceptualization of the "public good" has also semantically evolved from local connotations to the global, even planetary scale. Likewise, the discussions around the public good (*menfaʿat -i umūmiye)* and the local climate in the context

[28] *"Evlâtlarının refah ve saʾadet-i hâllerinin kendisinden daha iyi olmasına hasr-ı gayret eyleyen bir hayr-u hava eder, nasıl ki kendi servetini teẕyīd ederek evlâtlarına devr-i intikāl ettirirse, nasıl hazır dahi öylece ormanları ıslah edüb ihlâfına devr-i intikāl ettirmelidir. Filāḥat,* 1 May 1913, 51.

[29] The whole historiography about the Land Code of 1858 and Forest Regulation (1870) interpreted this problem in the context of property relations and class struggles but overlooked the newly emerging field of global climatology and the idea of global climate. My aim here is to bring the climate -science- into the discussion. Besides, I argue that the discussions around climate change should encapsulate the class dimension even in the context of the nineteenth-century empires. For the importance of class differences in the history of climate change, see: Jessica Barnes, *"Rift or Bridges?" Ruptures and Continuities in Human-Environment Interactions*, in Whose Anthropocene? Revisiting Dipesh Chakrabarty's Four Theses, edited by: Robert Emmett and Thomas Lekan, RCC Perspectives: Transformations in Environment and Society 2016, no: 2. 41-45.; Kathleen, MCAfee, *The Politics of Nature in the Anthropocene*, Ibid, 65-72.

of the nineteenth-century Ottomans were immanently tied to imperial politics and climate science.[30] Those discussions were also crucial for the emergence of the concept of dynamic climate on a local scale. In the remaining part of this chapter, I will explore the emergence of scientific agriculture and its relation to climate science, whose scale was much more global.

2.2. Scientific Agriculture and Imperial Climates

During the 1894 International Meteorological Congress in Upsala, the members of the International Meteorological Committee proposed an ambitious project of *International Cloud Atlas* that could be used by mariners, scientists, and especially farmers who needed accurate knowledge of clouds more than any other groups. The proposed project aimed to document the diverse and constantly changing clouds, the direction in which the clouds come, and their further movements by using the revolutionary technological medium of photography.[31] Likewise, in 1927, Ahmet Tevfik (Göymen), a graduate of the Halkalı School of Agriculture (*Halkalı Zirāʿat Mekteb-i ʿAlīsi*) and later the president of the Meteorological Institute in the Turkish Republic, utilized the Cloud Atlas to elucidate the formations and movements of miscellaneous forms of clouds in his Agricultural Meteorology (*Zirāʿī* Meteoroloji), which was initially written as a textbook for the students at Halkalı School of Agriculture. "Our knowledge of weather events," Ahmet Tevfik wrote, "flourished thanks to the discovery of the reciprocal relationship between the atmospheric

[30] For a discussion of public good, usufruct rights of people, and local climates, see: Ali Rıza, Orman ve Mer'a Kanūnunun Esbâb-ı Mucibe-i Lâyihâsı, 1910.; Filāḥat, *Ormancılık Iktisâd-ı Usūl-ü İdarenin Fevâidi*, vol: 4, 1 May 1329 (1 May 1913).

[31] *Report of the International Meteorological Committee Upsala, 1894*. Published by Authority of the Meteorological Council, London: Printed for Her Majesty's Stationery Office, 1895. The participant countries included Austria- Hungary, Denmark, Belgium, England, France, Germany, Holland, Italy, Norway, Portugal, Romania, Russia, Spain, Sweden, Switzerland, United States, India, and Canada.
For an amazing history of International Cloud Atlas see: Lorraine Daston, "Cloud Physiognomy", Representations, No: 135, Special Issue: Description Across Disciplines (Summer 2016), 45-71.

pressure and the condition of the weather in the middle of the nineteenth century."[32] To explain this, Tevfik discussed the low-pressure systems (depression), which usually bring unsettled or stormy weather, and high-pressure systems (anti-cyclones), which bring stable and bright weather. Then, he states that the physiognomies of clouds allow observers to predict the atmospheric events in different localities beforehand. With the help of climate science, which was global in its scale and cosmopolitan in its networks, local farmers could read the skies and foresee the rains or extremities of weather. Yet, what was the incentive to invest in climate science to increase agricultural productivity? The intellectuals, imperial and local elites overwhelmingly agreed that scientific and rational agriculture was the ultimate path for the modernization of the Ottoman Empire and to catch up with the West.[33] As the forest-climate question implied, the economic motivation provided a rational basis to consult atmospheric and physical sciences (e.g. chemistry, geology) in the implementation of scientific agriculture.[34] Thus, knowing that the weather had an

[32] Ahmet Tevfik, Zirai Meteoroloji, Istanbul: Ziraat Vekaleti, vol:2, 1927, 530.
"*Istidlāl-i hava meselesi, son asrın evasîtinde (ortasında), semânın hâli ile tazyikin tevzī'ātı arasındaki münasebet anlaşıldıktan sonra, mühim bir hatvâ-i terakkī etmişti. Bu sayede bir de atmosferin muhtelif mıntıkalarında, havanın -Temps- seyr-i ʿumūmīsini bildiren cetveller tertīb etmek imkânı ḥāṣıl olmuştur*."
Agricultural Meteorology covers issues ranging from planetary systems and the atmospheric event to agriculture. Even though it was overlooked by scholars so far, the persnicketiness in using the scientific data resulted in a prosperous scientific work.
[33] For different approaches to development proposed by the Ottoman intellectuals in the nineteenth-century see: Deniz Kılınçoğlu, The Political Economy of Ottoman Modernity: Ottoman Economic Thought During the Reign of Abdülhamid II (1876-1909), Princeton: Princeton University, (PhD Dissertation), 2012. Deniz Kılınçoğlu, Economics and Capitalism in the Ottoman Empire, London: Routledge, 2015. Zafer Toprak, Türkiye'de Milli Iktisat 1908-1918, Istanbul: Dogan Kitap, 2012.
[34] For many scholars the term agricultural revolution is primarily used to define the controversial array of programs and policies that introduced high-yield seeds, intensive irrigation techniques, herbicides, pesticides, mechanization, and petrochemical fertilizers to parts of the developing world during the 1960s and 1970s. However, as Edward M. Melillo remarkably explains in "The First Green Revolution: Debt Peonage and the Making of the Nitrogen Fertilizer Trade, 1840-1930", this understanding overlooks the First Green Revolution which resulted in the transportation of millions of metric tons of nitrogen fertilizers and significant changes in environments across the globe throughout the nineteenth century. Among many other scientific discoveries, the developments in chemistry in the late eighteenth and nineteenth-century, and the discovery of the nitrogen cycle on a global scale had impacted in profound ways the agricultural sciences. For instance, Justus Von Liebig, one of the founders of organic chemistry, published the first concepts of global biospheric cycles and recognized the importance of nitrogen in crop production. Liebig

impact on the quality and quantity of yields, nineteenth-century observers of climate and nature agreed that the more reliable knowledge of weather patterns could result in a more predictable and standardized agricultural production.

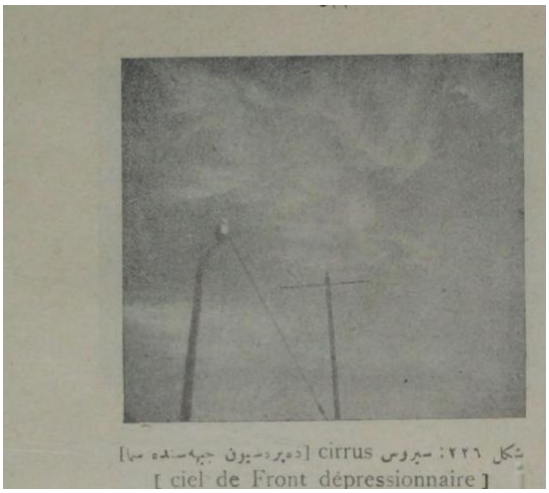

Image 1: Cirrus (Sky from the Depression Side) Ahmet Tevfik- Agricultural Meteorology

Image 2: Cirrus and cirro-cumulus Ahmet Tevfik: Agricultural Meteorology.

Moreover, towards the end of the book, Ahmet Tevfik discusses the impact of plants and landscapes on climates as well. He states that "it is possible to make inferences on climate by investigating the plants and animals as the climate has an impact on them."[35] Tevfik and other royal scientists in the nineteenth century were very much cognizant that the distinctive flora of particular geography were the reflection of the climate. Therefore, I argue that nineteenth-century Ottoman royal scientists in collaboration with local agriculturalists aimed to render legible

showed that higher crop yields were impossible without higher nitrogen inputs. Besides, as Jane Hutton explains, over the four decades following 1840, ten million tons of guano, valued at half a billion dollars, were extracted and shipped away towards American and European ports. Through the application of synthetic fertilizers, the farmers in Europe as well as in the vast farmlands of North America increased yields of staple crops such as corn and wheat. I claim that these developments in physical sciences as well as the accelerated anthropogenic destruction of the world are interconnected to the development of climate science and the scientific agriculture in the nineteenth century.

[35] Ahmet Tevfik, Ibid, 573. "(…) *Binaenaleyh hâl ve vaziyetlerinin [plants and animals] tedḳīḳi ile vaziyet-i havâiyeyi bir dereceye kadar istidlāl mümkün olabilir*. (…)"

Ottoman climates through the lens of plant geography and the implementation of scientific agriculture. It is possible to follow the mutually constructive relationship between scientific agriculture and climate science in the treatises of the royal scientists at the Halkalı School of Agriculture and the writings of the local intellectuals, agriculturalists, and scientists who published their articles in contemporary journals and newspapers.

The modernization and rationalization of agriculture had a long history in the Ottoman Empire. The first Agricultural School (*Zirāʿat Talimhânesi*) opened in 1848 though it did not last long. Another attempt to open a new agricultural school in the empire was made by Amasyan Efendi, an Armenian man of letters who educated in France, in 1878. After several years of searching for an ideal place for the school and preparations for technical materials, the Halkalı School of Agriculture was opened in 1893. Between twenty and thirty students from different geographies and confessional backgrounds graduated each year from 1896 to 1914.[36] In a similar vein to the Forestry School, the agricultural school had a broad curriculum that aimed to train farmers, agricultural engineers, meteorologists as well as botanists. The school was located on the outskirts of the capital, and its environs were arranged for the implementation of new techniques of horticulture as well as forestry. Furthermore, an observatory was built next to the school, and daily meteorological observations were carried out by the students and published as series in the Journal of Halkalı School of Agriculture (*Halkalı Zirāʿat Mekteb-i ʿAlī Mecmūʿası)*.[37] The school was a pioneering institution not only in the spread of scientific agriculture but also in the appreciation of the extremely 'nuanced geography of difference', hence the dynamic climate, it instilled in its students.

[36] Sevtap Kadıoğlu, "Halkalı Ziraat Mekteb-i Âlisi Mecmuası Üzerine Bir Inceleme", Osmanlı Bilimi Araştırmaları IV/1 (2002), 99-118. For further history of the Halkalı School of Agriculture see: Volkan Cesme, Halkalı Ziraat Mektebi, Istanbul: Istanbul Üniversitesi, unpublished M.A. Thesis, 2011.
[37] Sevtap Kadıoğlu, *Ibid*, 103-109.

The comprehensive documentation of plant geography was spearheaded by the Armenian Mıgırdiç Hekimyan (1847-1927) who was a student of Louis Tassy at the School of Forestry and later the director of it from 1881 to 1892. In his The Science of Plants *(ʿilm -i Nebātāt*) (1880), which was used as a textbook at the School of Agriculture, Hekimyan makes a taxonomical division of the plants across the empire. His treatise about the plants includes not only biological information about plants but also introduces plants, which are endemic to certain climates and geographies.[38] The most inspiring aspect of these botanical surveys and agricultural courses was the phenological observations, which was a nascent scientific field that aimed to record and process the periodic phenomena in the lives of plants and animals in relation to climate. As Deborah Coen discussed in the context of the Habsburg Empire, phenology, likewise, became an essential tool for visualizing the space of the empire and its history in the nineteenth-century Ottoman Empire.[39] Though he identified similar dynamics like phenology concomitant to his counterparts abroad in the Habsburg Empire, Hekimyan nevertheless, eschewed using European terminology from the onset of his book and tried to come up with an Ottoman-Turkish equivalent for all scientific terms as well as the names of plants.[40] Hekimyan's study was a harbinger in its attempts to delineate imperial climatic zones by using plants and to make Ottoman climates palpable in the minds of people. Likewise, Hoca Ali Rıza, an assistant to Mıgırdiç Hekimyan at the School of Forestry, and Apraham Allahverdiyan, another Armenian scientist in the empire, wrote two significant treatises

[38] Mıgırdiç Hekimyan, '*İlm -i Nebātāt*, İstanbul: Mihran Matbaasi, (1297) 1880.
[39] Deborah Coen, Ibid, 96.
[40] "(…) *cem ve tertibe muvaffaḳ olduġumuz iş bu kitapta mümkün olduğu kadar luġat-ı garbîye ve gayr-i menûseden ictināb olunmuş ise de funūna muteʿallik istilâhatin noksanından nāşī, bil-mecbūriye istiʿmāl olunan lügatlerin Türkçe meʿānīlerini ve Fransızca olarak te'lif olunan nebātāt kitapları ile biʾl-muḳābele muṭāleʿa buyuranlar içün mûcib-i suhûlet olmak üzere kitabın nihayetinde Fransızca isimler ile esmâ-yı Turkiyeyi havi bir küçük luġat cedveli derc olunmustur*." Mıgırdiç Hekimyan, *Ibid*, Foreword.

on the science of plants and the imperial ecologies in which the imperial paradigm of climate was even more buttressed via those treatises.[41]

Apart from the scientific treatises written by royal scientists, journals and newspapers are unique venues to trace the diffusion of the idea of the imperial climate in the context of scientific agriculture. For instance, in an article which was published in Filāḥat (Agriculture), an Armenian intellectual Sinekerim Istepanyan, a director of large commercial farm in the northern Anatolian city of Kastamonu, introduces the names and characteristics of different plants and pastures from across the world. In particular, Istepanyan points out that British and Italian pastures (Raygrass) are conducive to different climates of the empire and profitable for grazing.[42] After discussing the plants and pastures in detail, he states that "we have difficulties in denominating plants in Turkish, as the empire does not have a botanical dictionary yet." He, therefore, entreated imperial officers and local collectors of nature to collaborate with farmers, and peasants to find the indigenous names of the plants and report them the imperial scientists.[43] At least two overarching conclusions can be drawn from this and numerous other examples across the empire. First, the multi-ethnic and multi-confessional Ottoman imperial scientists and local practitioners/experts, from disparate geographies and different occupations were keen on documenting the diverse ecologies,

[41] Hoca Ali Rıza, Ormancılık Iktisadı, Istanbul: (1333) 1915. For further information see: Şeref Etker, Ormancılık ve Ziraât Okullari için Ilm-i Nebâtât: Mıgırdiç Hekimyan, 1880 ve Apraham Allahverdi (Hûdaverdi), 1911-1913, Osmanlı Bilim Tarihi Arastirmalari XI- 1-2 (2009-10), 305-318.

[42] Filahat, 1 Haziran 1329, 14 June 1913. Throughout the article Istepanyan gives the names of pastures and plants in Latin such as: Paturin Commun, Vulpin des pres, Fetuqe despres, Fleole.
According to the Encyclopedia of Islam: "*Falḥ*, the act of cleaving and cutting, when applied to the soil has the meaning of "to break up in order to cultivate", or "to plough". *Fallāḥ* "ploughman", "ploughing". But from pre-Islamic times the word *filaha* has assumed a wider meaning to denote the occupation of husbandry, agriculture. In this sense it is synonymous with *zirāʿa*, to which the ancients preferred *filaha* (all the earlier writers called their works on agriculture *Kitāb al-Filaha*)."
"*bir ḳāmūs -u zirāʿīmiz olmadığı için bir çok otlarımızın Türkçelerini yazmakta terdad edemiyoruz. Maʿamā-fīh şimdiye çayır çimen mevsimi olduğu için şu makalede bahsi geçen nebâtların klişelerini koymakla fen memurlarımızdan, mekteb muallim ve talebelerinden bir ricâmız var. Çayır otlarını bu klişelere tatbik ederek, otların usûl-ü Türkçe isimlerini köylülerden sorsunlar ve bize bildirsinler.*"

[43] Filāḥat, *Ibid*.

landscapes, and climates of the empire. Because the harmonic coexistence of the infinitely diverse particularities in nature -unity in diversity- was a providential and useful metaphor for the Ottoman intellectuals to imagine their diverse empire. Nothing can be more illustrative to explain the mutually constitutive relationship between the multifariousness of climate and the diversity of the people of the empire than the overlooked journal Filāḥat, which was published by Armenian intellectual Sebouh Istepanyan from 1913 to the World War I. Agricultural experts, farmers, chemists, state officials, bacteriologists, forest experts, merchants, and meteorologists from Egypt and Kastamonu, to Istanbul, Skopje, and Thessaloniki contributed to the journal.[44] Their writings covered issues from the relationship between climate and agriculture, and the documentation of flora of the empire, instructions on using barometers at different altitudes.

Secondly, the example of Filāḥat and other composite scientific communities challenge the prevalent idea that the Ottoman Empire completely suffered from the disconnection between imperial scientists and local populations. I claim that the dialogue between the local observers, farmers, naturalists, and imperial elites was indispensable for the recognition of the impalpable but incessantly changing climates of the empire, hence the emergence of dynamic climatology. For instance, in another article published in Filāḥat, an Ottoman intellectual and scientist called Feridun (probably a pseudo-name) responds to letters of farmers, which were sent from the Western Anatolian town of Adapazarı, whose soil was depleted as a result of the application of the wrong fertilizers for different types of soils.[45] Throughout the article, Feridun discusses the chemical compositions of different synthetic fertilizers and compares them with each other. He

[44] Some of the contributors of the journal: Sinekerim Istepanyan (Armenian): A director of a farm in Kastamonu. Hikmet (Muslim): A retired agricultural officer from Thessaloniki, Kalfayan (Armenian): A Teacher at the Halkalı School of Agriculture. Kiryakou (Greek): Chemist from the Ministry of Agriculture, Mihalaiki (Christian): An Agricultural Officer in Egypt, Osman Nuri (Muslim): Bacteriologist, Haik Mardikyan (Armenian): A Private Entrepreneur and Agricultural Engineer in Smyrna.
[45] Filāḥat, 15 Eylül 1329, 28 September 1913.

skillfully combines scientific language and vernacular language to transmit useful knowledge to scientific communities as well as farmers concomitantly.

However, he also calculates both enduring and volatile variables of climate such as the vegetation on particular landscape, weather events, and anthropogenic factors. These uninterrupted dialogues but fragmented snapshots between science, state, and society reveal that different techniques of scaling the climate have been developed by the Ottomans in the nineteenth century.

Concluding Remarks

In this chapter, I explored the emergence of both climate science and the paradigm of imperial climate in the context of scientific forestry and scientific agriculture. In the first part, I argued that the conflicting interests over the usufruct rights of natural resources between the imperial elites at the center and the local people resulted in the recognition of dynamic local climates. Ottoman imperial scientists utilized different techniques to scale their environments and local climates. However, in the second part, I investigated the mutually constitutive relationship between climate science and agriculture. The attempts to document plant geography, the implementation of phenology, and scientific agriculture led to a recognition of the miscellaneously diverse geography of difference in the late Ottoman Empire. This climatic difference was also a useful discourse for imperial elites to imagine multifarious geographies as part of one Ottoman universe as well as to consolidate its power on its subjects. Unlike the forest-climate problem, the interests of the imperial elites and the local people mostly converged in the context of scientific agriculture. I argue that these transformations in the empires of the Ottomans and their neighbours happened approximately between the last quarter of the nineteenth century and World War I, when climate science emerged and became truly global.

CONCLUSION

In this thesis, I explored the simultaneous emergence of the global science of meteorology and the climate science both in overseas empires and in the Ottoman Empire from the second half of the nineteenth-century to the WW1. In the first chapter, I showed that the Imperial Observatory in Istanbul had a salient role in the production and dissemination of the weather data with its international partners across the globe as well as the subjects of the empire. It is my contention in this thesis that the Ottoman Empire was on a global scale an indispensable actor in the production of weather data and the proliferation of this nascent science of meteorology across the world. In this context, this thesis attempted to accentuate the polycentric histories of science and challenge Eurocentric historiography of science. I cannot emphasize this enough, given that almost all historians working on lands outside Europe assume themselves that Europe was and remained the nucleus of all scientific innovation. As I have demonstrated, most of the existing literature which dares to subvert this grand-narrative still settles to convey that the Ottomans adapted European sciences in small-scale, idiosyncratic ways in limited applications. These studies over-emphasize the idea that the Ottomans largely imported most technical knowledge and sciences, but they do not acknowledge the mutual production of knowledge. However, as I discussed in light of the Ottoman archival documents, the scientific treatises of imperial scientists, and contemporary European sources, the Imperial Observatory in Istanbul operated as an imperial and global center of knowledge production in the context of the climate science from the last quarter of the nineteenth-century onwards.

In this thesis, I also discussed the reasons behind the meticulous observation of the weather patterns in Istanbul and disparate geographies of the empire. I argued that the meticulous observations of volatile weather data served for scaling the mental proximity of geographically

distant possessions in the minds of the Ottoman subjects. This process was also intersected with the discovery of the dynamic and interrelated nature of atmospheric phenomena on a global scale. I found that Ottoman imperial scientists, for the first time, scientifically strove to delineate the climatic zones of the empire in the nineteenth century by carefully measuring every aspect of weather cycles both in Istanbul and in other geographies of the empire. As *zeitgeist* of the time, the imperial scientists believed that they could decipher the laws of nature by systematically observing the general patterns of weather as well as the deviations from the normal.

In the second chapter of my thesis, I explored how the legal promulgations and the scientific treatises regarding the utilization and preservation of natural resources throughout the second half of the nineteenth century led to an emergence of forest climatology as well as the environmental protectionism in the late Ottoman Empire. The existing literature has discussed these codifications and their impacts on the people and the environments only in the context of the property relations. However, I reformulated this dilemma as a question of climate and explored how this new science of climate became an ultimate authority in the making of the Empire's environmental policies.

Moreover, climate scientists and activists who reflect on the impact of climate change in the age of Anthropocene reiterate the idea of "public good" on a global scale and even include the future generations. We also know that the historically under-privileged groups were affected from the climatic change more adversely than wealthy people. In a similar vein, I explored the imperial origins of the concept of the "public good" (*menfaʿat -i ʿumūmiye)* in relation to anthropogenic climate change in the nineteenth-century Ottoman Empire. I proposed that the concept of the public good, however, semantically was something that was negotiated between the Ottoman government, imperial scientists, and common subjects across the empire in late Ottoman society.

In my thesis, I have also established a palpable relationship between the imperial paradigm of climate and the emergence of climate science in the nineteenth century. I argued that the acknowledgement of the diversity of climate and nature was an efficacious metaphor for the multi-cultural, multi-ethnic Ottoman society. However, every argument needs to be constructed by considering the possible criticisms. In recent years historians who aim to challenge the nationalist historiographies tend to interpret composite [early-modern] empires as extremely tolerant, fluid, as well as cosmopolitan political and social configurations.[1] This naïve exaggeration mostly resulted in the anachronistic celebration of diversity across vast geographies of the Ottomans and their imperial rivals.

However, I try to move beyond these popular "imperial-turn' paradigms to show, as I did in my second chapter that the appreciation of the multifariousness of climate -nature- and society also intersected with the internal colonization of disparate geographies and the exclusion of historically underrepresented groups such as the nomads and the peasants in the Ottoman realms. In a similar vein to European empires at the time, the Ottoman Empire concomitantly utilized science to consolidate its power on the people and extract the natural resources of different geographies more effectively. Even though such acts of "creative destruction," economist Joseph Schumpeter's famous phrase, blurred the utility value of the science, I still argue that the "unity in diversity" in nature was a sturdy epistemological and emotional ground for the multi-ethnic and multi-religious Ottoman imperial scientists to render legible the empire's social, ecological, and climatic diversity before WW1.[2] In this context, as Deborah R. Coen eloquently stated, "climate had come to be understood as a multi-scalar, dynamic system sensitive to small perturbations- and

[1] For an example of this kind of historiography see: Karen Barkey, Empire of Difference: The Ottomans in Comparative Perspective, Cambridge: Cambridge University Press, 2008.
[2] Joseph A. Schumpeter, *Capitalism, Socialism, and Democracy,* London and New York: Routledge, 1994.

as a circulation that connects rather than divides, creating relations of mutual dependence."[3] The imperial science of climate was, therefore, a double-edged sword used not just for connecting but also differentiating people and climatic zones.

[3] Deborah R. Coen, *Climate in Motion: Science, Empire, and the Problem of Scale*, Chicago: The University of Chicago Press, 2018, 345.

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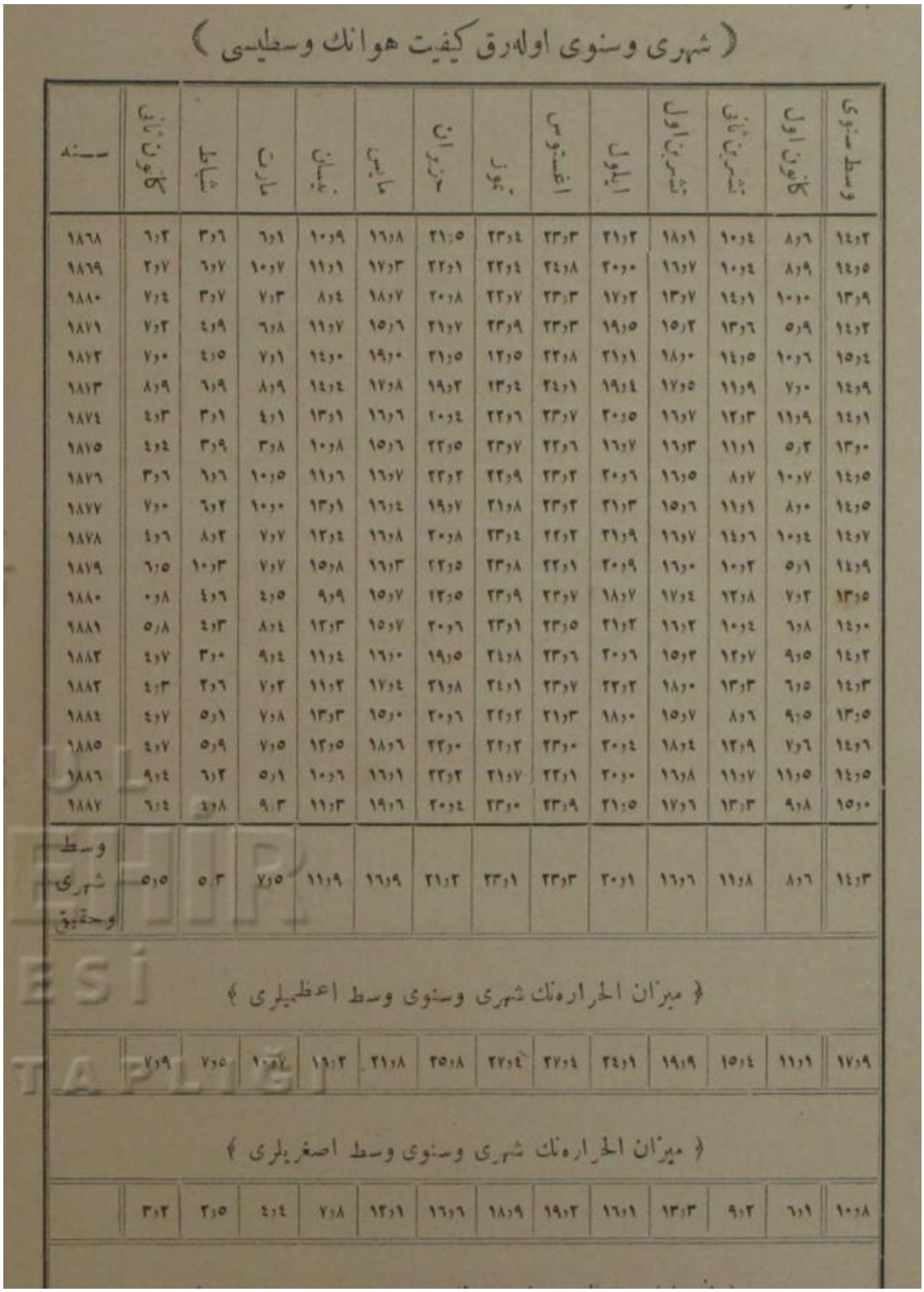
APPENDIX



(شهری وسنوی اولهرق کیفیت هوانك وسطیسی)

سنه	کانون ثانی	شباط	آذار	نیسان	مایس	حزیران	تموز	آغستوس	ایلول	تشرین اول	تشرین ثانی	کانون اول	وسط سنوی
١٨٦٨	٦٫٢	٣٫٦	٦٫١	١٠٫٩	١٦٫٨	٢١٫٥	٢٣٫٤	٢٣٫٣	٢١٫٢	١٨٫١	١٠٫٤	٨٫٦	١٤٫٢
١٨٦٩	٣٫٧	٦٫٧	١٠٫٧	١١٫١	١٧٫٣	٢٢٫١	٢٢٫٤	٢٤٫٨	٢٠٫٠	١٦٫٧	١٠٫٤	٨٫٩	١٤٫٥
١٨٨٠	٧٫٤	٣٫٧	٧٫٣	٨٫٤	١٨٫٧	٢٠٫٨	٢٢٫٧	٢٣٫٣	١٧٫٢	١٣٫٧	١٤٫١	١٠٫٠	١٣٫٩
١٨٧٩	٧٫٢	٤٫٩	٦٫٨	١١٫٧	١٥٫٦	٢١٫٧	٢٣٫٩	٢٣٫٣	١٩٫٥	١٥٫٢	١٣٫٦	٥٫٩	١٤٫٢
١٨٧٢	٧٫٠	٤٫٥	٧٫١	١٤٫٠	١٩٫٠	٢١٫٥	١٢٫٥	٢٢٫٨	٢١٫١	١٨٫٠	١٤٫٥	١٠٫٦	١٥٫٤
١٨٧٣	٨٫٩	٦٫٩	٨٫٩	١٤٫٤	١٧٫٨	١٩٫٢	١٣٫٤	٢٤٫١	١٩٫٤	١٧٫٥	١١٫٩	٧٫٠	١٤٫٩
١٨٧٤	٤٫٣	٣٫١	٤٫١	١٣٫١	١٦٫٦	٢٠٫٤	٢٢٫٦	٢٣٫٧	٢٠٫٥	١٦٫٧	١٢٫٣	١١٫٩	١٤٫١
١٨٧٥	٤٫٤	٣٫٩	٣٫٨	١٠٫٨	١٥٫٦	٢٢٫٥	٢٢٫٦	٢٣٫٧	١٦٫٧	١٦٫٣	١١٫١	٥٫٢	١٣٫٠
١٨٧٦	٣٫٦	٦٫٦	١٠٫٥	١١٫٦	١٦٫٧	٢٢٫٢	٢٣٫٩	٢٣٫٢	٢٠٫٦	١٦٫٥	٨٫٧	١٠٫٧	١٤٫٥
١٨٧٧	٧٫٠	٦٫٢	١٠٫٠	١٣٫١	١٦٫٤	١٩٫٧	٢١٫٨	٢٣٫٢	٢١٫٣	١٥٫٦	١١٫١	٨٫٠	١٤٫٥
١٨٧٨	٤٫٦	٨٫٢	٧٫٧	١٢٫٤	١٦٫٨	٢٠٫٨	٢٣٫٤	٢٢٫٢	٢١٫٩	١٦٫٧	١٤٫٦	١٠٫٤	١٤٫٧
١٨٧٩	٦٫٥	١٠٫٣	٧٫٧	١٥٫٨	١٦٫٣	٢٢٫٥	٢٣٫٨	٢٢٫١	٢٠٫٩	١٦٫٠	١٠٫٢	٥٫١	١٤٫٩
١٨٨٠	٠٫٨	٤٫٦	٤٫٥	٩٫٩	١٥٫٧	١٢٫٥	٢٣٫٩	٢٣٫٧	١٨٫٧	١٧٫٤	١٢٫٨	٧٫٢	١٣٫٥
١٨٨١	٥٫٨	٤٫٣	٨٫٤	١٢٫٣	١٥٫٧	٢٠٫٦	٢٣٫١	٢٣٫٥	٢١٫٢	١٦٫٢	١٠٫٤	٦٫٨	١٤٫٠
١٨٨٢	٤٫٧	٣٫٠	٩٫٤	١١٫٤	١٦٫٠	١٩٫٥	٢٤٫٨	٢٣٫٦	٢٠٫٦	١٥٫٣	١٢٫٧	٩٫٥	١٤٫٢
١٨٨٢	٤٫٣	٢٫٦	٧٫٢	١١٫٢	١٧٫٤	٢١٫٨	٢٤٫١	٢٣٫٧	٢٢٫٢	١٨٫٠	١٣٫٣	٦٫٥	١٤٫٣
١٨٨٤	٤٫٧	٥٫١	٧٫٨	١٣٫٣	١٥٫٠	٢٠٫٦	٢١٫٣	٢٢٫٢	١٨٫٠	١٥٫٧	٨٫٦	٩٫٥	١٣٫٥
١٨٨٥	٤٫٧	٥٫٩	٧٫٥	١٢٫٥	١٨٫٦	٢٢٫٠	٢٢٫٢	٢٣٫٠	٢٠٫٤	١٨٫٤	١٢٫٩	٧٫٦	١٤٫٦
١٨٨٦	٩٫٤	٦٫٢	٥٫١	١٠٫٦	١٦٫١	٢٢٫٢	٢١٫٧	٢٢٫١	٢٠٫٠	١٦٫٨	١١٫٧	١١٫٥	١٤٫٥
١٨٨٧	٦٫٤	٤٫٨	٩٫٣	١١٫٣	١٩٫٦	٢٠٫٤	٢٣٫٠	٢٣٫٩	٢١٫٥	١٧٫٦	١٣٫٣	٩٫٨	١٥٫٠
وسط شهری وحقیق	٥٫١٥	٥٫٣	٧٫٥	١١٫٩	١٦٫٩	٢١٫٢	٢٣٫١	٢٣٫٣	٢٠٫١	١٦٫٦	١١٫٨	٨٫٦	١٤٫٣

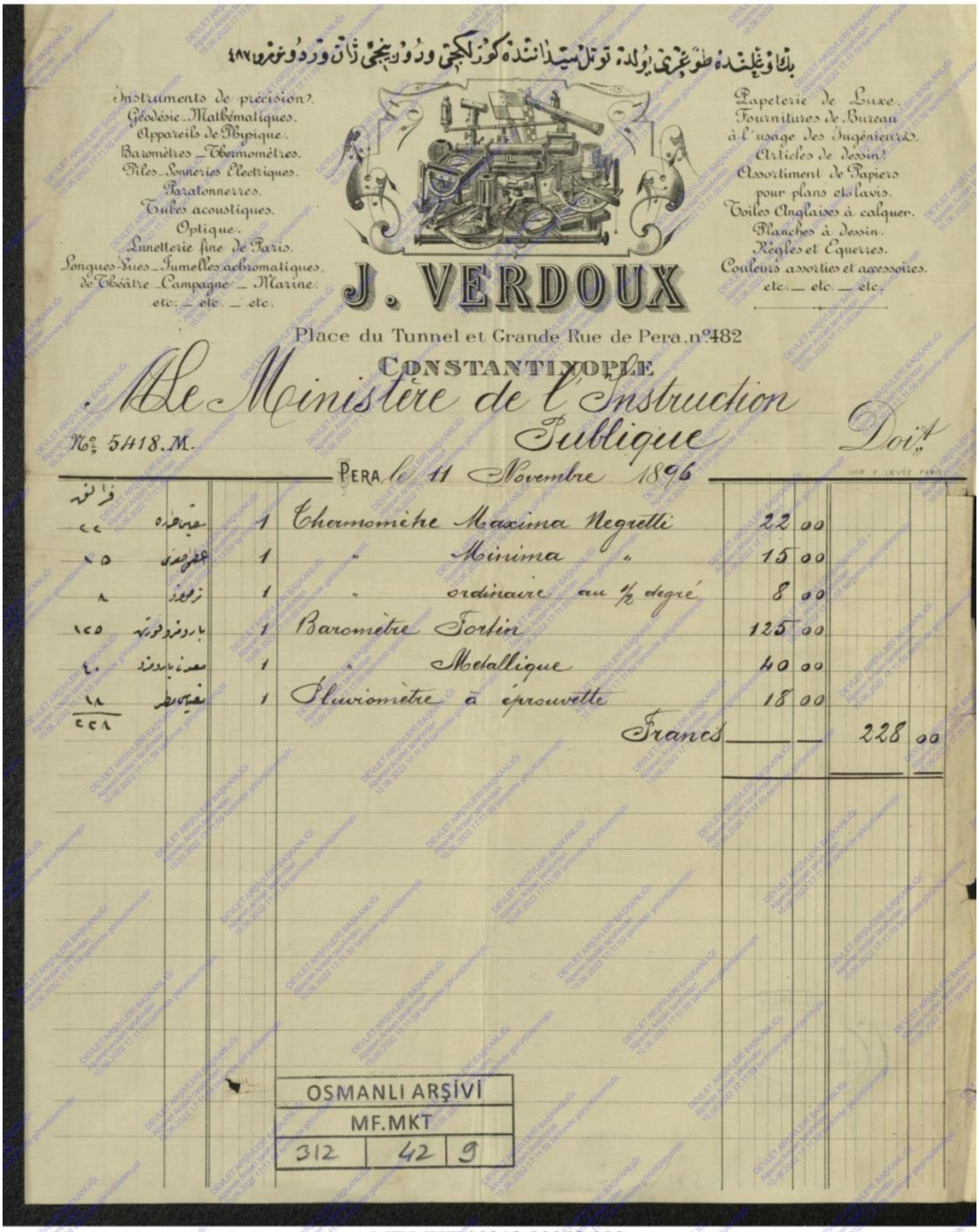
(میزان الحرارهنك شهری وسنوی وسط اعظیلری)

٧٫٩	٧٫٥	١٠٫٧	١٩٫٢	٢١٫٨	٢٥٫٨	٢٧٫٤	٢٧٫٤	٢٤٫١	١٩٫٩	١٥٫٤	١١٫١	١٧٫٩

(میزان الحرارهنك شهری وسنوی وسط اصغریلری)

٣٫٢	٢٫٥	٤٫٤	٧٫٨	١٢٫١	١٦٫٦	١٨٫٩	١٩٫٢	١٦٫١	١٣٫٣	٩٫٢	٦٫١	١٠٫٨

1. A table shows The Mean Temperature Records of Istanbul from 1868- 1887. In *Dersaadet Rasadhane-i Âmiresi'nin Cevv-i Havaya Dair Yirmi Senelik Tarassudatı Neticesi*, Dersaadet: Matbʿa-i Osmaniyye, 1304 (1887).


Instruments de précision. Géodésie. Mathématiques. Appareils de Physique. Baromètres. Thermomètres. Piles. Sonneries Électriques. Paratonnerres. Tubes acoustiques. Optique. Lunetterie fine de Paris. Longues-Vues. Jumelles achromatiques, de Théâtre. Campagne. Marine. etc. etc. etc.

Papeterie de Luxe. Fournitures de Bureau à l'usage des Ingénieurs. Articles de dessin. Assortiment de Papiers pour plans et lavis. Toiles Anglaises à calquer. Planches à dessin. Règles et Équerres. Couleurs assorties et accessoires. etc. etc. etc.

J. VERDOUX

Place du Tunnel et Grande Rue de Pera, n°482

CONSTANTINOPLE

Me Ministère de l'Instruction Publique Doit

N° 5418.M.

PERA, le 11 Novembre 1896

1	Thermomètre Maxima Negretti	22	00	
1	" Minima "	15	00	
1	" ordinaire au ½ degré	8	00	
1	Baromètre Fortin	125	00	
1	" Metallique	40	00	
1	Pluviomètre à éprouvette	18	00	
	Francs			228 00

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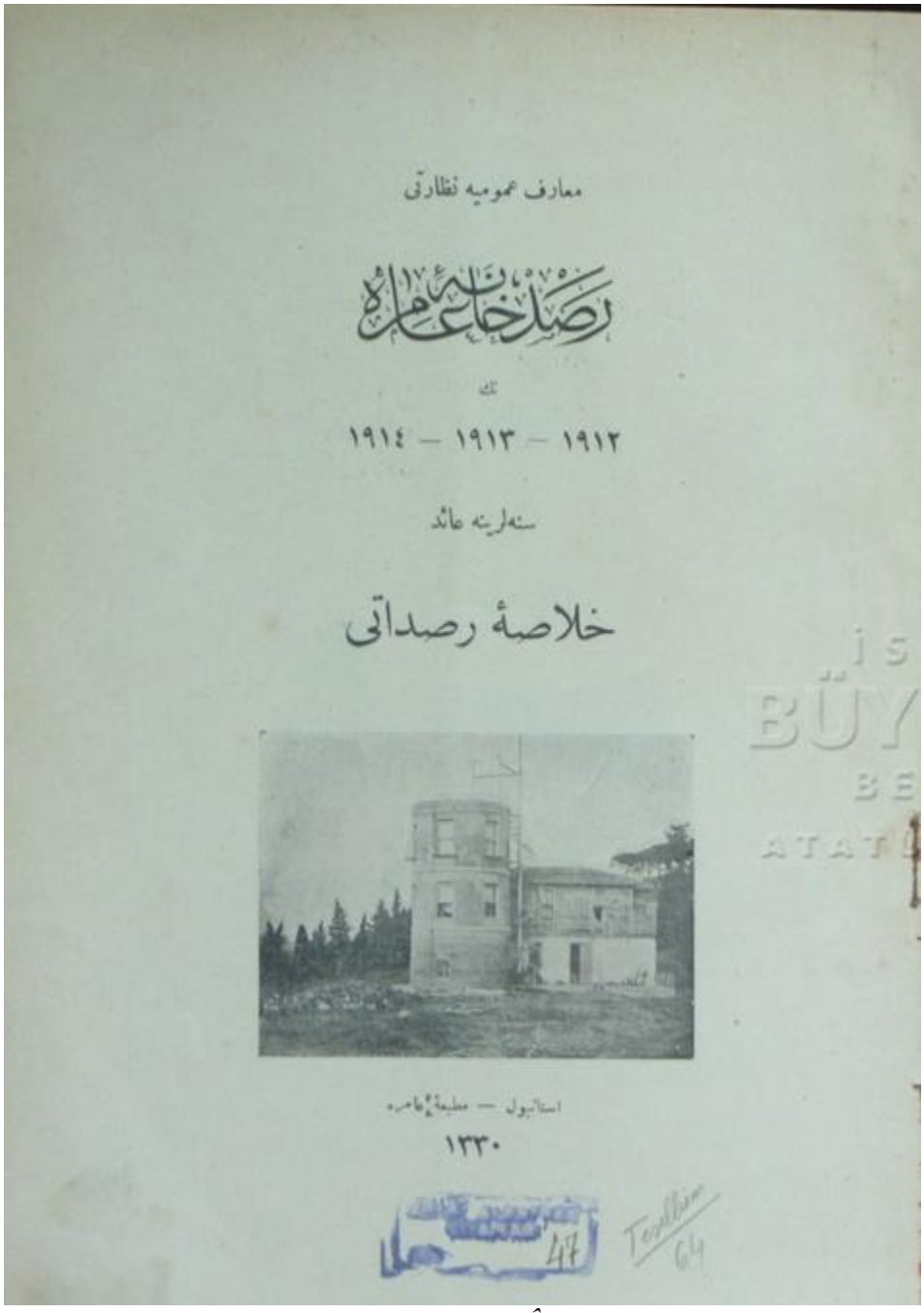
2. A Price List of the Measurement Equipments which were bought for the Imperial High School in Jerusalem.


معارف عمومیه نظارتی

رصدخانه عامره

۱۹۱۲ — ۱۹۱۳ — ۱۹۱٤

سنه‌لرینه عائد

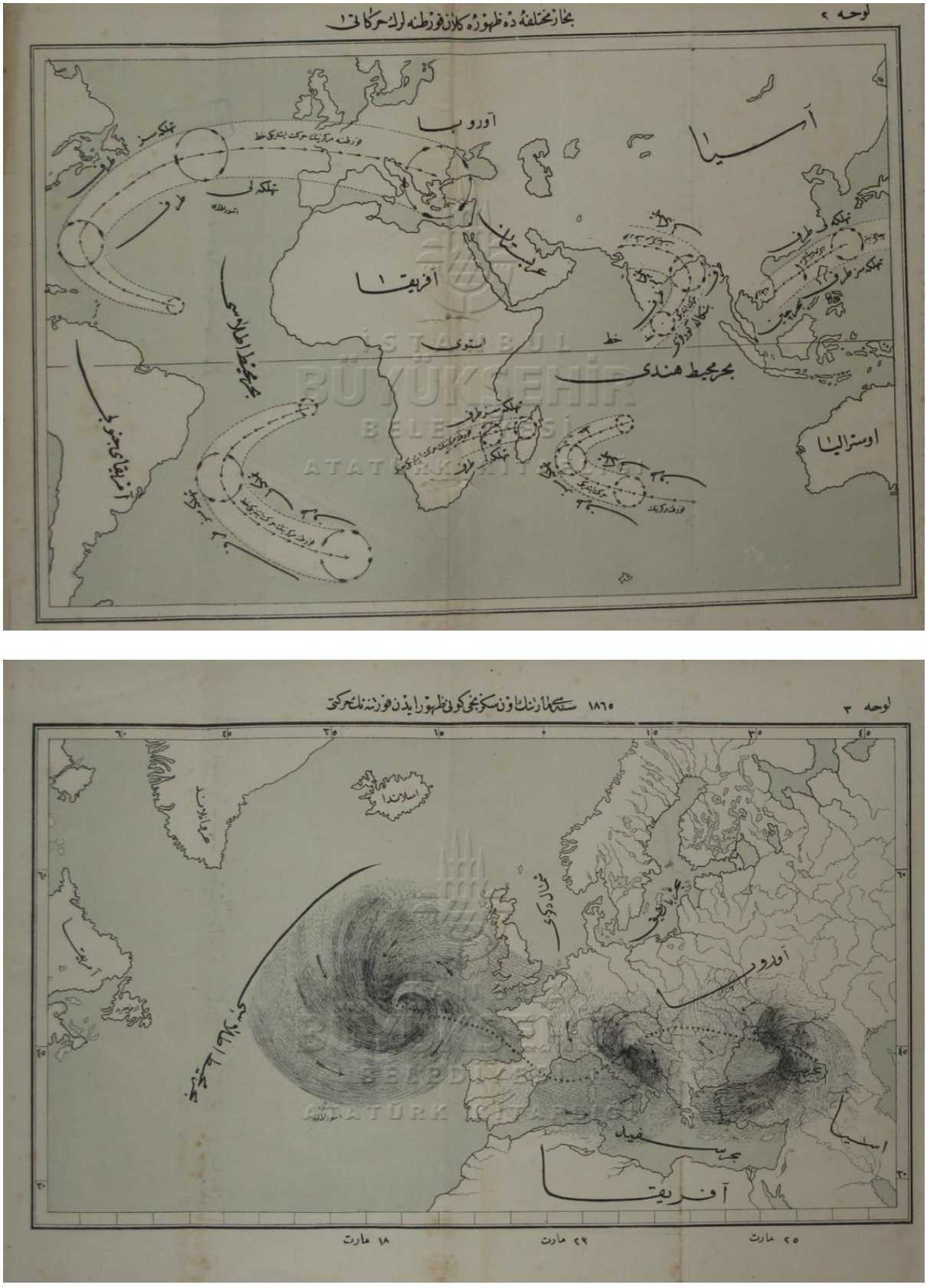
خلاصهٔ رصداتی

استانبول — مطبعهٔ عامره

۱۳۳۰

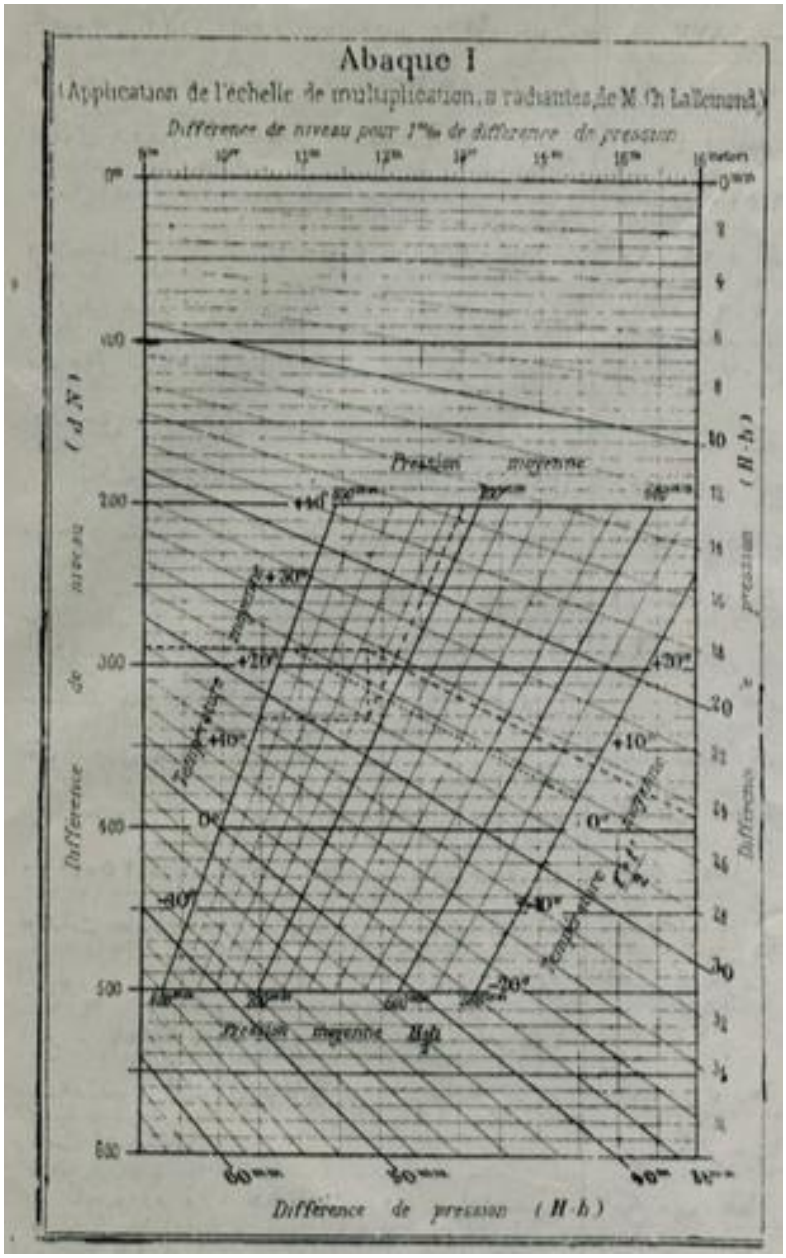
3. A Cover Page of the *Rasadhâne-i Âmire'nin 1912-1913-1914 Senelerine Aid Hülâsa-i Rasadatı,* Istanbul: Matbʿa-i ʿĀmire: 1330, [1915]. [Kandilli Observatory under construction]

4. A Diagram explains the Directions of Winds in the Northern and Southern Hemispheres in Aristide Coumbary's *The Law of Storms for the Mariners*.

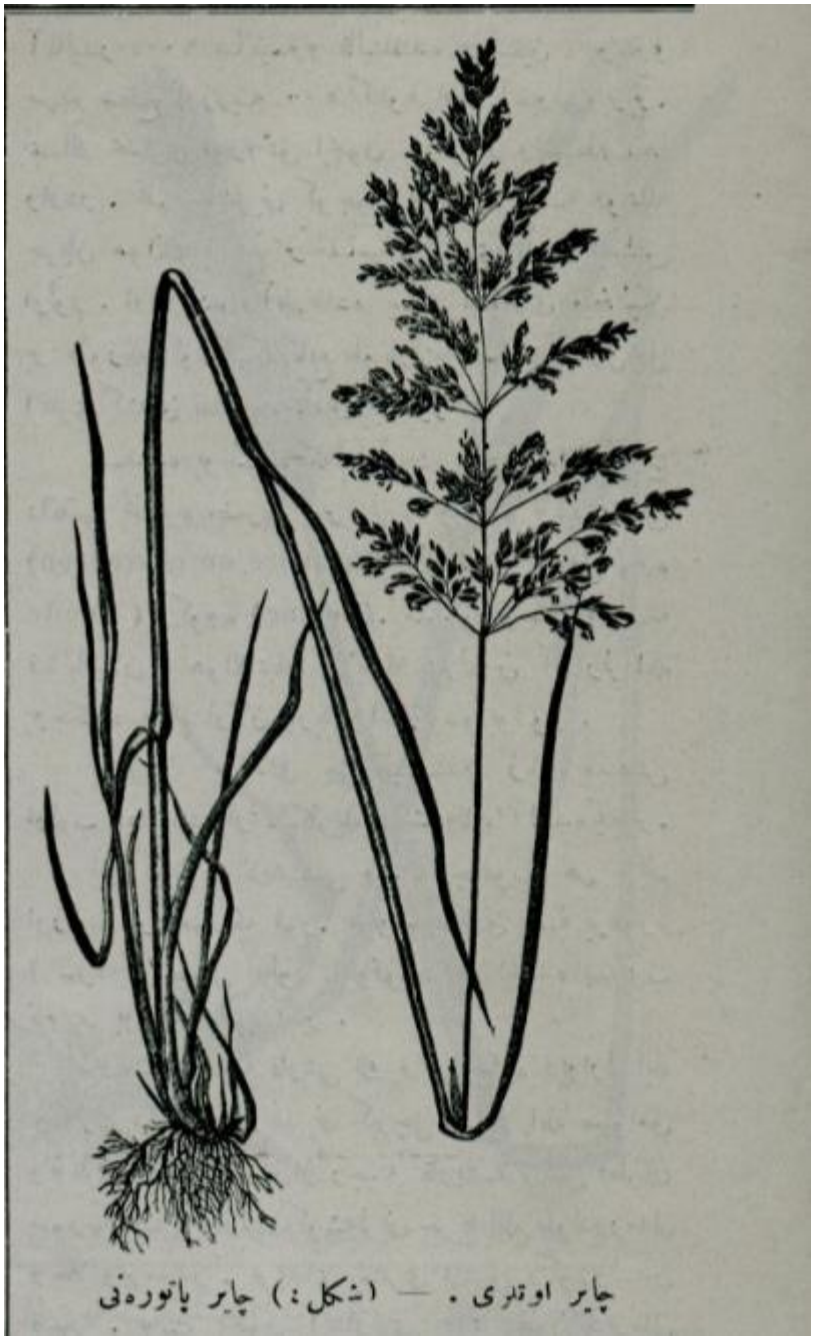


5. Maps Show the Directions of Winds in Aristide Coumbary's *The Law of Storms for the Mariners.*

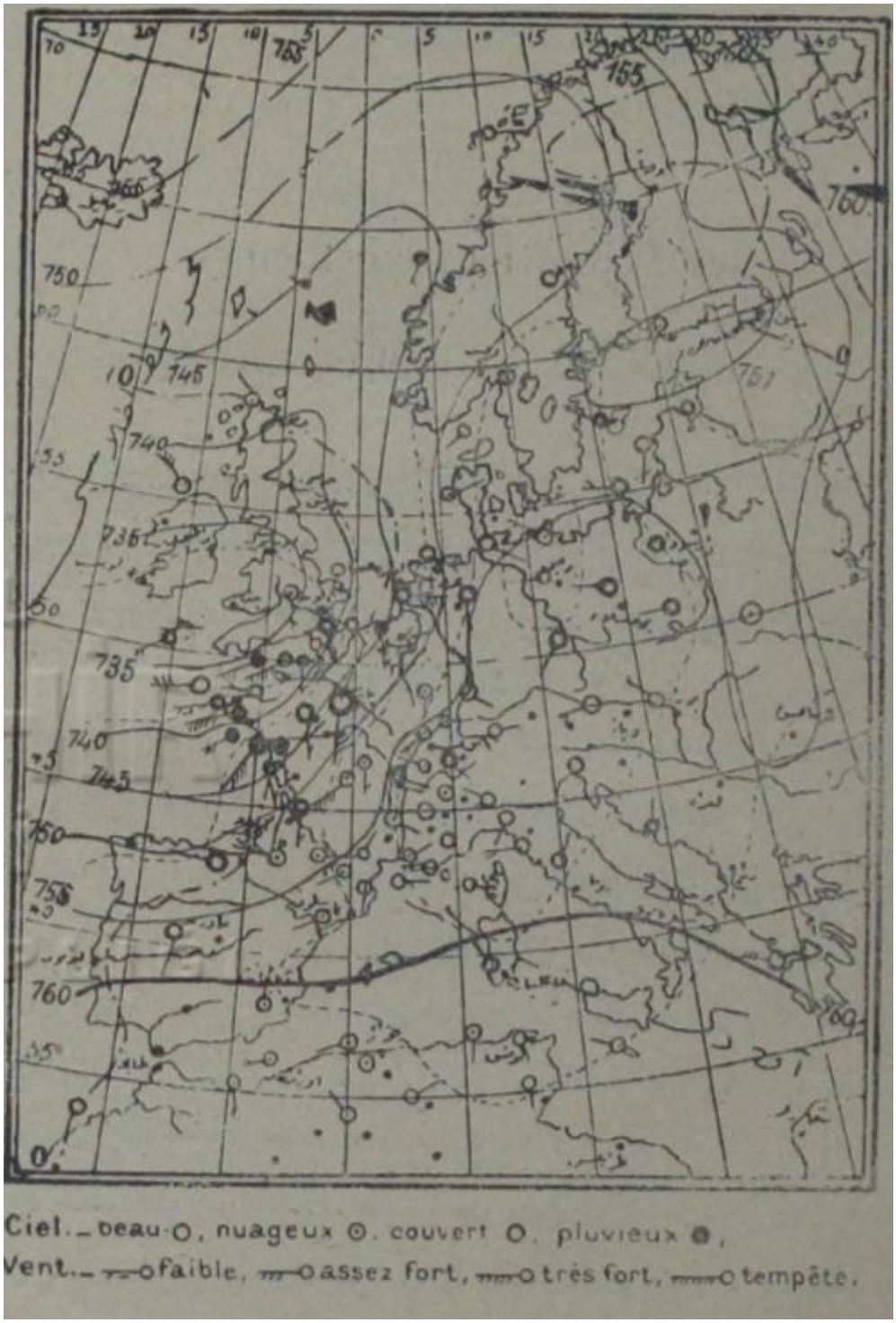
6. A female farmer is resting and observing nature, in Filāḥat 7- (1 Temmuz 1329- 14 July 1913)



7. An Instruction Manual of Barometer for Peasants, which was published in Filāḥat 12 (15 Kanun-u Evvel 1329- 28 December 1913)



8. An example from the Floral Archives of the Empire, published in Filāḥat 6 (1 Haziran 1329- 14 June 1913)



9) An isobaric map for the students of agriculture and meteorology, in Ahmet Tevfik's *Agricultural Meteorology*

10. Students of the Halkalı School of Agriculture (*Halkalı Zirāʿat Mekteb-i ʿAlīsi*) (*İstanbul Üniversitesi Nadir Eserler* Kütüphanesi)