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Meteorological Imperialism: Climate Science, Environment, and Empire in Liberal and Fascist Italy (1870-1940)

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Meteorological Imperialism:

Climate Science, Environment, and Empire in Liberal and Fascist Italy (1870-1940)

by

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Committee in charge:

Professor Massimo Mazzotti, Chair
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Abstract

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"Meteorological Imperialism" is the first history of Italian colonialism from the perspective of the history of science and environmental history. I argue that the experience of colonizing African environments transformed Italian imperialism from a liberal to a fascist organization of science, politics and nature, that is, to a "techno-political regime." I focus on the mutation of meteorology from the nineteenth-century paradigm of international meteorology to its militarization under fascism as a product of Italian colonialism. By combining the approaches of the history of science, environmental history and Science and Technology Studies, I use meteorology as the "infrastructure of knowledge" of Italian imperialism in the arid environments of North and East Africa.

The Italian invasion of the Horn of Africa triggered the ecological unraveling of the Ethiopian Empire and the myth of a settlement colony for Italian emigrants in Africa. Italy's defeat at the hands of Ethiopia in the battle of Adwa in 1896 posed a set of environmental and political challenges which Italians addressed with the organization of a liberal techno-political regime. Scientific experts, including meteorologists, mobilized to build a new consensus on the colonial project and promote the economic development of the dry colonies of Eritrea and Somalia. The conquest of Libya, the Great War, and the re-conquest of the colony in the interwar period marked the crisis of Italian liberal imperialism. The birth of aviation, the invention of chemical weapons, and the disappointment of projects in the arid environment of Libya transformed Italian meteorology and colonial practices into a more authoritarian organization. Finally, the 1935 invasion of Ethiopia marked the triumph of Italian fascist techno-politics as an alternative strategy to compete with the hydro-politics of the British Empire.

Drawing on research carried out in English, French, German, and Italian in hitherto unexplored archives, I reconstruct the transformation of liberalism into fascism as the product of imperial tensions and environmental constraints in Africa, rather than as a political event occurring in Europe. I advance a new interpretation of Italian colonialism as a palimpsest of liberal and fascist imperialism whose knowledge-production practices are crucial to understanding Italy's socially-constructed ignorance of its colonial past.

To my father Alfredo and my mother Silvana

[43] You have heard that it was said,
'Love your neighbor and hate your enemy.'[44]
But I tell you, love your enemies and pray for those who persecute you, [45]
that you may be children of your Father in heaven.
He causes his sun to rise on the evil and the good,
and sends rain on the righteous and the unrighteous.

Matthew 5: 43-45

TABLE OF CONTENTS

Acknowledgments p. v

Introduction
The Mystery of the Archive p. vi
Italian Colonialism as Palimpsest of Liberal and Fascist Techno-Politics p. ix
Contribution to the Historiography p. xi
Method and Concepts: Meteorology as Knowledge Infrastructure of Italian Techno-Political Regimes p. xvi
Periodization, Structure, and Sources p. xx

Chapter 1. Empire, Drought, and Famine: The Climate Sciences and the Ecological History of Early Italian Colonialism (1870-1896)
1.1 Introduction: Ecology and Techno-Political Regimes of Italian Colonialism p. 1
1.2 Ethiopia's Climates and European Explorations (1770s-1870s) p. 4
1.3 Scientific Controversies and the Birth of Italian Colonialism (1870-1885) p. 12
1.4 Drought, Disease, and Famine (1885-1890) p. 25
1.5 Colonizing Eritrea (1890-1896): Competing Projects p. 38
1.6 Conclusion: Adwa and the Origins of Liberal and Fascist Imperialism p. 47

Chapter 2. Liberal Techno-Politics
2.1 Introduction p. 54
2.2 Italy's First Colonial Meteorological Network (1899-1905) p. 57
2.3 The Making of a Scientific Colonial Community: The Colonial Conference of Asmara (1905) p. 64
2.4 Building an Imperial Infrastructure of Knowledge p. 67
2.5 International Competition p. 70
2.6 Conclusions: The Limits of Italy's Liberal Imperialism p. 76

Chapter 3. The Crisis of Liberal Meteorology: The Conquest of Libya, the Great War, and the Collapse of the Paradigm of International Meteorology (1911-1931)
3.1 Introduction p. 80
3.2 The Paradigm of Liberal International Meteorology: Aerology, Terrestrial Magnetism, and European Empires before WWI p. 84
3.3 Libya 1911-1914: The Rise and Fall of Liberal Techno-Politics p. 104
3.4 The Destruction of an International Community: The Great War and the Rise of Local Weather Forecasting p. 116
3.5 Libya's New Techno-Politics p. 135
3.6 Conclusions p. 152

Chapter 4. From Liberal to Fascist Techno-Politics: Ethiopia and the Militarization of Italian Meteorology (1919-1940)
4.1 Introduction: From Liberal to Fascist Techno-Politics p. 155
4.2 Environment: The "Hydrographic Problem of Ethiopia" p. 160

4.3 Empire: The Conquest of Ethiopia as Infrastructural War p. 177
4.4 Autarchy and *Colonialismo Integrale*: The Reorganization of Science under Fascism p. 194
4.5 Conclusions p. 210

Conclusions
Results of the Approach of Ecological History p. 215
New Research Directions and a Warning for the Future p. 218

Bibliography
Archival References and Abbreviations p. 222
Primary Sources p. 222
Secondary Literature p. 238

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This dissertation is the result of a very unexpected journey. When I visited the United States as an exchange student from the University of Padua in 2010, I did not imagine that I would join the PhD program in the History Department at UC Berkeley to work on the history of science and the history of Italian imperialism. I am very grateful to the mentors and colleagues who believed in me, helped me cultivate my research interests, and allowed me to grow tremendously as a scholar and as a human being. They made me who I am, across worlds, in the United States and in Europe.

My dissertation committee was a constantly supportive team that allowed me to improve my project at every step. I am particularly grateful to Professor Massimo Mazzotti for listening to and encouraging all the ideas and questions that led to this research project. Professor Mia Fuller provided invaluable guidance from the first day we met at UC Berkeley. Professor Tom Laqueur inspired me "to connect the particular to the cosmic" and taught me by example, as a true teacher of humanity. I immensely valued Professor James Vernon's challenges to think bigger, expand my horizons, clarify my arguments, and support my effort to examine Italy as part of Europe, and Europe as part of a global context. I am very much indebted to their teachings and guidance. Thanks to their support, I was able to cultivate my interests across traditional disciplinary boundaries in a way that would not have been possible in Italy.

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The International Workshop "Climate in Meteorology, Meteorology in Climate Studies" in Bergen (Norway) allowed me to place the history of Italian meteorology in a broader context.

I hope that this work will open new research directions and "unexpected journeys" to other scholars as well, since writing the history of Italian scientific imperialism is just at the beginning.

INTRODUCTION

Fig. 1: The archive of the 19th-century Italian Central Meteorological Office at the time of its discovery in December 2012.

The Mystery of the Archive

On a cold morning in December 2012, I discovered the abandoned archive of the nineteenth-century Italian Meteorological Office. Several paper boxes laid in thick black dust, covered with spiderwebs. Wearing mask and gloves, I started pulling out some folders (while praying not to find any mice in the mix). The tags written on them were still readable: "Tripoli," "Benghazi," "Asmara," "Mogadishu." Opening the consumed binders and crumbling files, I immediately realized that I had found the forgotten weather records of the Italian colonial empire and the archive of Luigi Palazzo, the unknown meteorologist that directed the Central Meteorological Office between 1901 and 1931. After decades of neglect, the archive was an uncharted and unexploited gold mine of documents that revealed the entanglement between meteorology and Italian colonial expansion.

Yet the archive posed even more questions than it actually answered: what was the role of meteorology in Italian colonialism? Why was the archive of the institution promoting meteorology in liberal Italy and its line of inquiry overlooked by scientists and historians alike? How could an entire scientific enterprise be entirely forgotten and abandoned? Who were the unknown meteorologists, agronomists, colonial officers, engineers, and military officers whose names emerged from the history of Italian colonialism for the first time?

From the start, it was apparent that the answers to these questions—like the sources themselves—were at the intersection of the history of science, environmental

history, and the history of empire. Approaching them through one lens alone would have produced a fine institutional history of the Central Meteorological Office, a respectable environmental history of the climate in Italy, and maybe a marginal footnote in the history of European scientific imperialism. Instead, I believed that understanding the neglect of the archive was as important as following the histories buried in it.

Thus, this is not just a history of the Central Meteorological Office. When I started exploring that history, I realized that the bigger picture, the architecture of the relationship between science, African environments, and Italian colonialism was missing. Instead, "Meteorological Imperialism" is the first ecological history of Italian imperialism across two systems of governance: liberalism and fascism. As such, an ecological history examines the interplay between nature and culture, brings together the approaches of the history of science and environmental history, and sheds light on political and cultural history.[1]

The discovery of the archive was due to the original angle of my inquiry across different fields as DPDF fellow at the Social Science Research Council in ecological history. Those documents were abandoned precisely *because* they could not be reclaimed by pure historians of science, traditional historians of empire, or exemplary environmental historians. Only an ecological history could offer a three-dimensional answer to the mystery of the archive and resurrect its histories for the first time ever. Within the well-studied histories of British and French scientific imperialism, such an archival discovery would have enriched an already clear framework of institutions, scientists, and colonial practices. Instead I set out to re-write the history of Italian colonialism starting from the climate and atmospheric sciences.

Archives are the material embodiment of collective memories, much in the same way as collections of data are fundamental for the production of scientific knowledge. Just as colonial archives represent the perspectives and biases of European imperial projects, scientific archives constitute the skeletons of research projects and lines of inquiry.[2] Correspondence, statistics, and maps were the fundamental infrastructures of knowledge that allowed Europeans to "see" their colonial possessions and exert their power from a distance.[3] They offer a partial but fundamental tool to understand the functioning of bureaucratic institutions, empires, and scientific research agendas alike.

An abandoned archive is a troubling sign that something went wrong in the process of accumulation of scientific knowledge and empire-building. While historians approach archives as repositories of memory and knowledge, the archive of the Central Meteorological Office is a monumental case of "agnotology," the social construction of

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[1] In William Cronon's words, "an ecological history begins by assuming a dynamic and changing relationship between environment and culture, one as apt to produce contradictions as continuities. Moreover, it assumes that the interactions of the two are dialectical. Environment may initially shape the range of choices available to a people at a given moment, but then culture reshapes environment in responding to those choices." William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England*, 1st rev. ed., 20th-anniversary ed. (New York: Hill and Wang, 2003), 13. On the history of the Central Meteorological Office, see Maria Carmen Beltrano's work and the special issue of *Agricoltura*, no. 277 (1996): 5-103. For a traditional history of meteorology in Italy, see Servizio Meteorologico dell'Aeronautica Militare, *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, voll. 2, 1975.

[2] On the history of archives and the history of science, see *Isis* 107, no. 1 (2016).

[3] James C. Scott, *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed*, Yale Agrarian Studies (New Haven: Yale University Press, 1998).

ignorance, as knowledge is deliberately concealed and overlooked.[4] The archive of the Central Meteorological Office is what remains of a derailed scientific and imperial project, namely the "techno-political regime" of liberal meteorology.[5] The neglect of the archive of the Central Meteorological Office is the result of the liquidation of the paradigm in which it operated, so that no institution was willing to continue its research projects, inherit its mission, and turn its history into memory.

Abandoned archives are more challenging to use because they lack a pre-organized catalogue, but they are also a repository of neglected memory that has never been manipulated through later projects of memorialization and disguising of the past. Indeed, while disclosing the files of the Central Meteorological Office for the first time ever, I saw coming back to life before my eyes early twentieth-century colonial meteorology, as if the Director Luigi Palazzo had abandoned his desk momentarily, never to return and clean up his office. Thus, I decided to use this Pompeii of Italian climate science to explain the many contradictions of Italian colonialism. Why is liberal colonialism considered a failure? How did the myth of Italian colonialism as an empire of emigrants emerge? What caused the rise of fascist imperialism? How is it connected with Italian colonialism in liberal Italy?

In this first ecological history of Italian colonialism I argue that the rise of a new, fascist techno-political regime transformed Italian meteorology from nineteenth-century climatology into modern weather forecasting as a result of the conquest of African environments. Because Italy's African colonies (Eritrea, Somalia and Libya) were constantly afflicted by lack of water and extremely irregular rainfall, Italian liberal imperialism struggled to exploit them to extract economic profit. Liberal techno-politics tried to use science to intercept the flow of natural resources by studying and exploiting nature for economic purposes.[6] Instead, fascist techno-politics put science at the service of military and autarkic goals. In particular, it needed meteorology to use airplanes during the 1935 invasion of Ethiopia. Fascist meteorology placed more importance on weather forecasting, was oriented toward the future, and became "modern" meteorology.

More broadly, the abandonment of the archive of the Central Meteorological Office poses a set of deeper questions about breaks and continuities between liberalism and fascism, and their different models of scientific imperialism. Why did Italians abandon the liberal method of data collection and empire-building? What caused such a massive interruption of the empire's research agenda and its colonial practices that led Italians to deliberately ignore its memory? How can we explain the metamorphoses of Italian imperialism from a liberal to a fascist model of governance of nature and science?

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[4] Robert Proctor distinguished three types of "ignorance": as a native state, as a selective choice (or passive construct), and as a strategic ploy or active construct. Robert Proctor and Londa L. Schiebinger, eds., *Agnotology: The Making and Unmaking of Ignorance* (Stanford: Stanford University Press, 2008), 1-36.

[5] "Techno-political regimes" are—in Gabrielle Hecht's words—"linked sets of people, engineering and industrial practices, technological artifacts, political programs, and institutional ideologies." Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II*, Inside Technology (Cambridge: MIT Press, 1998), 16. See also Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002).

[6] Italy's liberal imperialism emulated the experience of liberal imperialism in the British and French empires. See Jennifer Pitts, *A Turn to Empire: The Rise of Imperial Liberalism in Britain and France* (Princeton: Princeton University Press, 2005).

What can we learn by recovering the history of Italian liberal meteorology from the limbo of the abandoned archive of the *Central Meteorological Office*? And why does it matter?

1880	Purchase of Assab (Eritrea)
1885	Conquest of Massawa (Eritrea)
1890	Creation of Eritrea; Protectorate on Italian Somaliland
1896	Battle of Adwa against the Ethiopian Empire
1911	Conquest of Libya
1919-1931	Reconquest of Libya
1935	Invasion of Ethiopia

Fig. 2: Map and timeline of Italian Colonialism

Italian Colonialism as a Palimpsest of Liberal and Fascist Techno-Politics

"Meteorological Imperialism" suggests that Italian colonial meteorology offers a key vantage point from which to understand the transformation of liberalism into fascism as the product of imperial tensions and environmental constraints, rather than just as a political transformation occurring in Europe. Italian colonialism is exceptional because it is a palimpsest of two different colonial projects: liberal and fascist imperialism. Like a palimpsest, liberal and fascist imperialisms shared the same material and geographical space. They reused features of the previous script, but covered and concealed other parts with new meaning, thus pushing in the hidden realm of intentional ignorance. They read, (mis)understood, and used the African landscape for different purposes. The overlapping of multiple colonial projects makes Italian colonialism escape the linear narratives of the history of science and the history of empire.

The general public ignores the very existence of any such thing as "Italian colonialism," even in Italy. Recently, the United Nations claimed that "ignorance of its colonial past contributes to Italian racism" as Italians perceive the arrival of migrants from Eritrea and Somalia through Sudan and Libya as if this was the first time they ever

encounter their ex-colonial subjects.[7] Until today, the dominant popular narrative of Italian colonialism is that Italians gained just a few small, poor and arid colonies in the scramble from Africa. Despite that, they promoted the construction of roads, cities and agricultural development without getting anything in return. Because Italians lost out on colonialism (unlike the British and the French) they feel absolved from the broader history of European imperialism in Africa and unaffected by their colonial past, as if it never existed. The paradox of this narrative is the victimization of the colonizers.[8]

Historians have not yet found a unifying ideological theme of Italian colonialism in the same way they identify British imperialism with the development of global capitalism, the free market and the rule of law, or French colonialism with the *mission civilisatrice*. The ideology of the "civilizing mission" toward African subjects is mostly absent from the discourse and practices of Italian colonialism. The creation of a settler colony in Africa for Italian emigrants was one of the most popular and recurring ideological goals of Italian colonialism that emerged in the late nineteenth century, but achieved limited results and left no long-lasting legacies, with the exception of fascist Libya.[9]

Moreover, historians have preferred to focus on fascist rather than liberal imperialism.[10] Italian liberal imperialism is usually perceived as so unsuccessful in conquering, exploiting or developing African colonies that it has no place in general histories of European colonialism and global capitalism, as well as European scientific imperialism.[11] Instead, Italian colonialism is more often conflated with fascist imperialism, since Mussolini made imperialism a crucial part of fascist ideology and policies. For example, the invasion of Ethiopia in 1935 is famous for the use of chemical weapons in violation of international law, for exposing the powerlessness of the League of Nations in the face of fascist expansionism, and for originating the alliance between fascist Italy and Nazi Germany.[12]

Sweeping aside again the legacy of fascist imperialism after World War II, Italians cultivated the post-colonial myths of *Italiani brava gente* ("Italians good people") and the stereotype of the "evil German" versus the "good Italian" (*il cattivo tedesco e il bravo italiano*) that portrayed Italians as less exploitative than the British and less cruel

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[7] Enrico Muratore, "Onu: L'ignoranza del passato coloniale tra le cause del razzismo in Italia (II Parte)" *Il Fatto Quotidiano*, August 22, 2015, http://www.ilfattoquotidiano.it/2015/08/22/onu-lignoranza-del-passato-coloniale-tra-le-cause-del-razzismo-in-italia-ii-parte/1972025/. Last accessed July 10, 2017.

[8] For the best and most recent synthesis of the major themes in Italian colonialism, see the contributions in Ruth Ben-Ghiat and Mia Fuller, eds., *Italian Colonialism* (New York: Palgrave Macmillan, 2008), and Patrizia Palumbo, ed., *A Place in the Sun: Africa in Italian Colonial Culture from Post-Unification to the Present* (Berkeley: University of California Press, 2003).

[9] See Mark I. Choate, *Emigrant Nation: The Making of Italy Abroad* (Cambridge: Harvard University Press, 2008); Federico Cresti, *Non desiderare la terra d'altri: La colonizzazione italiana in Libia* (Rome: Carocci, 2011) and *Oasi Di italianità: La Libia della colonizzazione agraria tra fascismo, guerra e indipendenza (1935-1956)*. Turin: Società Editrice Internazionale, 1996); Claudio G. Segrè, *Fourth Shore: The Italian Colonization of Libya* (Chicago: University of Chicago Press, 1974).

[10] Angelo Del Boca, ed., *Le guerre coloniali del fascismo* (Rome: Laterza, 1991).

[11] Gian Luca Podestà, *Il mito dell'impero: Economia, politica e lavoro nelle colonie italiane dell'Africa Orientale, 1898-1941* (Turin: G. Giappichelli, 2004).

[12] See Angelo Del Boca, *I gas di Mussolini: Il fascismo e La guerra d'Etiopia* (Rome: Editori Riuniti, 1996); Enzo Collotti, *Fascismo e politica di potenza: politica estera 1922-1939* (Florence: La Nuova Italia, 2000); Nicola Labanca, *La guerra d'Etiopia: 1935-1941* (Bologna: Società Editrice Il mulino, 2015). Giorgio Rochat, *Le guerre italiane 1935-1943: dall'impero d'Etiopia alla disfatta* (Turin: Einaudi, 2005).

than the Germans.[13] The rhetoric of *Italiani brava gente* and *il cattivo tedesco e il bravo italiano* were essential for the post-war rehabilitation of the Italian government. If Italians wanted to get any of their colonies back from the British and the Americans, they needed to distance themselves from the atrocities of their former allies in the Nazi Reich and deny any war crimes that took place under fascism.[14] For example, General Pietro Badoglio—the main planner of the deportation of Arab population in Libya in 1930 and the man directly responsible for violating international law with the use of poison gas in Ethiopia in 1935—signed the armistice with the allies in 1943 and remained Prime Minister in the puppet Italian kingdom of the South almost until the end of the war. As a result, he never went through a trial for his colonial war crimes.[15] Facing the challenge of the Cold War against the Soviets, the Americans and the British were willing to forget this history of violence and allow Italians to forget their colonial past as well.

In short, Italian colonialism was so successful in fabricating ignorance due to changing political and techno-political regimes that many people do not even know that such a thing as an "Italian empire" ever existed. Historians Angelo del Boca and Giorgio Rochat spearheaded the attack against the myth of *Italiani brava gente*, denouncing this account as based on Italians' manufactured ignorance of their colonial past, an ignorance itself enabled by decades-long restrictions on colonial archives. The first committee in charge of publishing the official history of Italian colonialism at the time of decolonization, largely composed of former colonial administrators and scientific experts, manipulated state archives which they "cleaned up" to hide embarrassing documents.[16] Independent historians faced all kinds of challenges in accessing the neglected and disorganized colonial archives. The discovery of the archive of the Central Meteorological Office offers an amazing opportunity to write a new history of Italian colonialism without the filters and fragmented evidence scattered in state and military archives.

Contribution to the Historiography

My research brings together the historiographies of science, environment and empire to examine the importance of colonialism in the history of liberalism and fascism in Africa. These fields have been recently converging toward the analysis of the world as a web or a network of reciprocal influences. In the last decades, the relationship between local and global phenomena has fascinated historians, whether their work dealt with European imperialism, the ecological transformations triggered by Europeans, or the universality of scientific knowledge. Since Richard Grove's seminal book *Green Imperialism* and William Cronon's *Changes in the Land*, scholars have tried to understand how colonial

[13] See Filippo Focardi, *Il cattivo tedesco e il bravo italiano: La rimozione delle colpe della Seconda Guerra Mondiale* (Bari: Laterza, 2013) and Angelo Del Boca, *Italiani, brava gente? Un mito duro a morire*. (Vicenza: N. Pozza, 2005).

[14] Nicola Labanca, "Colonial Rule, Colonial Repression and War Crimes in the Italian Colonies," *Journal of Modern Italian Studies* 9, no. 3 (2004): 300–13.

[15] Giorgio Rochat, *Pietro Badoglio* (Turin: UTET, 1974).

[16] See the series edited by the Comitato per la Documentazione dell'Opera dell'Italia in Africa: Elio Migliorini and Enrico de Leone, eds., *L'Italia in Africa* (Rome: Istituto poligrafico dello Stato, 1955).

ecologies, environmental sciences, and imperialism shaped one another.[17]

The history of empire has been at the forefront of the discovery of such interconnections. For a long time, historians of empire tried to understand how Europe had become the center of a "world system" by examining the economic history of colonialism.[18] The perspective of Subaltern Studies tried to respond with an alternative take on the history of colonialism.[19] Social and cultural historians have complicated Western narratives of colonialism and showed their deep cultural, social and economic legacies.[20] Colonialism is what made the world "modern", if by modern we mean increasingly interrelated and if we admit that such "modernity" was born in the eyes of European beholders at the time of their encounters with "the Other."[21] The arrival of an increasing number of immigrants from their former colonies forced European historians to acknowledge not just how much Europe shaped the world, but how much it was shaped by other cultural perspectives in turn. The very notion of "Europe" and its social sciences have been considered the product of the interaction with the colonial and post-colonial world.[22] Historians of empire have focused on the economy and the social sciences, rather than European scientific knowledge.

Environmental historians combined for the first time a critique of colonial power relations, an appreciation for different cultural understandings of nature, and the analysis of global environmental transformations triggered by European colonialism.[23] Settlers' colonialism, ecological imperialism and the inscription of power relations in the North American landscape proved exemplary to examine how colonialism reshaped the environment elsewhere in the world, from the Caribbean to the Middle East.[24] Richard Grove masterfully highlighted the role of tropical islands from the Atlantic to the Indian Ocean in shaping cultural understandings of the environment as fragile ecosystems and showed how colonialism transformed European conceptions of nature in the early

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[17] Richard Grove, *Green Imperialism: Colonial Expansion, Tropical Island Edens, and the Origins of Environmentalism, 1600-1860*, 1st pbk. ed., Studies in Environment and History (Cambridge; New York: Cambridge University Press, 1996).

[18] See Immanuel Maurice Wallerstein, *The Modern World-System* (New York: Academic Press, 1974) and Fernand Braudel, *Civilization and Capitalism, 15th-18th Century* (London: Fontana Press, 1985).

[19] See Ranajit Guha and Gayatri Chakravorty Spivak, eds., *Selected Subaltern Studies* (New York: Oxford University Press, 1988).

[20] Edward W Said, *Orientalism*, 1st Vintage Books ed. (New York: Vintage Books, 1979). Dipesh Chakrabarty, *Provincializing Europe: Postcolonial Thought and Historical Difference* (Princeton: Princeton University Press, 2000).

[21] See Frederick Cooper and Ann Laura Stoler, eds., *Tensions of Empire: Colonial Cultures in a Bourgeois World* (Berkeley: University of California Press, 1997) and Frederick Cooper, *Colonialism in Question: Theory, Knowledge, History* (Berkeley: University of California Press, 2005).

[22] See Dipesh Chakrabarty, *Provincializing Europe: Postcolonial Thought and Historical Difference* (Princeton: Princeton University Press, 2000).

[23] See David Arnold and Guha Ramachandra, eds., *Nature, Culture, Imperialism: Essays on the Environmental History of South Asia* (Delhi and New York: Oxford University Press, 1995).

[24] See Alfred W. Crosby, *Ecological Imperialism: The Biological Expansion of Europe, 900-1900*, 2nd ed., (Cambridge and New York: Cambridge University Press, 2004). Donald Worster, *Rivers of Empire: Water, Aridity, and the Growth of the American West* (Oxford and New York: Oxford University, 1992); John Robert McNeill, *Mosquito Empires: Ecology and War in the Greater Caribbean, 1620-1914* (New York: Cambridge University Press, 2010); Diana K. Davis and Edmund Burke, eds., *Environmental Imaginaries of the Middle East and North Africa* (Athens: Ohio University Press, 2011).

modern period.[25] Climate historians in particular have been interested in the intersection between imperial and climate histories, as empires offered the first opportunity to engage local and global spaces at once.[26] With the benefit of hindsight, environmental historians have reconstructed how climate and empires interacted, but they have often overlooked how scientific knowledge emerged from those encounters.[27]

Similarly, historians of science investigated the relationship between local forms of natural knowledge and the universality of "science" by using empires as the first spaces of inquiry where these epistemological encounters took place for the first time.[28] The first step in this direction was to stop imagining the production of knowledge as an export of Western science spreading from Europe to the rest of the world. The origin of this turn lay in the rejection of the notion that colonial sciences were peripheral to scientific developments occurring in the metropole.[29] Over time, historians moved away from the center-periphery model and acknowledged that scientific knowledge and practices shape and are shaped by social, political and cultural relations.

The discovery that questions about the natural order were questions about the social and political order revolutionized the field of the history of science as well as science studies.[30] A focus on scientific practices and intellectual communities rather on than theoretical discoveries and isolated geniuses ushered in a new historiographical perspective that overcame the so called Needham question ("Why did the scientific revolution not happen in China?"), a point of view that tried to understand non-European scientific knowledge using European culture as universal standard of scientific rationality.[31] As a result of this new approach, historians explored the history of European science as the product of the circulation of data, specimens and instruments, and as "contact zones" with other cultures.[32]

The principle of the universality of science was clearly at stake in these debates. For example, historians like Lewis Pyenson denied that European sciences in the colonies were qualitatively different from those in Europe.[33] Against this perspective, historians

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[25] Richard Grove, *Green Imperialism*.
[26] Sam White, *The Climate of Rebellion in the Early Modern Ottoman Empire* (New York: Cambridge University Press, 2011). Geoffrey Parker, *Global Crisis: War, Climate Change and Catastrophe in the Seventeenth Century* (New Haven and London: Yale University Press, 2013).
[27] Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (London and New York: Verso, 2001).
[28] David Arnold, *Colonizing the Body: State Medicine and Epidemic Disease in Nineteenth-Century India* (Berkeley: University of California Press, 1993).
[29] See Nathan Reingold and Marc Rothenberg, eds., *Scientific Colonialism: A Cross-Cultural Comparison; Papers from a Conference at Melbourne, Australia 25-30 May 1981* (Washington, D.C. and London: Smithsonian Institution Press, 1987).
[30] See Jan Golinski, *Making Natural Knowledge: Constructivism and the History of Science* (Chicago: University of Chicago Press, 2005) and Shapin, Steven, *Leviathan and the Air-Pump: Hobbes, Boyle, and the Experimental Life.* (Princeton: Princeton University Press, 1985).
[31] See Joseph Needham, S. Irfan Habib, and Raina Dhruv, eds., *Situating the History of Science: Dialogues with Joseph Needham* (New Delhi and New York: Oxford University Press, 1999).
[32] See Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (New York: Palgrave Macmillan, 2007).
[33] See Lewis Pyenson, *Civilizing Mission: Exact Sciences and French Overseas Expansion, 1830-1940* (Baltimore: Johns Hopkins University Press, 1993); Paolo Palladino and Michael Worboys, "Science and Imperialism," *Isis* 84, no. 1 (1993): 91–102; Lewis Pyenson, "Cultural Imperialism and Exact Sciences Revisited," *Isis* 84, no. 1 (1993): 103–8.

questioned Eurocentric narratives in the history of science, or even the notion of "colonial science" as something separate from European science.[34] Stuart McCook proposed the notion of "creole science" to describe the production of knowledge in the Spanish Caribbean, while Helen Tilley recurred to the image of Africa as a laboratory and the metaphor of "vernacular science" to describe how form of knowledge are produced, used and adapted to different contexts.[35]

Among all scientific disciplines, the question of how local and global environments and their scientific observation come together is particularly key to understand the history of meteorology. As a scientific discipline, meteorology struggled for centuries to correlate local and elusive weather phenomena with global observations about the climate and universal laws of weather prediction. Because of its belated development in the nineteenth and twentieth centuries, far later than physics and chemistry, for example, intellectual historians and philosophers of science overlooked meteorology as an ancillary discipline without a long pedigree of captivating theoretical breakthroughs.

After the pioneering work of Jim Fleming and Vladimir Jankovic, the history of meteorology has become a burgeoning field, as I am witnessing myself as co-editor of the next issue of the journal *History of Meteorology*.[36] They used the notion of "intimate universality" to encompass the global and local features of the history of the discipline.[37] The instability of the weather and the fluctuations of the climate made meteorology stand out because they exposed the "limits" of Enlightenment rationality and human control over nature.[38] While European scientists in the nineteenth century resort to statistics, probability and international cooperation to make sense of a secularized atmosphere—where storms, hail and drought were no longer the product of God's will—today we rely on computer models and global agreements to find shelter from our shared, human vulnerability to weather extremes and climate change.[39]

The limit of all these narratives in the history of science, environment and empire is that they are written from the standpoint of Western liberal democracies, as if liberal techno-politics regimented science and colonialism. All these narratives come with a set

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[34] See Arun Bala, ed., *Asia, Europe, and the Emergence of Modern Science: Knowledge Crossing Boundaries* (New York: Palgrave Macmillan, 2012) and *The Dialogue of Civilizations in the Birth of Modern Science*, 1st ed. (New York: Palgrave Macmillan, 2006).

[35] See Stuart George McCook, *States of Nature: Science, Agriculture, and Environment in the Spanish Caribbean, 1760-1940* (Austin: University of Texas Press, 2002); Helen Tilley, *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950* (Chicago: University of Chicago Press, 2011).

[36] Vladimir Jankovic, *Reading the Skies: A Cultural History of English Weather, 1650-1820* (Chicago: University of Chicago Press, 2000); James Rodger Fleming and American Meteorological Society, eds. *Historical Essays on Meteorology, 1919-1995: The Diamond Anniversary History Volume of the American Meteorological Society* (Boston: American Meteorological Society, 1996); James Rodger Fleming, *Meteorology in America, 1800-1870* (Baltimore: Johns Hopkins University Press, 1990).

[37] Fleming, James Rodger, ed., *Intimate Universality: Local and Global Themes in the History of Weather and Climate*. Science-History Studies on Atmospheres, vol. 1 (Sagamore Beach: Science History Publications/USA, 2006).

[38] See Jan Golinski, *British Weather and the Climate of Enlightenment* (Chicago: University of Chicago Press, 2007).

[39] See Deborah R. Coen, *Vienna in the Age of Uncertainty: Science, Liberalism, and Private Life* (Chicago: University of Chicago Press, 2007) and Clark A. Miller, *Climate Science and the Making of a Global Political Order*, in Sheila Jasanoff, ed., *States of Knowledge* (New York: Routledge, 2004), 46-66.

of assumptions about the role of Western science and technology in creating the modern world, even when they are critical of European imperialism, of the entanglement between scientists and Europe's colonial projects, and of the ecological destruction caused by capitalist exploitation. That is why "modernity" and modernization theory have been such a crucial battleground at the intersection of the history of empire, environment, and science.

With the benefit of hindsight, these stories conflate the history of European colonialism with the history of capitalism, liberalism, and rational-scientific thought. They have illustrated—in Timothy Mitchell's words—the rational, modernist, and often environmentally disastrous techno-politics that Europeans set in place to extract profit from nature, maximize colonial labor, and produce a world organized according to economic principles.[40]

Often, historians have used the shortcut of adopting national case studies and ideologies to build connections between scientific communities, European empires, and colonial environments. Thus, science has become a crucial protagonist of the history of British imperialism and its colonial project of "improvement of the world."[41] The French civilizing mission would be unthinkable without the authority of technocrats involved in the restoration of Algeria as "the granary of Rome."[42] Andrew Zimmermann has called Wilhelmine Germany a model of scientific colonialism, because scientific proficiency was advanced as the main justification for German sovereignty in Africa.[43] In the early modern period, the pursuit of objectivity in the analysis of exotic commodities and natural specimens shaped Dutch scientific culture.[44] Nationalism plays a great role also in Iberian imperial sciences.[45] Unlike any other European empire, Italy has been overlooked because the traditional lenses of the history of colonialism as part of the expansion of capitalism fail to grasp its ecological history, namely the relationship between science, environment, and imperialism across two different techno-political regimes.

The continuity of Italian colonialism from the middle of the nineteenth century to World War II offers a unique laboratory of the metamorphosis of liberal imperialism into fascism, unlike the usually privileged focus on Germany. In vain historians have tried to find connections between early twentieth century German colonialism and the Nazis'

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[40] Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002). See also James C. Scott, *Seeing like a State: How Certain Schemes to Improve the Human Condition Have Failed* (New Haven: Yale University Press, 1998).

[41] See Richard Harry Drayton, *Nature's Government: Science, Imperial Britain, and the "Improvement" of the World* (New Haven: Yale University Press, 2000); Brett M. Bennett, and Joseph Morgan Hodge, eds., *Science and Empire: Knowledge and Networks of Science across the British Empire, 1800-1970* (New York: Palgrave Macmillan, 2011).

[42] See Diana K. Davis, *Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa* (Athens: Ohio University Press, 2007). Paul Rabinow, *French Modern: Norms and Forms of the Social Environment* (Cambridge: MIT Press, 1989).

[43] Andrew Zimmerman, "Ruling Africa. Science as Sovereignty in the German Colonial Empire and Its Aftermath," in *German Colonialism in a Global Age*, ed. Bradley Naranch and Geoff Eley (Durham and London: Duke University Press, 2014), 93–108.

[44] See Harold John Cook, *Matters of Exchange: Commerce, Medicine, and Science in the Dutch Golden Age* (New Haven: Yale University Press, 2007).

[45] See Jorge Caèanizares-Esguerra, *Nature, Empire, and Nation: Explorations of the History of Science in the Iberian World* (Stanford: Stanford University Press, 2006).

invasion of Europe.[46] Unsurprisingly, their analogies focused especially on the history of genocide and produced a lively debate about the history of violence, but it is hard to point to "hard" connections in terms of personnel, ideology, and institutions involved. The Italian case in contrast allowed me to watch the seamless transformation of liberalism into fascism.

Method and Concepts: Meteorology as Knowledge Infrastructure of Italian Techno-Political Regimes

I selected meteorology as the foundation of the first ecological history of Italian colonialism because it is a scientific discipline that uniquely combines the analysis of local and global phenomena. Moreover, its history requires the adoption of a methodology that is able to connect national, international, and global history. Thus, I use the concepts and methods of Science and Technology Studies to write history as part of the emerging interdisciplinary field of environmental humanities and inspire new research beyond Italy itself.

There is no history outside of the atmosphere that surrounds us and that is by definition already global. Food, specimens, public health, agriculture, diseases, navigation, trade, and wars were always affected by seasonal rhythms and regional climates. For European empires—the first political institution facing the complexity of climates on a global scale—ignoring the climate in new tropical environments was not just dangerous: it was impossible. Notions about the climate of the regions that Europeans crossed were usually their first observations and the base for any other prospect of colonial development. Since Humboldt, every traveler brought with himself a thermometer and a barometer.[47] Thus, the collection of meteorological data offers a unique vantage point to show how science and colonialism connected distant cultures and local environments, produced a global imperial world, and in turn this encounter changed scientific and environmental knowledge in Europe itself.

First, my study of meteorology builds on the analysis of hydro-politics, aridity, and the politics of water as a contested natural resource and explores their methodology in environmental history.[48] Meteorological observations were political acts due to their geography of knowledge, even just for the fact that they were collected in Africa. Thus, I followed the histories of climate, rainfall, and weather data to examine the locations where they came from, the environmental expectations that they revealed, and the role of local environments in shaping Italian scientific knowledge. Because the geographical spaces of Libya and the Horn of Africa are a critical part of this story rather than its silent background, I have re-located Italian colonial history from Europe to Africa.

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[46] See Benjamin Madley, "From Africa to Auschwitz: How German South West Africa Incubated Ideas and Methods Adopted and Developed by the Nazis in Eastern Europe," *European History Quarterly* 35, no. 3 (2005): 429–64. doi:10.1177/0265691405054218. See also Mark Mazower, *Hitler's Empire: Nazi Rule in Occupied Europe* (London: Penguin, 2009).

[47] See Andrea Wulf, *The Invention of Nature: Alexander von Humboldt's New World* (New York: Alfred A. Knopf, 2015).

[48] See Sara B. Pritchard, "From Hydroimperialism to Hydrocapitalism: 'French' Hydraulics in France, North Africa, and beyond," *Social Studies of Science* 42, no. 4 (2012): 591–615. See also Diana K. Davis, *The Arid Lands: History, Power, Knowledge* (Cambridge: The MIT Press, 2016).

Second, I chose meteorology as a "knowledge infrastructure" of Italian colonialism to interpret this discipline as a natural and social science of Italian colonialism at once.[49] Thanks to the ubiquity of weather, water, and meteorology in the history of European colonialism, I have broadened the label of "scientific experts" to include unknown colonial officers, doctors, and scientists in the broadest possible sense. Explorers, travelers, merchants, doctors, colonial officers, military and navy captains, and later geologists, geophysicists, engineers, and agronomists always recorded their experience, observations, and measurements of colonial climates. Because everyone could be a "colonial meteorologist" *ante litteram*, using weather data as the traces of their travels sheds light on the social fabric of colonialism. My method is to follow Edwards' invitation to "invert knowledge infrastructures" and trace their history to show not just their final results, but the hidden social processes that have been erased from view.[50]

The meteorologists that emerged from the archive of the Central Meteorological Office did not achieve any Nobel prize or produce any groundbreaking discovery. For the most part, they did not have prestigious political and intellectual connections, unlike the illustrious Exner family described by Deborah Coen.[51] They rarely expressed explicitly a wider political and intellectual worldview in their writings. They did not leave behind sophisticated scientific diaries. While not "subaltern" at all compared to their colonial subjects that bore the brunt of the results of their reports to Prime Ministers, colonial governors, and ultimately Mussolini, they belonged to a forgotten milieu between the rock stars described by intellectual historians of science and the military and political personalities preferred by political historians of empire. I decided to analyze them as if they belonged to the world of subaltern studies, namely by looking at their practices.

Their seeming marginality spurred me to make sense of their world and their work based not just on what they wrote and said, but also on what they did. This was a methodological revolution that forced me to work on modern history with the method of an early modernist or a medievalist, namely by navigating through poor, disorganized and spotty sources on a modern but abandoned archive. Thus, I found myself working like an anthropologist of the past, as any forgotten piece of paper—even if it dealt with menial tasks of scientific work rather than captivating scientific discoveries—revealed something about their practices, their mind, and the world that they were changing around them. In short, they constituted an invisible, but essential part of both the history of science and the history of Italian colonialism as they stood as intermediaries between

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[49] In Paul Edwards' words, "knowledge infrastructures comprise robust networks of people, artifacts, and institutions that generate, share, and maintain specific knowledge about the human and the natural worlds" P. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge: The MIT Press, 2010), 17.

[50] Knowledge infrastructures are based on communities with shared standards and values that allow them to produce consensus about scientific facts. Since weather observations must be collected and processed, meteorology is based on social networks because it is "a sociotechnical system that collects data, models physical processes, tests theories, and ultimately generates a widely shared understanding of climate and climate change." P. Edwards, *A Vast Machine*, 8. "Inverting the weather and climate knowledge infrastructures and tracing their history reveal profound relationships, interdependencies, and conflicts among their scientific, technological, social, and political elements. Over time, as knowledge production becomes infrastructural, these relationships become increasingly invisible, even as they continue to evolve" *Ibidem*, 22.

[51] See Deborah R. Coen, *Vienna in the Age of Uncertainty: Science, Liberalism, and Private Life* (Chicago: University of Chicago Press, 2007).

local and global research questions, nature and the state, and ultimately between Europe and Africa.

Finally, by examining meteorology as a practice of data collection and knowledge infrastructure, I reconstructed the logic of Italian colonialism, the production of different socio-technical imaginaries (settlers' colonialism, capitalist exploitation, and fascist autarchic imperialism) and the transformation of liberal techno-politics into a fascist techno-political regime.[52] This method allowed me to understand the different projects hidden in the palimpsest of Italian colonial history and find continuities amid the constant *pentimenti* ("repentances") covering the intentions of previous colonial projects.

I adopted Hecht's concept of "techno-political regimes" to examine liberalism and fascism as different configurations of science and politics that aimed at regulating, governing, and harnessing nature. Two factors support this choice. First, it is not a coincidence that the word "regime" is used both as "political" regime (e.g. fascism, communism, etc.) and as natural "regime" (for rainfall, rivers, etc.). The Latin root of the word (from *rex - regis*) is ultimately connected with the concept of sovereignty, namely the ability of a ruler (whether a king, institution, or social group) to issue norms, rules, and regulations for the management and control of natural regimes, such as the regularity or irregularity of natural resources.

Second, calling fascism a "techno-political regime" is more than just a pun with the word "regime." Without using this concept, fascism claimed to offer a radical alternative to liberalism in its way of organizing society and nature. At the core of fascism's project as "alternative modernity" placing the collective before the individual, political will above economic constraints, and state management above individual capitalist interests, there was an "integral" or integrated approach coordinating the natural and social world by authoritarian means.[53] The famous concept of *bonifica integrale*, or "total reclamation", makes no sense without reference to fascism's claim to be able to reorganize the social *and* the natural realm.[54]

Weather data—even when they were presented without any explicit explanation of why they were collected—are the silent traces of explorers' travels, the environmental imaginaries that they carried with them, and their colonial projects. Meteorology reveals how liberal and fascist techno-political regimes differed especially in their model of imperial organization of nature, knowledge, and society, competing for the control and management of natural *regimes*, in particular flows of water and rainfall.

Nineteenth-century liberalism assumed the indefinite productivity of nature and the endless ability of capitalism to harness its power and turn into commodities and capital. When facing environmental constraints, liberalism relied on science and technology to promote the flow of natural resources and multiply its reproductive capacity.[55] Meteorology in the liberal period mattered for agricultural purposes and the

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[52] Socio-Technical Imaginaries are "collectively held, institutionally stabilized, and publicly performed visions of desirable futures, animated by shared understandings of forms of social life and social order attainable through, and supportive of, advances in science and technology." Jasanoff, Sheila, ed. *Dreamscapes of Modernity. Sociotechnical Imaginaries and the Fabrication of Power* (Chicago: University of Chicago Press, 2015): 4.

[53] Roger Griffin, *A Fascist Century* (New York: Palgrave Macmillan, 2008).

[54] A great example of such approach was visible in fascism's "war against malaria": see Frank M. Snowden, *The Conquest of Malaria: Italy, 1900-1962* (New Haven: Yale University Press, 2006).

[55] Of course, the British empire is the best case where colonialism, capitalist development, the ideology of

settlement of Europeans. Liberal meteorology required the transmission of climate data in sets of ten days for their elaboration *a posteriori*.

The collection of data under fascism privileged military meteorology for aerial warfare. Fascism is an ideology of crisis whose environmental assumption is the lack or limited availability of natural resources. Fascism viewed the world as a closed system rather than an open space of opportunity, with competing ethnic groups and civilizations fighting for natural resources. As Adam Tooze has shown in the case of Nazi Germany, fascism's political economy was a zero-sum game where gaining resources meant conquering them from others, not producing them anew.[56] In this model, the state was a crucial actor to promote military expansion, plan colonial settlements, and centralize the organization of science and society around the modernist goal of fascism dominating nature.[57]

This fundamental assumption explains why imperialism and racial inequality are in the DNA of fascism, why authoritarian organization is necessary to coordinate the allocation of resources in the general interest of the nation (against other nations), and why fascism's "alternative modernity" proposed to use science and technology as means to organize nature as an integrated system for the renewal and rationalized exploitation of existing resources, rather than creating new ones (see the notion of *bonifica integrale*). In short, abundance is the premise of a liberal techno-political regime, whereas scarcity—or its perception—is the premise of fascism.

The centrality of fascism's environmental anxiety about space and resources explains also why fascism emerged in multiple countries at different times, with similar international characteristics and yet very peculiar, even local features. Volumes discussing the similarities and differences between Nazi Germany, fascist Italy, Franco's Spain, Salazar's Portugal, Horthy's Hungary, and World War II Japan can fill libraries, as similar techno-political approaches and ideological family resemblances contrast local cultures, contexts, and environments that these regimes faced and from which they emerged. Thus, I explore the rise of Italy's fascist techno-political regime not as an abstract ideology, but in the context of colonial management in Africa, at a different time of fascism's political rise in Italy.

Tiago Saraiva has recently described how fascism' different approach to the natural world drove the production and circulation of organisms across fascist regimes in Italy, Germany, Portugal, and their colonial empires.[58] Yet he presents fascist techno-politics as if they were born out of nowhere, or suddenly along with the political rise of the regime. Quite to the contrary, I contend that there are significant continuities between Italian liberal and fascist imperialism. The ecological history of Italian colonialism explains in the three dimensions of the history of empire, science, and environment how fascist techno-politics emerged from liberalism, while at the same time proposing a radically alternative model of modernization, colonization, and development.

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the "improvement of the world" and the use of liberal values and ideology went hand in hand. Offering a synthetic literature review here is beyond the scope of a footnote.

[56] J. Adam Tooze, *The Wages of Destruction: The Making and Breaking of theNazi Economy* (London and New York: Allen Lane, 2006). See also Mark Mazower, *Hitler's Empire: Nazi Rule in Occupied Europe* (London: Penguin, 2009).

[57] See Tiago Saraiva, *Fascist Pigs: Technoscientific Organisms and the History of Fascism* (Cambridge: MIT Press, 2016).

[58] Tiago Saraiva, *Fascist Pigs*.

Periodization, Structure, and Sources

Since I argue that the history of Italian meteorology in Africa reveals the transformation from liberal to fascist technopolitics as responses to the environmental challenges they faced in Africa, the dissertation is spatially organized to bring the reader on a journey across Italy's colonial empire. Beginning with the Horn of Africa more broadly in Chapter 1, Chapter 2 focuses on Eritrea. Chapter 3 shifts its attention to Libya and offers the first survey of international meteorology before the after the Great War. Chapter 4 returns to the Horn of Africa, in particular Somalia and Ethiopia. Throughout the dissertation, I stress how events on the colonies transformed Italy as well as the production of scientific knowledge.[59]

The periodization of the dissertation is structured on the basis of the transformation of liberal techno-politics into a fascist techno-political regime. Since I use the notion of "liberal" and "fascist" as techno-political regimes in the context of ecological history, my periodization differs from traditional political categorizations of "liberal Italy" as the period between the unification and the early twentieth century. Instead, I identify a hybrid period setting the origins of both techno-political regimes (1870-1896), the peak of the liberal techno-political regime (1897-1911), its crisis (1911-1931), and its transformation into fascist techno-politics (1919-1940).

In Chapter 1 (1870-1896), I explain the environmental and cultural reasons why Italians failed to conquer Ethiopia in late nineteenth century. I argue that Italians tried to exploit the ecological unraveling of the Ethiopian Empire due to years of drought, cattle plague, and famine to establish their protectorate over the Horn of Africa. In this period, they sowed the seeds of both liberal and fascist techno-politics between the middle of the nineteenth century and the battle of Adwa.

The perception of the landscape as empty and uncultivated sparked Italy's first projects of demographic colonialism in Africa and the socio-technical imaginary of Eritrea as a settlement colony, only to find out that the retreat of indigenous agriculture was a setback due to devastating but temporary environmental conditions. Divisions among competing colonization projects and the recovery of the Ethiopian Empire stopped Italian expansionism at the ecological peripheries of the fertile Ethiopian highlands, on the mountainous Eritrea and the arid Somalia. Adwa interrupted the linear history of Italian colonialism as accumulation of knowledge and power. It set problems of colonization that Italians tried to address by organizing their efforts first in a liberal and later in the fascist techno-political regime.

In Chapter 2 (1897-1911), I describe the creation of a liberal techno-political regime during the efforts of the liberal state to turn Eritrea and Somalia—the two bridgeheads left in Africa after the unsuccessful bid to conquer Ethiopia's highlands—into productive colonies. In such a techno-political paradigm, settlement plans for Italian emigrants were shelved for a later time and the economy became a paramount problem. The liberal State believed that Adwa's lesson was that more knowledge was necessary to

[59] The study of meteorology in the Dodecanese islands, Italy's colonial possession in the Aegean Sea, is unfortunately beyond the scope of this work. There, meteorological observations were collected by the navy and the meteorological observatory of Taranto by the meteorologist Luigi Ferrajolo, but the poor conditions of their archives did not allow to include them significantly in this history.

imitate the British and French and use science to make the most of the poor coasts of Eritrea and Somalia. As a matter of fact, the fifteen years between Adwa (1896) and the invasion of Libya (1911) were a period of observation, learning, and preparation for the following colonial war. Thus, chapter 2 describes the creation of those infrastructures of knowledge that allowed Italian colonialism to overcome the limits of the individualism, regionalism, and controversial projects of the previous age. Yet Italian liberal techno-politics were too little and too late to compete with the French and British for hegemony in Ethiopia.

In Chapter 3 (1911-1931), I describe how Libya became the colonial laboratory of the transformation from a liberal to a fascist techno-political regime. The successful organization of an epistemic community of scientific experts working with the State tried to help out in the colonization of Libya in 1911. The disappointment of the conquest of Libya, "the big sand box" as it was called at the time, exposed the limits of the liberal techno-political regime and confirmed the myth that plagued Italian liberal imperialism: Italy had only a few miserable colonies, did not profit from them, and therefore was only a victim of the colonial experience. The liberal state was unable to realize or deactivate the mirage of a settlement colony for Italian emigrants—a target originated before Adwa, during the ecological destruction of the Ethiopian empire. Fascism claimed to be able to fulfill that goal.

Libya shows that the seeds of fascism were sowed in the disillusionment with liberal techno-politics, in its inability to make Italian colonies productive, and in its failure to restore Italy's status in the world by gaining more colonial spaces. The destruction of the international paradigm of liberal meteorology in the Great War paved the way for the rise of a new, modernist, and more aggressive techno-political regime even before fascism took over power. As a crucial example of this change of gear within Italian colonialism and of the continuities between Italian liberal and fascist colonialism in Libya, I present the discovery of the creation of the meteorological service in Libya in 1919, which had the covert goal of using chemical weapons in Africa against Arab insurgents, an idea actually implemented during the 1935 conquest of Ethiopia.

In Chapter 4 (1919-1940) I move back to the Horn of Africa to examine how fascist techno-politics in that region emerged because of the frustration with the difficult development of the colonization of Somalia and Eritrea, the perception that critical water resources were beyond Italians' reach in Ethiopi—what I call "the hydrological problem of Ethiopia"—and the competition with the British Empire to extend Italy's influence in Ethiopia. My analysis of colonial meteorology shows that we can fully understand the struggle between Italy and the water-rich Ethiopia only by taking into account their competition for hegemony over crucial water resources in the Horn of Africa. The 1935 invasion of Ethiopia marked the final replacement of liberal meteorology with a new meteorological service devoted to military weather forecasting.

Fascism tried to complete the colonial project left unfinished at Adwa with the military occupation of the entire Horn of Africa. In such a techno-political regime, demographic and imperial goals (rather than immediate economic benefits) were at the forefront of the conquest. Finally, I show how the entanglement between scientific experts and Italy's two techno-political regimes would finally reshape Italian climate sciences themselves and lead to the marginalization of the liberal Central Meteorological Office.

Italian colonialism escapes linear narratives of European colonialism because liberal imperialism was suddenly stopped at Adwa and faced challenging environments and lack of resources in Eritrea, Somalia, and Libya. While liberal imperialism mutated in a more aggressive form in Libya already in 1919 in continuity with fascism, new fascist techno-politics would turn suddenly against the Horn of Africa to conquer new space and vindicate the sense of racial humiliation generated in 1896 at Adwa.

My goal is to show what in Science and Technology Studies is called the "co-production" of scientific knowledge and the ecological basis of liberal and fascist imperialism, as well as to reveal how African geographies produced the entanglement between scientific knowledge and Italian colonialism on the ground.[60] In short, this is the first history of Italian colonialism seen from its African colonies and from the global perspective of the history of the climate sciences.

The archive of the Central Meteorological Office provided the traces of many of the histories that I unveil for the first time ever in this research, but it could not explain the broader reasons of its abandonment. Therefore, the ecological history of Italian colonialism required to put the archive of the Meteorological Office in dialogue with other archives in Italy and abroad, as well as other types of sources, such as oral interviews.

In Italy, I carried out research at the Italian National Archive (*Archivio Centrale dello Stato*) and the archives of Aeronautics and the Chief of Staff (Ministry of Defense), the archives of the *Istituto Agronomico per l'Oltremare* and the Ministry of Foreign Affairs, and the archive and library of the Italian Geographical Society. In Rome, I consulted the National library, the Library of the Ministry of Agriculture, and the Library of Modern and Contemporary History. I also benefited from the sources available in the libraries of the Departments of Agriculture at the Universities of Naples and Perugia, as well as the International Institute of Agriculture at the Food and Agriculture Organization of the United Nations.

In the United States, I consulted the Archive of the Carnegie Institution for Science and the Department of Terrestrial Magnetism in Washington D.C. and I greatly benefited from the work of librarians at the University of California, Berkeley. In England, I visited the British National Archive in Kew and the British Library. In Norway, I examined the papers of the founder of modern meteorology, Vilhelm Bjerknes, at the National Library in Oslo, and visited the University of Bergen during the workshop "Climate in Meteorology, Meteorology in Climate Studies."

I would like to thank particularly Ms. Maria Carmen Beltrano and Director Luigi Perini for letting me access the documents of the Central Meteorological Office. I also found invaluable support and a great deal of published materials thanks to Mirella Petitto Eredia, the granddaughter of the meteorologist Filippo Eredia. This work would have never seen the light had I not interviewed the sons of the Director of the colonial meteorological service in Libya, Ugo and Annibale Fantoli. The account of their father's story as a daring meteorologist, empire-builder, and prisoner of war during World War II, and their courage to describe the military origin of the colonial meteorological service in Libya for the use of chemical weapons convinced me to pursue this research further, until

[60] See Jasanoff, *States of Knowledge*. See also David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003.

I discovered the abandoned archive the Central Meteorological Office, which proved them right.

CHAPTER 1

Empire, Drought, and Famine: The Climate Sciences and the Ecological History of Early Italian Colonialism (1870-1896)

"When the war broke with [...] Abyssinia,
the Colony [Eritrea] was strengthened
by the test of combat [...].
Nevertheless, a storm thickened far away
on the mountains southward.
The most tragic and strange circumstances
united to prevent us from forecasting,
avoiding, and dividing the invasion."
General Oreste Baratieri (1898)[61]

1.1 Introduction: Ecology and Techno-Political Regimes of Italian Colonialism

This chapter intends to debunk two foundational misconceptions about Italian colonialism by examining the origins of Italy's liberal and fascist techno-political regimes.[62] First, the fascist myth that Italian colonialism was an empire of emigrants, whose goal in Africa was to give land to Italian peasants and find a demographic outlet for the Italian population, had its roots in Italian colonial imagination and policies of the late nineteenth century. Indeed, the first settlements of Italian peasants in Africa that would later inspire fascist colonial projects were first tested in the 1890s.

Second, the liberal-economic notion that Italy was an unlucky colonial power, because its poor colonies did not provide any economic profit, was born as well between the middle of the nineteenth century and the 1896 defeat of the battle of Adwa against Ethiopia. Both myths fundamentally disguise the predatory nature of Italian plans to control the natural resources of the Horn of Africa. Yet it is evident that they contradict one another. How could Italians complain about the poor environments that they were colonizing and at the same time claim that their mission in Africa was to create a settlement colony where their peasants would find future prosperity?

Colonial climates figured prominently in debates about whether the Horn of Africa was rich of natural resources for capitalist exploitation or whether it could host Italian peasants for a settlement colony. Some geographers argued that Ethiopia was a rich and fertile country, whose climate enjoyed abundant rainfalls and was very suitable to Europeans. Other explorers reported

[61] Oreste Baratieri, *Memorie d'Africa (1892-1896)* (Turin: Fratelli Bocca, 1898) iv.

[62] As explained in the Introduction, a "techno-political regime" consists of "linked sets of people, engineering and industrial practices, technological artifacts, political programs, and institutional ideologies." See Gabrielle Hecht, *The Radiance of France: Nuclear Power and National Identity after World War II* (Cambridge: MIT Press, 1998), 16. See also Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002).

that the region was dry and poor. Who was telling the truth? Did supporters of colonization lie about Ethiopia's climate in order to promote Italian imperialism? What about scientific experts? Were they complicit with the Italian colonial project?

Investigating European knowledge of Ethiopia's environment in the nineteenth century and the entanglement between meteorologists, geographers, and colonial officers with Italian colonialism is crucial to understand the early history of both liberal and fascist techno-political imperialism in Africa. Angelo Del Boca, the most critical historian of Italian colonialism, accused Italy's government of feeding the public "an image of Ethiopia that was completely fake," namely "a fabric of inaccuracies and lies produced by legions of pseudo-explorers, pseudo-scientists, pseudo-diplomats, pseudo-experts."[63] Yet, how could all Italian scientists and explorers be "pseudo-experts"?

In this chapter, I argue that disagreements about the climate and natural resources of Ethiopia fostering arguments in favor of and against Italian colonial settlement were due to a combination of *ecological* and *social* factors.

First, Italian colonial experts were divided in a number of regional scientific communities that did not yet constitute an epistemic community working with the state. The political scientist Peter Haas coined the term "epistemic community" to describe "a network of professionals with recognised expertise and competence in a particular domain and an authoritative claim to policy relevant knowledge within that domain or issue-area. [...] They have a shared set of normative and principled beliefs […] shared causal beliefs […], shared notions of validity [...], and a common policy enterprise."[64] As Paul Edwards has shown, the relationship between knowledge production and policy-making is more dialectical than the linear model of "epistemic communities" would suggest.[65] Italy had barely achieved its political unification when it started its colonial campaigns and its scientists did not share a common "policy enterprise" because they disagreed on Italy's colonial mission in Africa.

Most importantly, Italians' distrust in one another across geographical and scientific communities caused constant disagreement on the validity of their own geographical reports and climate data. Knorr Cetina describes how scientists need to build "epistemic cultures" to validate their results.[66] Producing scientific knowledge is difficult because it requires a social effort to analyze and validate data before turning them into reliable and "objective" scientific knowledge. Controversies can be recomposed only within a scientific community whose truth-making rules and values are universally accepted.[67]

This problem was exacerbated when it came to producing data about distant *colonial* environments, because they were so far from Europe that naturalists had to find criteria of

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[63] Angelo Del Boca, *Gli italiani in Africa Orientale*, v. I. (Milan: Mondadori, 1999) 878.
[64] Peter Haas, "Introduction: Epistemic Communities and International Policy Coordination," *International Organization* 46 (1992), 3. Knorr Cetina has also promoted the notion of "epistemic cultures," see *Epistemic Cultures* (Cambridge: Harvard University Press, 1999).
[65] Clark A. Miller and Paul N. Edwards, eds., *Changing the Atmosphere: Expert Knowledge and Environmental Governance* (Cambridge: MIT Press, 2001).
[66] Karin Knorr Cetina, *Epistemic Cultures: How the Sciences Make Knowledge* (Cambridge: Harvard University Press, 1999).
[67] Steven Shapin, *A Social History of Truth: Civility and Science in Seventeenth-Century England*, 1 ed. (Chicago: University of Chicago Press, 1995).

verification and truth in order to distinguish reality from propaganda.[68] In *Empire and Information* Christopher Bayly has argued that "successful intelligence-gathering was a critical feature of the British domination of India."[69] The British developed over time "standards of credibility and authenticity [that] were never fixed and inviolate but were defined, at turns, by social context, individuals' expectations, disciplinary conventions, and audience demand."[70] The major difference between Italy and England in the second half of the nineteenth century was that Italians—fragmented in multiple geographical and scientific communities—could not come to any "objective" conclusion about their colonies. Until the creation of an Italian liberal techno-political regime—which I discuss in Chapter 2—even weather data about Ethiopia's climate remained controversial and untrustworthy. Thus, I take seriously the collection of weather data and information by Italian colonial explorers to examine the relationship between scientists, the environment, and the state.

Second, there is also an ecological set of reasons that explains the divergence of Italian travel accounts picturing Ethiopia as a country at once rich and poor, fertile and dry. The environment that Italian explorers described was changing before their eyes. The Horn of Africa is a land of environmental extremes characterized by fertile highlands and deep deserts. European geographical reports often described a static picture of the environmental features of the country that did not account for the occurrence of droughts, such as the devastating "Great Ethiopian Famine" (1888-1892) that took place right at the time of Italian invasion. Moreover, the arrival of Italian troops, animals, and diseases contaminated the very nature they intended to colonize before they could even see it. As I will show, the "Great Ethiopian Famine" was a social as much as a natural social disaster. In short, Italian accounts of Ethiopia's climate and resources differed from one another because they did not account for the extreme ecological diversity of the Horn of Africa and for the dynamic ecological transformations that colonialism itself was producing. While European sciences captured static snapshots of Ethiopia's climate through weather data and explorers' accounts, the natural environment changed dynamically as a result of European invasion. Ethiopia's changing climate was a moving target that Italian colonial meteorology struggled to represent in numbers and charts.

In order to capture the co-production of Italian imperialism, Italy's climate sciences, and Ethiopia's colonial ecologies, I first describe the peculiar climatological characteristics of the Horn of Africa. Next, I compare Italian colonial literature with British and French practices of exploration of Ethiopia, in order to show the peculiarly conflictual character of Italian explorers. Section 2 shows how such divisions undermined any possibility of agreement among Italian scientists even for the definition of the climate of a small area like the bay of Assab, Italy's first colony in Africa. Section 3 describes how the arrival of Italian troops in Massawa amid a devastating drought disrupted the ecology of the Ethiopian highlands and allowed the creation of

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[68] See Charles W. J. Withers, "Voyages et Crédibilité. Vers une Géographie de la Confiance," *Géographie et Cultures* 33 (2000): 3-17 and Mary Louise Pratt, *Imperial Eyes: Travel Writing and Transculturation* (New York: Routledge, 1992).

[69] Christopher Bayly, *Empire and Information: Intelligence Gathering and Social Communication in India 1780-1870* (Cambridge: Cambridge University Press, 1999), 365.

[70] Innes M. Keigheren, Charles W.J. Withers, and Bill Bell, *Travels into Print: Exploration, Writing, and Publishing with John Murray, 1773-1859* (Chicago: Chicago University Press, 2015), 72.

the colony of Eritrea. Finally, I show that the persisting disagreement between conflicting Italian projects of colonization caused the Italian defeat of Adwa in 1896.

Ultimately, my argument is that both the liberal and the fascist techno-political regimes tried in different ways to address the problems left unsolved at Adwa, namely the failed conquest of Ethiopia's water and highlands. In short, this chapter is an environmental history of early Italian colonialism and a history of Italian climate sciences showing the entanglement between African environments, scientific knowledge and colonial politics.

1.2 Ethiopia's Climates and European Explorations (1770s-1870s)

The Horn of Africa is a land of extremes that make Ethiopia a fertile and vulnerable country at once. The Ethiopian highlands are an ecologically diverse region created by the geological movements of the Rift Valley. Difference in altitude determines dramatic contrasts in average temperature and climate. Lowland deserts towards the coast of Somalia and Djibouti, the Danakil desert in the north-east, and the mountains of Eritrea were the main obstacle for European travelers trying to reach the country from the coast.

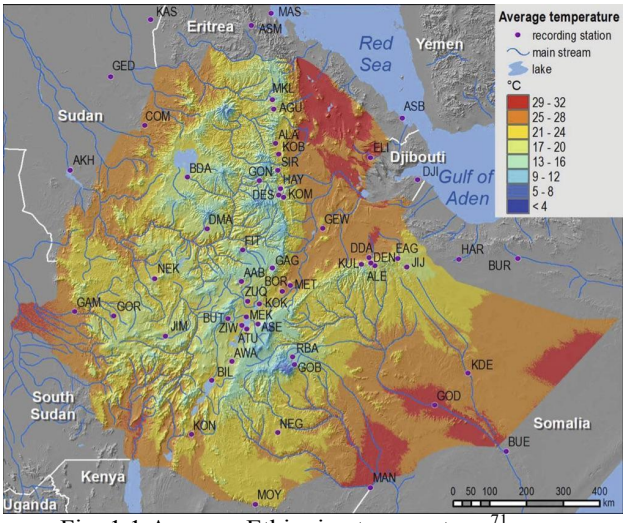

Fig. 1.1 Average Ethiopian temperature.[71]

Meteorology is crucial to understanding climate and agricultural regime of the area, because rainfall is the most important climatic element that influences Ethiopian agriculture.[72] There are three seasons in Ethiopia. The highlands receive a considerable amount of water in two rainfall seasons, called in Amharic *Kremt* or summer rains (May-August) and the *Belg* (February-May), the spring rains. The *Bega* (October-January) is the harvest season. During the

[71] From Massimiliano Fazzini, Carlo Bisci, and Paolo Billi, "The Climate of Ethiopia," in *Landscapes and Landforms of Ethiopia*, ed. Paolo Billi (Springer: World Geomorphological Landscapes, 2015), 67, f. 3.1.
[72] Workineh Degefu, "Some Aspects of Meteorological Drought in Ethiopia," in *Drought and Hunger in Africa. Denying Famine a Future*, eds. Michael H. Glantz, and National Center for Atmospheric Research (U.S.), (Cambridge and New York: Cambridge University Press, 1987), 23–36.

summer rainfall season, travel and transportation across the country became impossible. Interacting with the altitude of reliefs, rainfalls variability is the most important factor determining the climate, agricultural regions, and natural resources of each region.

This rainfall pattern makes Ethiopia's environment a fertile but fragile ecology. *Belg* and *Kremt* rains allow two harvests every year of annual crops (tef, wheat, barley), but expose the country to extreme vulnerability to drought in case of El Niño cycles and rain failures, as we have seen during more recent famines in the 1970s and 1980s.[73] 85-95% of food crops are produced during the *Kremt*, but long-season crops (maize and sorghum) are planted during the *Belg* season and their failure can be particularly devastating. The northern Tigray region, the historical heartland of the Axumite Empire, is particularly drought-prone because precipitations move from the Southeast and Southwest to the North. In short, the climate of Ethiopia varies by extremes in space between different regions, but also in time depending on the yearly timing of the two rainfall seasons.

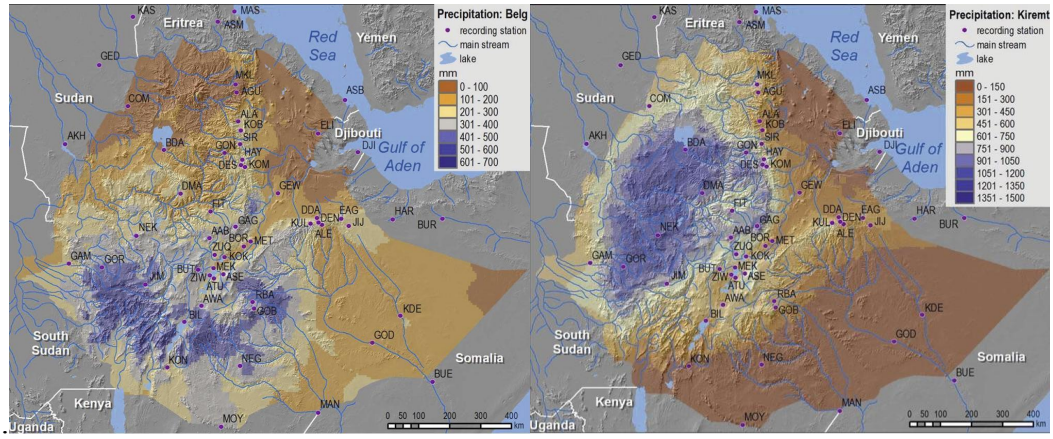

Fig. 1.2 and 1.3: Geographical Distribution of the Precipitation of *Belg* and *Kremt* Rainfalls.[74]

The regional concentration of the rainfalls in the south-west of the country contributes to 84% of the Nile's hydrographic basin, producing the famous seasonal floods of silt that fertilized Egypt's agriculture. On the other hand, no significant river reaches the coasts of the Red Sea to the north and the Gulf of Aden to the east, because the Awash river fills an endorheic basin southwest of Djibouti. Only the seasonal Shebelle River flows southward into the Indian Ocean. As a result, Ethiopia's highlands are like an agricultural bastion surrounded by a coastal belt of deserts and mountains. The challenge for European explorers discovering Ethiopia was to cross the ecological periphery of the Ethiopian empire that granted Ethiopians isolation and independence for centuries.

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[73] See Masfen Waldamāryām, *Rural Vulnerability to Famine in Ethiopia: 1958-1977* (London: Intermediate Technology, 1986).

[74] From Massimiliano Fazzini, Carlo Bisci, and Paolo Billi, "The Climate of Ethiopia," in *Landscapes and Landforms of Ethiopia*, ed. Paolo Billi (Springer: World Geomorphological Landscapes, 2015), 78-9, figg. 3.10 and 3.11.

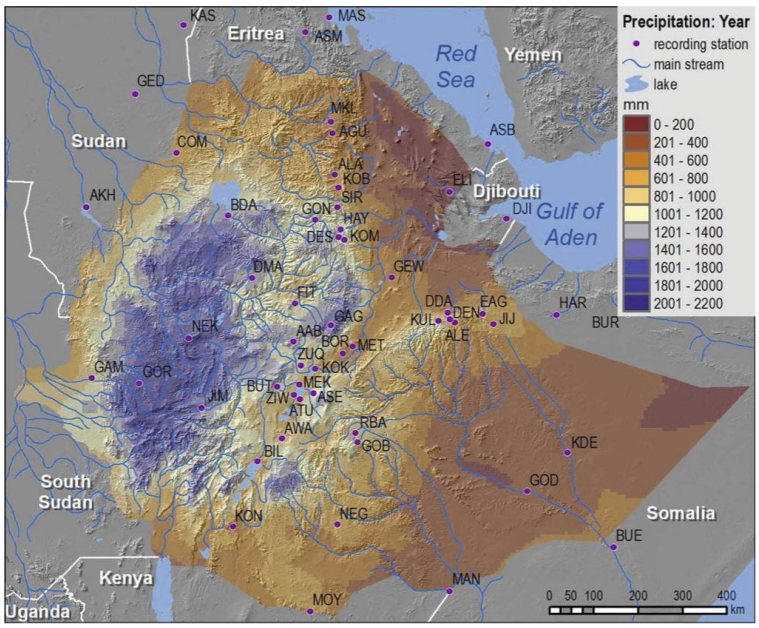

Fig. 1.4: Ethiopia. Distribution of annual precipitation.[75]

In addition to the peculiar geography of the region, there were three factors that made European literature of exploration in the region different from any other. First, Ethiopian nature refuted European exoticizing stereotypes of African wilderness. Ethiopians had transformed the landscape through centuries of agricultural practices. What made Abyssinia "exotic" was its geographical isolation, not its pristine nature. Cut off from the rest of Christianity during the Arab expansion in North Africa, Ethiopia was one of the most unknown regions in the world to nineteenth-century Europeans. Scientific information from missionaries—a traditional support for colonial powers—was very little because Ethiopians had expelled the Jesuits in the fifteenth century. Even after French missionaries received permission to settle in the region, the clergy was hostile to Italian liberal elites because of the conflict between the Pope and the new Italian State.[76] Until the early twentieth century, Italians could not rely on scientifically educated missionaries for information about African countries, unlike the British, French and German empires.[77]

[75] From Massimiliano Fazzini, Carlo Bisci, and Paolo Billi, "The Climate of Ethiopia," in *Landscapes and Landforms of Ethiopia*, ed. Paolo Billi (Springer: World Geomorphological Landscapes, 2015), 77, fig. 3.7.
[76] The *Memoirs* of the highest ranking Italian prelate in Africa, Cardinal Massaia, did not include any scientific information, because "I did not go there [to Ethiopia] as a traveler cultivating scientific research, but as a missionary of Jesus Christ… To get busy with such studies—which are not the goal of a Catholic missionary, even if they are useful—would be a betrayal of God, of the Church, and its souls." Guglielmo Massaia, *I miei trentacinque anni di missione nell'Alta Etiopia. Memorie Storiche* (Rome: Tipografia Poliglotta di Propaganda Fide, 1885) xii.
[77] See Uoldelul Dirar, "Church-state relations in colonial Eritrea: missionaries and the development of colonial strategies (1869-1911)," *Journal of Modern Italian Studies* 8, no. 3 (2003): 391-410.

Furthermore, Europeans recognized that Abyssinia was unlike any other African country. Ethiopians were neither a "people without history" nor a "natural people" without culture.[78] Ethiopia was a multi-ethnic kingdom with a sophisticated written culture and a fairly well-documented history. Indeed, Ethiopia was the first country to adopt Christianity as a state religion in antiquity, along with Armenia. "Few peoples on the earth can boast such a glorious history as the Ethiopians," wrote the explorer Pellegrino Matteucci.[79] From the Europeans' point of view, Ethiopians had fallen behind over time, but their civilization posed questions of cultural hierarchy more similar to British imperialism in India than European colonialism in Africa. Ethiopians treated Europeans like peers and fellow Christians without any civilizational superiority. Italy's claims of colonial superiority over Ethiopia were weak and embarrassing vis-à-vis Ethiopia's history and culture.

Lastly, the strongest difference between Italian travel accounts in Ethiopia and those produced by other European countries was their very controversial and polemical standpoint, despite the claim of being trustworthy witnesses.[80] A comparison with British and French explorers in the same region highlights the peculiar divisions among Italian scientific experts and shows how other European powers with a longer history of colonial exploration solved issues of trust in travel accounts and colonial literature.[81]

Problems with the reliability of travel accounts occurred in the British Empire until the late eighteenth century. For example, James Bruce, the British consul in Algiers, travelled to Ethiopia between 1769 and 1773 and claimed to have discovered the source of the Nile, but his account was not believed in England at the time.[82] In the nineteenth century, British informants travelled to several areas of east Africa, but the most important contact between the British Empire and Ethiopia was a military expedition in 1867-1868 to rescue 61 hostages captured by the King Tewodros, including the British consul Duncan Cameron.[83] An Anglo-Indian army of thirty-two thousand men led by Lord Robert Napier landed in Massawa, on the northern coast of Eritrea. The mission was so expensive (a total of 9 million pounds to build roads across miles of mountains for what was called "the most expensive affair of honor in history") that the British withdrew content of replacing Tewodros with the Dej Kassa of Tigray, who took the imperial

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[78] See Eric R. Wolf, *Europe and the People without History* (Berkeley: University of California Press, 2010). Seel also Andrew Zimmerman, *Anthropology and Antihumanism in Imperial Germany* (Chicago: University of Chicago Press, 2001).

[79] Pellegrino Matteucci, *In Abissinia; viaggio* (Milan: Fratelli Treves, 1880), 1.

[80] On the importance of trust in science and technology Studies, see Theodore M. Porter, *Trust in Numbers: The Pursuit of Objectivity in Science and Public Life* (Princeton: Princeton University Press, 1996).

[81] Richard Pankhurst, ed., *Travelers in Ethiopia* (London: Oxford University Press, 1965). Pankhurst did not select any French and Italian travelers to Ethiopia for the 19th century in this collection.

[82] James Bruce, *Travels to Discover the Source of the Nile, In the Years 1768, 1769,1770, 1771, 1772 and 1773* (London: G.G.J. and J. Robinson, 1790). See also Miles Bredin, *The Pale Abyssinian: A Life of James Bruce, African Explorer and Adventurer* (London: Harper Collins, 2000) and J.M. Reid, *Traveler Extraordinary: The Life of James Bruce of Kinnaird* (London: Eyre&Spottiswoode, 1968).

[83] After Bruce, Pankhurst lists the trips of Henry Sault on behalf of the British Government in 1805 and 1809-1810, but his travels were limited to the Tigray region; a British naval surgeon, Charles Johnston, visited the Shewa region in the 1840s; Richard Burton visited Harar in 1855; Walter Plowden was appointed first British Consul of Abyssinia in 1848; Henry Dufton visited in 1862-3; Clements Markham travelled with the 1867 military expedition. See Richard Pankhurst, ed., *Travellers in Ethiopia* (London: Oxford University Press, 1965).

title as Johannes IV.[84] Ever since, British direct control never went farther than the coastal city of Zeila in British Somaliland, the access point for trade between the Red Sea and inland Ethiopia that they cheaply administered from Aden in Yemen. In other words, Ethiopia was an inland fortress surrounded by mountains and deserts that was impossible to control for a maritime superpower like the British Empire.

Among all European empires, France was the best organized to produce knowledge about Ethiopia thanks to several scientific expeditions that were commissioned, organized, and eventually rewarded by the State. Edmond Combes (1812-1848) and Maurice Tamisier travelled to Ethiopia between 1835 and 1837.[85] Pierre Victor Ferret and Joseph German Galinier were both awarded the Legion of Honor after their return from a trip to Ethiopia where they had been sent by the Ministry of Foreign Affairs in 1839.[86] The naval officer Charlemagne Théophile Lefebvre (1811-1960) coordinated a sophisticated scientific expedition between 1839 and 1843 that brought back important scientific data, despite the death of many of its members.[87] The most impressive and successful French naturalist in Ethiopia was Antoine D'Abbadie (1810-1897), the founder of the French Meteorological Society.[88]

Influenced by Humboldt and Gauss, D'Abbadie was interested in terrestrial magnetism and was sent to Ethiopia by his teacher, François Arago. He travelled with his brother Arnauld to Massawa in 1837. In order to produce the first modern map of Ethiopia, D'Abbadie invented a system called "expeditionary geodesy" that was based on networks of geodetic triangles. For twelve years Abbadie travelled across Ethiopia charting the territory with such method. The Abbadie brothers wore local clothes, adopted indigenous habits and managed to gain the trust of local chiefs, which was indispensable to study the country. Upon their return to France, the French scientific community rewarded them.[89] In short, Abbadie was successful in such geophysical work because he relied on local social networks in Ethiopia. The structure of French scientific institutions validated it as reliable and scientific knowledge.

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[84] Harold Marcus, *A History of Ethiopia* (Berkeley: University of California Press, 2002), 69-72.

[85] Edmond Combes and Maurice Tamisier, *Voyage en Abyssinie* (Paris: L. Desessart, 1838).

[86] They produced the first geological maps of the region and collected some meteorological observations between 1840 and 1841. See Pierre Victor Ferret and Joseph German Galinier, *Voyage en Abyssinie dans les Provinces du Tigré* (Paris: Paulin, 1847-1848).

[87] Charlemagne Théophile Lefebvre, *Voyage en Abyssinie: exécuté pendant les années 1839, 1840, 1841, 1842, 1843 par une commission scientifique composée de Théophile Lefebvre, A Petit et Quartin-Dillon, Vignaud; publié par ordre du Roi, sous les auspices de le vice-admiral Baron de Mackau, Ministre de la Marine* (Paris: Arthus Bertrand, Libraire de la Société de Géographie, 1845-1851), vv. 6.

[88] See Lewis Pyenson, *Civilizing Mission. Exact Sciences and French Overseas Expansion 1830-1940* (Baltimore: John Hopkins University Press, 1993) 24. Gaston Darboux, *Notice Historique sur Antoine d'Abbadie*, "Mémoires de l'Académie des Sciences de l'Institut de France," v. 50, Paris, Gauthier-Villars, 1908, n. 2, pp. i-xlii. Antoine d'Abbadie, *Sur le tonnerre en Éthiopie* (Paris: Imprimerie Impériale, 1859); Id., *Climat des Rivages de la Mer Rouge* (Paris: Cosmos 1868); Id., *Géodésie d'une partie de la Haute Ethiopie* (Paris: A. Bertrand, 1861); Id., *Géographie de l'Ethiopie: ce que j'ai entendu, faisant suite à ce que j'ai vu* (Paris: Mesnil, 1890); Arnaud D'Abbadie, *Douze ans de séjour dans la Haute-Ethiopie (Abyssinie)* (Rome: Biblioteca Apostolica Vaticana, 1868).

[89] Antoine received a silver medal in 1837 and a gold medal from the French Geographical Society in 1850, along with the Legion of Honor. Finally, Antoine was elected to the Academy of Science in 1867.

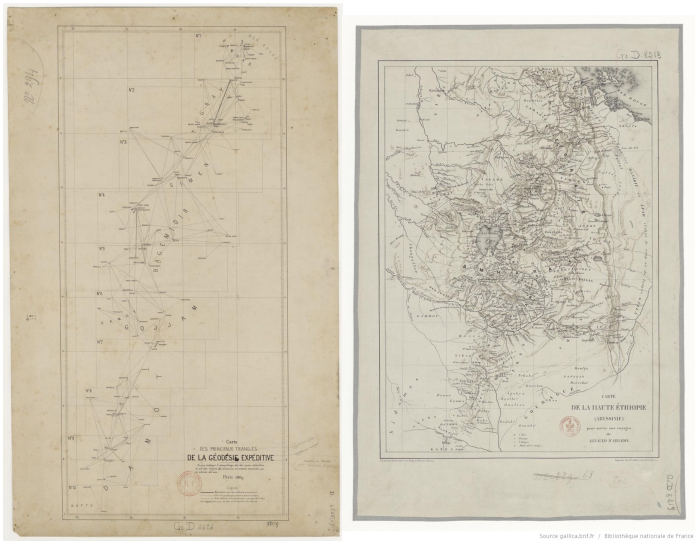

Fig. 1.5: These two maps show Abbadie's method of the "expeditionary geodesy." In the image on the left, ten maps of triangles created a network spanning from the Red Sea (in the north) to the region of Kaffa (in the South). By filling such triangles with information gathered during his trips, Abbadie could chart in extensive detail the map of Ethiopia in 1868 (see image to the right).

Thanks to the studies of the Abbadie brothers, the French scientific community understood that geography shaped Ethiopia's social and political characteristics. Mountains and insalubrious rivers divided regions rather than connecting them, especially during the rainfall season. Such geographical features had protected Ethiopia and its Christian faith from foreign invasions, such as Muslim Somalis. However, the rugged nature of the region favored internal divisions between the formal authority of the emperor and local kings: "the partition of the soil, which isolated inhabitants, created something similar to a European feudal system."[90] Thus, French influence in the region came later with the creation of a railroad for communication between Addis Ababa and Djibouti, on the coast of French Somaliland. In other words, French imperialism was a process of cumulative knowledge, because it infiltrated local networks and relied on a rewarding infrastructure of knowledge back in Europe.

Unlike France and England, Italians did not act with a single strategy in their exploration of Ethiopia. The fragmentation of Italy's institutional infrastructure of knowledge in a number of regional scientific and geographical communities translated into a lack of consensus about the geography and natural environment of Ethiopia. The modern Italian state was a recent creation, proclaimed in 1861. Nineteenth-century Italy had three different geographical societies, located respectively in the center, north, and south of the country: The Società Geografica Italiana in Florence—which was later moved to Rome; the Società di Esplorazione Commerciale in Africa in Milan; and the Club Africano in Naples.[91] Regional groups competed for the State's

[90] Gaston Darboux, *Notice Historique sur Antoine d'Abbadie*, xvi.
[91] The *Club Africano* was created in 1880 and renamed two years later as Società Africana d'Italia. The Milan Society was funded in in 1879. Later there were the Association of Commercial Geography in Bari; the Committee

attention.[92] Universities lagged behind and the most prestigious agricultural-scientific institutions were local scientific academies founded in pre-unitarian states that did not benefit by the rise of natural history catalyzed by colonial expansion, like in England and France.[93] Museums of natural history resembled private collections more than research institutions and were organized as civic museums.[94] As a result, Italy lacked a central scientific archive and the institutional infrastructure to collect environmental knowledge about Africa in the middle of the nineteenth century.[95] The State's access to information and the collaboration among Italian naturalists was difficult, erratic, and controversial.

Colonial scientific institutions matter because they allow the collection, centralization, and de-personalization of knowledge and power. In Victorian England, African explorations were organized by "private individuals of high social standing who worked mainly to outdo their rivals and realize their personal ambitions. Controversy was of the essence in order to ensure the dynamic of the geographical enterprise."[96] However, differences in opinion were recomposed "within the discussion spaces of the Royal Geographic Society and the British Association for the Advancement of Science."[97] These organizations played a major role in the diffusion and legitimization of colonial reports in the British Empire, so that the public was confronted with "a textbook account of consensual, cumulative knowledge formation, the success—and indeed the very possibility—of which required the foreclosure of all dispute, and a degree of control over the material and social world which was beyond the means of individuals."[98]

As individuals, Italian explorers were often good naturalists, but they lacked organization as a community. Italian scientists had been agents of national unity before the unification thanks to a series of national congresses between 1837 and 1849.[99] However, "neither their structure nor goals made such periodical meetings of Italian scientists even close to a cultural-scientific

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for Explorations in Africa in Turin; the Society of Exploration in Genoa—connected to the local Museum of Natural History. See Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 53.

[92] Anna Milanini Kemény, *La Società d'Esplorazione Commerciale in Africa e la Politica Coloniale (1879-1914)* Florence: La Nuova Italia, 1973,), 52-53. Roberto Battaglia, *La Prima Guerra d'Africa* (Turin: Einaudi, 1958), 107-9.

[93] For example, the Accademia dei Georgofili in Florence (founded in 1753), the Royal Academy of Agriculture in Turin (1785), the Regio Istituto d'Incoraggimento in Naples (1806), the Società Agraria in Bologna (1807), the Accademia Agraria in Pesaro (1829), the Associazione Agraria Friulana in Udine (1847). Such academies were elitist institutions of peers whose permanent members had to be residents of the city where the institution was based. See Alberto Mario Banti, *Storia della borghesia italiana: L'età liberale* (Rome: Donzelli, 1996), 81.

[94] Italy still does not have today a centralized national museum of natural history. See Lucio Russo, *Ingegni Minuti: Una Storia Della Scienza in Italia* (Milan: Feltrinelli, 2010), 319.

[95] The physicist, meteorologist, and Senator Carlo Matteucci tried in vain to cut the number of universities and turn the Museum of Natural History in Florence—his hometown and the capital of the kingdom between 1866 and 1870—into a national institution. Russo, *Ingegni Minuti*, 342-47.

[96] Kapil Raj, *Relocating Modern Science: Circulation and the Construction of Knowledge in South Asia and Europe, 1650-1900* (New York: Palgrave Macmillan, 2007), 208.

[97] Lawrence Dritsas, "Expeditionary Science: Conflicts of Method in Mid-Nineteenth Century Geographical Discovery," in *Geographies of Nineteenth Century Science*, ed. David Livingstone and Charles Withers (Chicago: University of Chicago Press, 2011), 255-78; 272.

[98] Raj, *Relocating Modern Science*, 207 and 209.

[99] Giuliano Pancaldi, ed., *I Congressi degli scienziati italiani nell'età del Positivismo* (Bologna: Clueb, 1983).

association" and they ceased after the unification in 1861 anyway.[100] They tended to follow regional networks and did not have a national venue to solve controversies.[101] The Italian version of the British Association for the Advancement of Science (the Società Italiana per il Progresso delle Scienze) was born in 1862 but stopped functioning in 1875.[102] "Teamwork" made no sense to Italian explorers whose travel accounts were often individual perspectives that struggled to be acknowledged as objective across regional scientific communities.

Against such a fragmented background, meteorology stood out as a science that required national coordination. The foundation of the Central Meteorological Office in 1876 was part of a cultural, institutional and political unifying effort from Italy's liberal elites. It took several years to coordinate all the agencies interested in the study of the weather, but eventually the Ministry of Agriculture, rather than the navy or the Ministry of Education, took over meteorology. Because Italy was mostly rural, meteorology was considered useful for agriculture, the main source of wealth in the country.[103] Pietro Tacchini (1835-1905), the first Director of the Central Meteorological Office was an internationally known astronomer and made multiple efforts to unify the Italian scientific community.[104] Tacchini was strategically positioned at the interface between the State and the scientific community as Director of the Central Meteorological Office

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[100] Claudio Cerreti, *Della Società Geografica Italiana e della sua Vicenda Storica* (Rome: Società Geografica Italiana, 2000), 7.

[101] A peculiarity reflected in the fragmentation of the historiography on disparate individuals and regional case studies. See for example, Gianpaolo Romanato, ed., *Giovanni Miani e il contributo veneto alla conoscenza dell'Africa. Atti del XXVII Convegno di Studi Storici, Rovigo, 14-15-16 novembre 2003* (Rovigo: Minelliana, 2005); Stefano Mazzotti, *Esploratori Perduti. Storie Dimenticate di Naturalisti Italiani di fine Ottocento* (Turin: Codice Edizioni, 2011); Renato Bertacchini, ed., *Continente Nero. Memorialisti Italiani dell'800 in Africa* (Parma: Guanda Editore, 1965); Silvio Zavatti, *Dizionario degli esploratori e delle Scoperte Geografiche* (Milan: Feltrinelli, 1967); Francesco Rodolico, ed., *Meraviglie della natura negli avventurosi viaggi degli esploratori italiani dell'Ottocento* (Florence, Le Monnier, 1968). An important primary source is the series *La Conquista della Terra. Esploratori e Esplorazioni* (Turin: Utet, 1960), 14 vv., edited by the prestigious geologist Giotto Dainelli, who had been a crucial explorer himself (see Chapter 2 of this dissertation).

[102] After the interruption of the conferences in 1848 due to the outbreak of the revolution, a new meeting took place in 1862. The S.I.P.S. was created in that meeting, but the association stopped working in 1875 until it was refounded by Vito Volterra in 1908. See Russo, *Ingegni Minuti*, 347.

[103] The birth of meteorological offices in England and Germany was influenced by the interests of the navy, whereas in France meteorology was under the centralized control of the Ministry of Education. See Simon Naylor, "Maritime Meteorology and the British Admiralty in the Nineteenth Century," in *Isis* 106, no. 4 (2015): 771-797. See also Fabien Locher, *Le Savant et la Tempête: Étudier l'Atmosphère et Prévoir le Temps au XIXe Siècle* (Rennes: Press Universitaire, 2008).

[104] Tacchini was a prominent nineteenth-century scientist that worked between personal, local, national, and international connections. He represented Italy at the International Conference for Universal Time at Washington D.C. and promoted unsuccessfully a project to rationalize the number of Italian observatories in order to maximize the allocation of funding. Like agricultural and scientific institutions, astronomical and meteorological observatories formed a complex and localized institutional landscape, because almost every regional state before the unification had its own. See Ileana Chinnici, "The 'Società Italiana degli Spettroscopisti Italiani': Birth and Evolution," in *Annals of Science* 65, no. 3 (2008): 393-438; also by Ileana Chinnici, "An 'Italian' Observatory in India. The History of the Calcutta Observatory," in *Studies in History of Medicine and Science* 14 (1995-1996), no. 1-2 (1995/6): 91-115; Massimo Mazzotti, "The Jesuit on the Roof," in David Aubin, ed., *The Heavens on Earth: Observatories and Astronomy in Nineteenth-century Science and Culture* (Durham: Duke University Press, 2010) 68-94.

and member of the Roman Italian Geographical Society. In short, he represented an embryonal epistemic community working with the State.

In the following pages, I will follow Tacchini's social and scientific network to understand how weather science, geography, and empire became entangled in the Italian colonial project through the exchange and circulation of meteorological instruments and data in Italian explorations. Temperature data and scientific information became a crucial piece of argument in debates about the beginning of Italian colonialism. Without a unified colonial scientific community, Italian scientists disagreed on the best strategy to explore Ethiopia based on scientific "facts."

1.3 Scientific Controversies and the Birth of Italian Colonialism (1870-1885)

In this section, I will examine how Italian divisions sparked controversies about the exploration of Ethiopia on a more local scale. The quantification and standardization of meteorological data were called upon to provide "scientific facts" that were never abundant and accurate enough to settle Italian controversies. Italians produced meteorological data, but their meaning changed depending on the goals of the actors producing them and the interpretations that Italy's scientific communities gave them. In other words, weather data were not like Latour's "immutable mobiles."[105]

Environmental knowledge and climate information were highly controversial because without social consensus there could be no scientific "objectivity." Only a few decades after the establishment of a unified Italian state, Italians' distrust of one another was so radical that even weather data produced opposite interpretations. *Environmental* debates about Ethiopia's climate were *political* debates about the politics of Italian colonialism in Africa. One would imagine that the production of quantified weather data would produce some degree of certainty. Instead, the climate of Assab—Italy's first colonial possession in Africa—became the focus of the debate about the direction of Italian colonialism in general.

Starting in the 1870s, Italian elites became convinced that the opening of the Suez Canal in 1869 would bring back the Mediterranean at the center of world trade and connect it with the Red Sea and the Indian Ocean.[106] The Horn of Africa had suddenly become closer. However, Italian explorers split between supporters of the exploration of the northern Tigray region, ruled by Emperor Johannes, and partisans of the ambitious Menelik, King of the southern region of Shewa. The Milanese Geographical Society preferred the former way because it offered easier commercial penetration. Instead, the Roman Geographical Society was allured by the agricultural fertility of the Shewa. The colonial politics of whether to establish contacts with Emperor Johannes or his more welcoming subordinate Menelik produced controversies among

[105] Bruno Latour, *Science in Action* (Cambridge: Harvard University Press, 1987).

[106] Guido Cora, *Da Brindisi a Suez attraverso il Canale di Suez* (Casale: Tipografia Corrado Diretta da P. Bertero, 1869). Cora (Turin 1851-1917) studied in Leipzig and Gotha and was the only professor of cartography that worked at the university in Turin and not in other state offices. See Maria Carazzi, *La Società Geografica Italiana e l'esplorazione coloniale in Africa. (1867-1900)* (Florence: La nuova Italia, 1972), 39.

Italian explorers since the first Italian mission to Shewa. Italian scientists were at the forefront of the exploration and became quickly involved in such political controversies.

This problem of national coordination is evident in the so called "Great Expedition," the first concerted effort to send an Italian geographical mission to Africa, that left from Italy in 1876.[107] The expedition had two goals: first, the establishment of political and commercial ties with Menelik, the ruler of Shewa region; second, a geographical and naturalist description of Ethiopia from the Shewa to the equatorial lakes of central Africa, with the creation of a permanent scientific station.[108] Such a station was necessary to transform meteorological observations into climatological studies of the region. Weather data collected while traveling through disparate locations were pretty much useless to turn meteorology into a useful climatology, as the meteorologist Guido Grassi (1851-1935) pointed out.[109] The Marquis Orazio Antinori (1811-1882) was appointed as leader of the expedition for his experience in Africa.[110] His previous trip in 1870 with the geologist, malacologist and paleontologist Arturo Issel (1842-1922) had been the origin of the first Italian manual for colonial scientific observations, a genre of imperialist travel literature that was thriving in the middle of the nineteenth century. Conceived in 1873, the *Instructions* were finally published only in 1881 thanks to the support of the Ministry of Agriculture, when Italian colonialism was already underway. This delay of eight years shows the challenge of coordinating Italian scientists and the state at the beginning of Italian colonialism, with personal trajectories constantly risking to wreck the colonial project.[111]

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[107] See Renato Bertacchini, ed., *Continente Nero. Memorialisti Italiani dell'800 in Africa* (Parma: Guanda Editore, 1965), 29-42 and 243-96.

[108] Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 63.

[109] "Where the traveller will not live in a certain place for a long time, it is useless that he will start his observations," in Arturo Issel et alii, *Istruzioni Scientifiche pei viaggiatori* (Rome: Tip. Eredi Botta, 1881), 122.

[110] Antinori travelled to Sudan between 1859 and 1861 and brought back a wide ornithological collection. He tried to rescue a colony of Italian peasants founded in the region of Sciotel in 1866 by the Lazarist Father Stella before the break between State and Church with an expedition in 1870 and 1871, but the region was occupied in the meantime by the Egyptian government, in competition with the Ethiopian kingdom. See Orazio Antinori, *Catalogo descrittivo di una collezione di uccelli, fatta nell'interno dell'Affrica Centrale Nord dal maggio 1859 al luglio 1861* (Milan: G. Dainelli e C., 1864) and Orazio Antinori, *Viaggio nei Bogos* (Rome: Società Geografica Italiana, 1887). Id. *Viaggio dei Signori O. Antinori, O. Beccari, ed A. Issel nel mar Rosso, nel territorio dei Bogos e regioni circostanti durante gli anni 1870-1871* (Genua: Tip. del R. Istituto sordo-muti, 1873). See also Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 19-22.

[111] Unlike the small, compact, and agile volumes of the British Geographical Society that were perfect for traveling, Issel's instructions about astronomy, geology, paleontology, botany, anthropology, ethnology, deep sea marine biology, geography, and topography appeared scattered in several issues of the journal *Rivista Marittima* between 1874 and 1875—not exactly the most functional way to provide an easily accessible textbook for travellers, considering how much harder is to collect articles from disparate papers. The early death in 1876 of the Captain of the navy Eugenio Pescetto—the director of the *Rivista Marittima* that sponsored the publication—almost wrecked the project: the *Rivista Marittima* hosted only another article about mineralogy, but then disagreements with the new direction of the journal spurred the publication of the articles concerning zoology and meteorology on a different journal, the *Memorie della Società Geografica Italiana*. Nevertheless, Issel himself recognized that "the collection of the instructions, so scattered in twelve issues of two different periodicals, could have hardly been helpful in the hand of any traveller and would therefore defeat its own purpose." See Issel et alii, *Istruzioni Scientifiche pei viaggiatori*. See also Arturo Issel, "Relazione Sommaria del Viaggio nel Mar Rosso dei Signori Antinori, Beccari ed Issel" *Bollettino della Società Geografica Italiana*, 5 (1870), pp. 43-70. For previous example of this genre, see Silvia Collini and Antonella Vannoni, *Les Instructions Scientifiques pour les Voyageurs (XVII-XIX siècle)*,

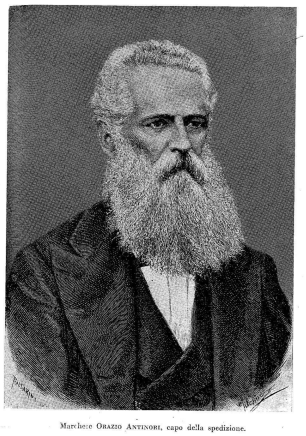

Fig. 1.6: The Marquis Orazio Antinori, founder of Let-Marefià.[112]

In the same way the famous International African Conference organized by Leopold II in 1876 in Brussels was meant to establish Belgian rule in Congo, the scientific station of Let-Marefià in Ethiopia was presented as the Italian claim to Abyssinia within the European "humanitarian" exploration of Africa. In addition to Antinori, the expedition included Giovanni Chiarini, Sebastiano Martini Bernardi, and later Antonio Cecchi.[113] Constant controversies among its members made the "Great Expedition" a failure.[114]

The mission was hampered by several factors: the ignorance of the kingdoms around the Shewa region; the conflict between Antinori and Martini and their disparate scientific and political goals; the diffidence of Cardinal Massaia, the leader of the Catholic mission at Menelik's court, towards the freemason Antinori and the scientist Chiarini; and the organization of a parallel mission organized by the Geographical Society of Milan. Thus, the mission was

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L'Harmattan, Paris 2005. Sir John F.W. Herschel, *A Manual of Scientific Inquiry Prepared for the Use of Officers in Her Majesty's Navy*, London, John Murray, 1849 (1st edition) - 1886 (5th edition). Georg Neumayer, *Anleitung zu Wissenschaftlichen Beobachtungen auf Reisen*, Berlin, 1875. David Kaltbrunner, *Manuel du Voyageur*, Zurich, Genéve, Paris, Milan 1879.

[112] Leopoldo Traversi, *Let-Marefià; prima stazione geografica italiana nello Scioà e le nostre relazioni con l'Etiopia (1876-1896)* (Milan: Edizioni Alpes, 1931), 77.

[113] The Antinori expedition was later joined by Captain Antonio Cecchi and three workers: Lorenzo Fredducci, Mariano Fagioli, and Niccole Fantini. Del Boca, *Gli Italiani in Africa Orientale*, V. 1, 68.

[114] Carazzi, *La Società Geografica Italiana,* 66; Battaglia, *La Prima Guerra d'Africa,* 113. Antinori (Perugia 1811 – Let-Marefià 1882) travelled to Egypt in 1858 after the first Italian war of independence; he was in Nubia in 1869; he had been to the Sciotel in 1870. He lived in Let-Marefià after 1878. Giovanni Chiarini (Chieti 1849 – Cialla, Ethiopia 1879) had a degree in Engineering from the University of Naples. He was a passionate alpinist and an expert of the natural sciences. See *Commemorazione del dottore Giovanni Chiarini, Membro della spedizione italiana nell'Africa equatoriale il 5 giugno 1881 in Chieti* (Chieti: Tipografia di Giustino Ricci, 1881). See also Kemény, *La Societá d'esplorazione commerciale*, 56. Pellegrino Matteucci (Ravenna 1850 – Londra 1881) had unsuccessfully tried to join the Antinori expedition (see Pellegrino Matteucci, *La Spedizione Italiana nell'Africa Equatoriale: Considerazione* (Bologna: Tip. Felsinea, 1875).

stuck in the Shewa and proved unable to reach its final destination, the equatorial lakes of central Africa.

Nevertheless, the main success of the "Great Expedition" was the creation of Let-Marefià, the first European scientific-sanitary station in Ethiopia. Let-Marefià became the linchpin of the Italian strategy to support Menelik against the Emperor Johannes, the so-called Shewan policy, in order to establish Italian influence in Abyssinia. Despite the opposition of the Milanese Geographical Society, the Roman Geographical Society turned Let-Marefià into the most important source of information, scientific data, and political espionage in Ethiopia.

Fig. 1.7: Augusto Valli, *Let-Marefià,* Modena, Museo Civico. Photo by Angelo Caglioti. Valli travelled to Let-Marefià like many Italian explorers of the time. Among his patrons there were Pietro Tacchini, the Director of the Meteorological Office, and Augusto Salimbeni, explorer from the same region. The area of Let-Marefià was surrounded by a forest and high mountains. It also enjoyed good rainfall. Illustrating a significant element of the environment of the Shewa, the painter decided to represent a cloudy landscape, unlike many other sunny orientalist paintings.

In Let-Marefià, Antinori made scientific observations in a fertile area of 95 hectares thanks to Menelik's concession. After Antinori's death in 1882, the station was directed by the doctors Vittorio Ragazzi (until 1890), Leopoldo Traversi (1890-1894) and the engineer Luigi Capucci (1894-1896). All of them became crucial diplomatic intermediaries between the Italian Government and Menelik. Menelik was keen to use foreign artisans, advisors and expertise to increase his power. For example, the engineer Capucci (1857-1920) was employed to build an armoury and design Menelik's imperial palace in Addis Ababa.[115] Until Adwa, the scientific station of Let-Marefià was the destination of several Italian explorers, such as Bianchi and Antonelli, that provided arms to Menelik in order to gain his alliance. Let-Marefià was the cornerstone of the Shewa policy and Italian imperialism in southern Abyssinia.[116]

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[115] Carlo Zaghi, *La Spedizione Capucci e Cicognani in Abissinia (con lettere e documenti inediti)* (Rocca S. Casciano: Cappelli, 1934), 34-35. Concerning Luigi Capucci, see Leopoldo Traversi, *Let-Marefià prima stazione geografica italiana nello Scioa e le nostre relazioni con l'Ethiopia (1876-1896)* (Milan: Alpes, 1931), 425-27.

[116] For example, Ragazzi brought to Italy the treaty signed by Menelik for the Italo-Ethiopian Treaty. See *Bollettino della Società Geografica Italiana* (from here on B.S.G.I.), s. III, v. III, 1890, 399; Traversi, *Let-Marefià*, 55; Ragazzi sent seeds to the Botanical Garden of Rome starting in 1887. The botanical collections were analyzed by the botanist Carlo Avetta. See Romualdo Pirotta, "Contribuzioni alla Conoscenza della Flora dell'Africa Orientale pel

Thanks to Let-Marefià, Italians learned a great deal about the great agricultural potential and climatic features of Ethiopia. Let-Marefià produced crops twice a year, in December and July/August. It was surrounded by good pastures, water, and forests. It was so prosperous that Antinori suggested that Italian farmers could easily settle there.[117] In his words: "If I had to write you everything that is to be done here in my mind, I would write a treaty in agronomy."[118] Similarly, Antonelli estimated that a couple of Italian families would have a better quality of life in Let-Marefià than in the countryside around Rome and Naples. Its position at the ecological boundary between highlands and coastal deserts made it a good stop for travellers, where they had to switch means of transportation between donkeys and camels.[119] Traversi described it as extremely rich in forests and water, a wonderful place that "looks even more beautiful after coming from the Danakil desert… and except for the temperature it looks like our Alps."[120] Capucci sent reports about agriculture in the region.[121] Upon a request of Giuseppe Dalla Vedova, President of the Italian Geographical Society, the Central Meteorological Office sent to Ragazzi in summer 1884 enough instruments and instructions to start the collection of meteorological data.[122] More than ten big cases of scientific and geographic reports, mineralogical and zoological specimens, and meteorological data spanning from 1876 to 1881 were shipped back to Italy and published in the third volume of Cecchi's book *Da Zeila alle Frontiere del Caffa*.[123] These measurements allowed a much better sense of Ethiopian climate, rainfalls, and agriculture.

Italians learned that agriculture in Ethiopia depended on climate and altitude. From Let-Marefià, Italians learned that Ethiopians divided their territory in three areas, each one with a different climate at different altitudes: the *kolla*, the *dega*, and the *woina dega*.[124] The *kolla* was the lowest and warmest part without precipitations, similarly to the Danakil desert that surrounded and protected Ethiopia on its eastern side. The *dega* was the highest part of Ethiopia, with mountains and high plateaus, where the temperature could go below freezing and usually

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Prof Carlo Avetta," in *Annuario del R. Istituto Botanico di Roma redatto dal prof. Romualdo Pirotta,* (Milan: Ulrico Hoepli, 1894) 44. A. Jatta published instead the collection of lichens from the Traversi collection, see *Giornale Botanico Italiano*, vol. XIV, no. 3., July 1882. On Leopoldo Traversi and how he became director of the station of Let-Marefià, see Traversi, *Let-Marefià*, 319-23. Traversi published extensively on the B.S.G.I. between 1885 and 1889.

[117] Traversi, *Let-Marefià,* 64-5; quoted in Del Boca, *Gli Italiani in Africa Orientale*, 96; Daniele Natili, "Lét Marefià: una stazione geografica tra realtà e propaganda," in B.S.G.I, 3, no. 1 (2010): 101–16.

[118] Quoted in Traversi, *Let-Marefià*, 72.

[119] Pietro Antonelli, "Letter from Let-Marefiá, June 3, 1883," in *Memorie e Relazioni. Lettere inviate dal Conte Pietro Antonelli*, B.S.G.I. 8 (1883): 790.

[120] Traversi, *Let-Marefià*, 57-9.

[121] Luigi Capucci, "Condizioni dell'agricoltura nello Scioa," in *Bollettino della Società Africana d'Italia* VI (1887): 277-83; Id. "Condizioni dell'agricoltura nello Scioa, continuazione" VIII (1888): 30-5.

[122] The list of instruments from the Central Meteorological Office to Ragazzi is in a letter dated July 22, 1884: "Strumenti per la Stazione alto Scioà (Let-Marefià)" (Archive C.R.A.-C.M.A, Fondo Palazzo, "Let-Marefià"). They were received on August 5, 1884 by the Geographical Society and sent to Shewa. See also Traversi, *Let-Marefià*, 77.

[123] Traversi p. 90 and 182. Antonio Cecchi, *Da Zeila alle Frontiere del Caffa: Viaggio di Antonio Cecchi*, Loescher, Roma, 1886-1887.

[124] French descriptions of these three agricultural regions date back to the 1840s instead. The first I found was in Lefebvre. *Voyage En Abyssinie,* 1845.

spanned from temperate to 0 Celsius. The *dega* had abundant rainfalls during the rainfall season called *Kiremt* or *cremt*, or season of big rains (June-August), but was largely barren of trees and was used mostly for barley and herding sheeps, since it was dominated by monsoons from South-East and North-East.

Let-Marefià was located between the *dega* and the *cuolla*, where there was the *woina degà* (wine area: "woina" comes from the Greek "oinos" that means "wine"): the most beautiful and fertile land, rich in pastures, springs and woods, and therefore also the most cultivated, with barley, wheat, tièf (*poa abissinica*), peas, peppers, corn, and potentially grapes, peaches, olives, sugar cane, and lemons. Traversi introduced tomatoes, salads, sweet peppers, artichokes, potatoes, and corn. They all flourished so well that they confirmed the fertility of the land and the advantages of the favorable climate. The temperature was always mild "as if one were on the Mediterranean." Let-Marefià was "not only bearable [to Europeans], but one of the most pleasant climates like none in Europe."[125]

While Italians used constant comparisons between the climate in the Shewa and in southern Italy to make Ethiopia's environment intelligible to their experience, it is important to highlight that they adopted the vocabulary of the natives to describe seasons and climatological regions. From the Italian perspective, it was crucial to take control of Ethiopia's highlands after learning these complex natural patterns. Ethiopia was a potentially rich and fertile land, but the extremely rugged orography of the highlands made Ethiopia a natural fortress, protected by the lowland deserts near the coast of Eritrea and Somalia. How to reach those inaccessible mountains from the coast?

The answer to this question was the occupation of the bay of Assab. This was the first official act of Italian colonialism, namely the first instance of direct involvement of the Italian government in the region with the goal of establishing a coastal access to both Let-Marefià and the Shewa region.

The ex Lazarist missionary Giuseppe Sapeto was the main actor behind the purchase of Assab for the company Rubattino as a proxy of the Italian government.[126] Sapeto travelled in 1870 to the Red Sea with the naturalists Antinori, Beccari and Issel, whom we encountered as the authors of the "Scientific Instructions to Travellers" and later founders of Let-Marefià. The scientists even assisted him in the negotiations for the purchase of the bay with the local sultan. Already in 1870, in a classified communication between the Ministry of War to the Ministry of Agriculture titled "Secret convention with Rubattino," the Ministry of Agriculture promised to contribute to the purchase of the bay "for the establishment of an agricultural colony" without

[125] Traversi 77.

[126] Giulio Giacchiero e Giuseppe Bisogni, *Vita di Giuseppe Sapeto* (Florence: Sansoni, 1942). A commission established on April 30, 1871 with the purpose of making a proposal of colonial action to the government failed to produce a final report. The naturalist and explorer Odoardo Beccari rejected the offer to be part of the commission, because the government did not seem to have any actual interest. The commission was directed by the president of the Italian Geographic Society Cristoforo Negri. See Romain Rainero, *L'Anticolonialismo italiano da Assab ad Adua (1869-1896)* (Milan: Edizioni di Comunità, 1871), 23.

any evidence of the agricultural prospects of the African coast. The creation of Let-Marefià gave momentum to the project of turning Assab into Italy's first colony in 1879.[127]

Fig. 1.8: Italy's first official colonial map representing the bay of Assab, the first Italian colonial possession in Africa, published on June 10, 1882. Assab was one of the closest coastal points toward Let-Marefià, but it was surrounded by the Danakil desert.[128]

The arrival of Italian ships and military personnel marked the beginning of Italian colonial cartography, since the navy needed precise information about the region. The first Italian colonial map (fig. 1.8) represented the bay of Assab based on surveys carried out by the ships Esploratore, Ischia, Vettor Pisani and Vedetta.[129] The presence of the navy required also the first collection of weather data near the coast. At the beginning of 1881, the Ministry of Foreign Affairs asked Pietro Tacchini, director of the Central Meteorological Office, to send meteorological instruments for a weather station to be established in Assab.[130] Tacchini provided

[127] The purchase was clearly a case of secret diplomacy. On August 10, 1870, the Ministry of the Navy asked the Ministry of Agriculture to contribute to the expenses for the purchase of the bay with a contribution of 15.327,56 Lire. The note of the *Segreteria particolare* of the Ministry of Agriculture reads "subsidy for the expenses of the Rubattino society for the establishment of an agricultural colony on the Red Sea." Promptly, on August 23, 1870, the Ministry of Agriculture disposed the payment of 10.000 lire to Raffaele Rubattino "for the establishment of an agricultural colony." On August 27, 1870 the Minister of Agriculture, in another "extremely reserved" note, claimed that he had promised only 10.000, not 15.327,56 lire to Sapeto. The payment was not actually disbursed to the Ministry of the Navy until December 1875, an even more scandalous way to proceeding considering that in 1875 Italians knew that turning Assab into an agricultural colony was impossible. A.C.S., M.A.I.C., V Vers., b. 999, f. 4346 "Impianto colonia e provvedimenti legislativi 1870-1890."

[128] "Carta Speciale della Baia di Assab e adiacenze," Central National Archive, A.C.S., M.A.I.C., V Vers., b. 999, f. 4346, "Impianto colonia e provvedimenti legislativi 1870-1890."

[129] See also Ministero degli Affari Esteri, Comitato per la Documentazione dell'Opera Italiana in Africa, *L'Italia in Africa: Storia della cartografia coloniale italiana* (Rome: Istituto Poligrafico dello Stato, 1964), 8.

[130] A letter from the Ministry of Foreign Affairs to Pietro Tacchini dated May 11, 1881 refers to shipment of a receipt for the instruments provided previously for the station of Assab on March 15, so the instruments must have

navy officers with detailed instructions for the standardization of weather data. This is the first known instance of direct collaboration between the Italian navy and civilian scientific experts.[131]

On a blank map, Assab looked like a good spot to land on the coast in the direction of the Shewa and Let-Marefià, but it actually was in a very challenging geographical position. Between Assab and Let-Marefià there is the Danakil desert—one of the hottest places on earth. Compared to other forms of European conquest—namely the creation of coastal settlements for future inland expansion, a crucial strategy of the scramble for Africa—Assab was not favored by a rich hinterland. In spring 1880, explorations in the interior were extremely disappointing: an Italian expedition found a few palm trees and some huts in "an ocean of burning stones… a dead town; a few wells of good enough water; and four miserable villages."[132] Was Assab the best bay on the coast of the Red Sea to get access to Ethiopia?

Assab, the first Italian base in Africa, was immediately controversial. Information about the climate of the region became the battleground of the controversy, depending on whether Italian explorers and geographical societies preferred the northern route from Massawa to the Tigray of Emperor Johannes or the southern route from Assab to Menelik's Shewa as access points to Abyssinia. Italy's geographical societies disagreed on the value of the purchase. The Società d'Esplorazione in Milan did not believe that Assab was a valuable port for commercial penetration in Africa. The Società Geografica in Rome was cautious, but was interested in finding a good access point to the scientific station of Let-Marefià, which was its creature. The Neapolitan Società Africana was a passionate and excited supporter of the enterprise but had unreal expectations. Amid so many contrasting opinions, the fragmentation of the Italian scientific and geographical communities produced ignorance rather than cumulative knowledge and made Italian colonialism controversial from the start.[133]

Three types of climatological descriptions of Assab circulated in Italy—a few enthusiastic, some cautiously positive, others radically negative. I explore them in order to show how geographical accounts about Assab's climate differed depending on the politics, previous

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been provided before that date. See letter from the Ministry of Foreign Affairs to Pietro Tacchini, May 26, 1881 (Archive C.R.A.-C.M.A., Fondo Palazzo).

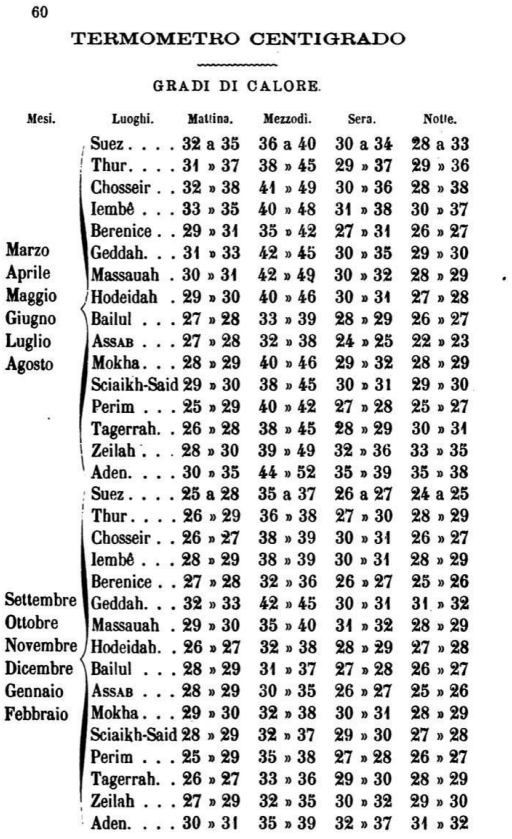
[131] Relying on meteorological data produced by naval officers in Africa posed even more problems of standardization for the Central Meteorological Office, whose methods to collect information were different. Thus, Tacchini asked officers to be more precise in noting the decimal figures of the thermometer and the barometer, or even better to use thermographers (machines recording the temperatures automatically) in order to eliminate human carelessness. Tacchini protested that navy officers did not make clear which scale they used to record the wind and the information provided about the amount of clouds in the sky was too generic (only "cloudy" or sunny). The barometer of the navy needed to be compared to the one provided by the Central Meteorological Office, and their difference notified to Rome in order to compute and standardize the observations. Letter from Tacchini to the Ministry of Foreign Affairs, June 1, 1881.

[132] Del Boca. *Gli Italiani in Africa Orientale*, v. 1, 109.

[133] "Contrasts of opinion were so stark [because] they were founded on objective ignorance of the geography of region, with the exception of the coast and the immediate hinterland… Every politician, explorer and geographer had his own opinion." Romain Rainero, *I primi tentativi di colonizzazione agricola e di popolamento dell'Eritrea (1890-1895)* (Milano: Marzorati, 1960), 33-5. The General Ezio De Vecchi (who travelled to explore the Red Sea on the ship Vettor Pisani), the Italian consul in Aden Carlo Guarmani, and the Captain Sebastiano Martini were against Assab. The naturalist Odoardo Beccari and the future consul of Assab Carlo De Amezaga were more favorable to that location.

experiences, expectations, and the social and cultural position of explorers in Italy's colonial and scientific networks.

First, the position of the supporters of Assab and the Shewa policy is best exemplified by Giuseppe Sapeto, Pietro Antonelli, and Gian Battista Licata. Sapeto, the main actor responsible for the purchase of the bay, attacked the critics of Assab with weather data in order to prove the feasibility of the colony in comparison with other locations in the Red Sea. Yet frankly, it is hard to say where Sapeto found the data.[134] Even later accounts that extolled him as the founding father of Italian colonialism acknowledged that Sapeto "was a ruthless man and his tales cannot be always taken as true."[135]



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TERMOMETRO CENTIGRADO

GRADI DI CALORE.

Mesi.	Luoghi.	Mattina.	Mezzodì.	Sera.	Notte.
	Suez	32 a 35	36 a 40	30 a 34	28 a 33
	Thur. . . .	31 » 37	38 » 45	29 » 37	29 » 36
	Chosseir . .	32 » 38	41 » 49	30 » 36	28 » 38
	Iembê . . .	33 » 35	40 » 48	31 » 38	30 » 37
	Berenice . .	29 » 31	35 » 42	27 » 31	26 » 27
Marzo	Geddah. . .	31 » 33	42 » 45	30 » 35	29 » 30
Aprile	Massauah .	30 » 31	42 » 49	30 » 32	28 » 29
Maggio	Hodeidah .	29 » 30	40 » 46	30 » 31	27 » 28
Giugno	Bailul . . .	27 » 28	33 » 39	28 » 29	26 » 27
Luglio	Assab . . .	27 » 28	32 » 38	24 » 25	22 » 23
Agosto	Mokha. . .	28 » 29	40 » 46	29 » 32	28 » 29
	Sciaikh-Said	29 » 30	38 » 45	30 » 31	29 » 30
	Perim . . .	25 » 29	40 » 42	27 » 28	25 » 27
	Tagerrah. .	26 » 28	38 » 45	28 » 29	30 » 31
	Zeilah . . .	28 » 30	39 » 49	32 » 36	33 » 35
	Aden. . . .	30 » 35	44 » 52	35 » 39	35 » 38
	Suez	25 a 28	35 a 37	26 a 27	24 a 25
	Thur. . . .	26 » 29	36 » 38	27 » 30	28 » 29
	Chosseir . .	26 » 27	38 » 39	30 » 31	26 » 27
	Iembê . . .	28 » 29	38 » 39	30 » 31	28 » 29
	Berenice . .	27 » 28	32 » 36	26 » 27	25 » 26
Settembre	Geddah. . .	32 » 33	42 » 45	30 » 31	31 » 32
Ottobre	Massauah .	29 » 30	35 » 40	31 » 32	28 » 29
Novembre	Hodeidah. .	26 » 27	32 » 38	28 » 29	27 » 28
Dicembre	Bailul . . .	28 » 29	31 » 37	27 » 28	26 » 27
Gennaio	Assab . . .	28 » 29	30 » 35	26 » 27	25 » 26
Febbraio	Mokha . . .	29 » 30	32 » 38	30 » 31	28 » 29
	Sciaikh-Said	28 » 29	32 » 37	29 » 30	27 » 28
	Perim . . .	25 » 29	35 » 38	27 » 28	26 » 27
	Tagerrah. .	26 » 27	33 » 36	29 » 30	28 » 29
	Zeilah . . .	27 » 29	32 » 35	30 » 32	29 » 30
	Aden. . . .	30 » 31	35 » 39	32 » 37	31 » 32

Fig. 1.9: Assab's temperature compared with other locations in the Red Sea.[136]

The explorer Pietro Antonelli, the staunchest supporter of the Shewa policy and Italian negotiator with Menelik, took it on himself to defy the hostile nature of the region around Assab

[134] Giuseppe Sapeto, *Assab e i suoi critici* (Genua: Stabilimento Pietro Pellas, 1879), 60.
[135] Carlo Giglio *et al*, *L'Italia in Africa* (Rome: Istituto Poligrafico dello Stato, 1958), 127, n. 20.
[136] Sapeto, *Assab e i suoi critici*, 60.

and connect the Italian base on the coast of the Red Sea with the Shewa region and Let-Marefià.[137] Upon his return, he gave a public lecture in the halls of the Collegio Romano, in the Great Hall next to the Central Meteorological Office and the Geographical Society.[138] He displayed his ethnographic collections in front of a map of his trip from the coast of Assab and to the highlands of Shewa and claimed to have opened a new road to Ethiopia, "the foremost premise for the future existence of this colony."[139]

The naturalist Giovan Battista Licata (1859-1896) produced an exotic and largely imaginary portrait of Assab. Licata was one of the founders of the Neapolitan Società Africana (the one that was most supportive of Italy's purchase of Assab in those years), the editor of its bulletin, and the promoter of the Commercial Society for the Colonization of Assab.[140] He went to Assab between May and October 1883 with the only goal of refuting "Assab's critics." Licata attacked those who "denied anything good over there, without even trying to travel there" and "those who were against the occupation of Assab on principle."[141] As a self-appointed scientific expert, he was the first university-trained naturalist to travel spontaneously to an official Italian colony to study its environmental value on behalf of the national community. This was a fundamental change from previous travelers' accounts of aristocratic naturalists or military personnel sent there for other practical reasons.

Licata was also the first to articulate the idea that Italians could improve natural environments with their scientific and agricultural expertise, regardless of how bad the climate and natural resources were in Africa. Influenced by the Italian Darwinist anthropologist Paolo Mantegazza—to whom the book was dedicated—Licata blamed the primitive conditions of local agriculture on the laziness of the natives: "Even if the Danachili do not practice agriculture, that does not mean that one cannot establish agriculture in some parts of the colony."[142] Licata was the first Italian scientific expert to offer a version of the "myth of the profligate native," namely the notion that only Europeans held the superior scientific and agricultural knowledge to change the environment.[143] He suggested that the hot climate made the natives lazy, thus articulating for the first time an Italian scientific version of the climate's "moral economy."[144]

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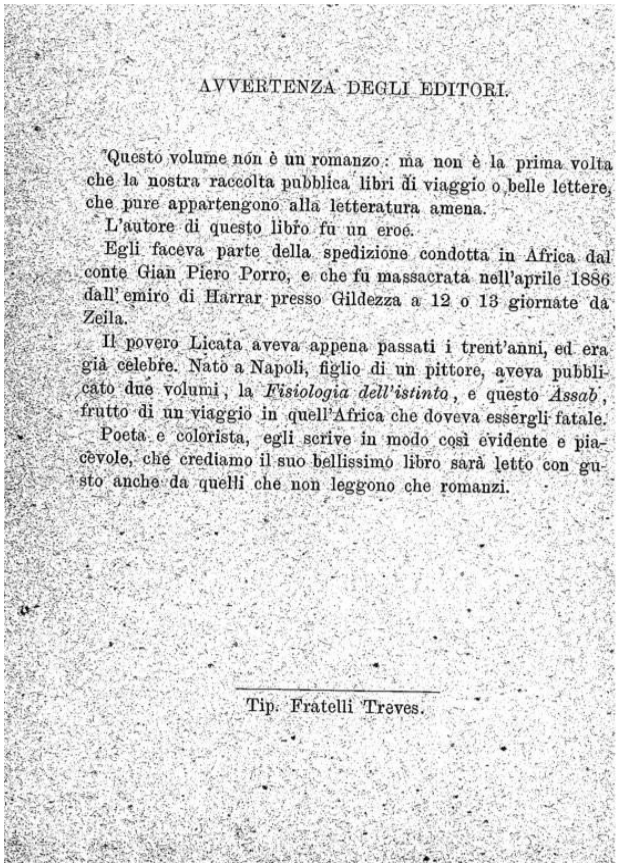
[137] Pietro Antonelli, "Memorie e Relazioni - Lettere Pubblicate dal Conte Pietro Antonelli" B.S.G.I, 1883, 782-95.
[138] Pietro Antonelli, "Il mio viaggio da Assab allo Scioa: conferenza tenuta presso la Società Geografica Italiana il giorno 18 novembre 1883" B.S.G.I., 856.
[139] *Ibid.*
[140] Carazzi, *La Società Geografica Italiana,* 96.
[141] I quote from Giovan Battista Licata, *Assab e i Danàchili*, 2nd ed. (Milan: Fratelli Treves, 1890), 184-5. The first edition came out in 1885; Licata attacked "the officers of our navy that were the first to curse our colony, with great damage for the development of a national enterprise that could bring advantage to the navy itself." Against Volpe, he argued that "the stay in Assab is very different on board of ships and on the mainland."
[142] Licata, *Assab e i Danàchili*, 276-77: "I do not believe generous propositions about the redemption of the race of the Dàncali. Do you want to teach those wretched the mystery of transubstantiation or you want to make them clock-makers?" See also 241: "In the struggle for existence […] savage races are fatally bound to get destroyed rather than to transform; and this one of the Afara seems to be the most doomed on earth."
[143] See Diana Davis, *Resurrecting the Granary of Rome* (Athens: Ohio University Press, 2007).
[144] David Livingstone, "Race, Space and Moral Climatology," in *Journal of Historical Geography* 28, no. 2 (2002): 159-80. Id., "The Moral Discourse of Climate: Historical Considerations on Race, Place and Virtue," in *Journal of Historical Geography* 17, no. 4 (1991): 413-34.

The major problem that undermined Licata's scientific credibility was that his account blurred the boundary between scientific reports and fictional travel literature. Licata's work was published by the editor "Fratelli Treves," that also printed novels and orientalist literature.[145] In a note at the beginning of the volume, the editor warned the reader that the book was not fiction and justified its publication in a catalogue of literature by adding that "the author writes in such a pleasurable manner that we believe that even readers of novels will enjoy his very beautiful book." For example, in order to spur Italians to study the region, he used a gendered trope of orientalist literature and called the bay of Assab "a poor virgin that received many caresses, but nobody loved her"—a sentence that sounds much more sexual in Italian: "*Povera vergine che molte carezze ebbe, nessun amplesso*."[146] The content of Licata's report, his language, and even his publication site were too fantastic to be taken seriously by Italian scientific elites.



AVVERTENZA DEGLI EDITORI.

Questo volume non è un romanzo: ma non è la prima volta che la nostra raccolta pubblica libri di viaggio o belle lettere, che pure appartengono alla letteratura amena.

L'autore di questo libro fu un eroe.

Egli faceva parte della spedizione condotta in Africa dal conte Gian Piero Porro, e che fu massacrata nell'aprile 1886 dall'emiro di Harrar presso Gildezza a 12 o 13 giornate da Zeila.

Il povero Licata aveva appena passati i trent'anni, ed era già celebre. Nato a Napoli, figlio di un pittore, aveva pubblicato due volumi, la *Fisiologia dell'istinto*, e questo *Assab*, frutto di un viaggio in quell'Africa che doveva essergli fatale.

Poeta e colorista, egli scrive in modo così evidente e piacevole, che crediamo il suo bellissimo libro sarà letto con gusto anche da quelli che non leggono che romanzi.

Tip. Fratelli Treves.

Fig. 1.10: "Editors' Warning" at the beginning of Licata's book that warns the reader about the content of his report, blurring the difference between scientific knowledge and fictional travel literature.

[145] About Treves, see Daniele Comberiati, *"Affrica": Il mito coloniale africano attraverso i libri di viaggio di esploratori e missionari dall'Unità alla sconfitta di Adua (1861-1896)* (Florence: Franco Cesati Editore, 2013).
[146] Licata, *Assab e i Danàchili*, 197.

Many Italian scientists were more cautious towards Assab. Weather data did not speak by themselves. They had to be interpreted back home by a fragmented scientific community that could not agree on how they were collected, because the very goal of collecting them in Assab made them political and controversial. Licata presented his scientific observations at the Italian Geographical Society of Rome on January 16, 1884, where they were met with strong skepticism.[147] Tacchini—the official scientific authority for the study of the weather as Director of the Central Meteorological Office—never commented on, validated, or even mentioned Licata's meteorological observations, despite being a member of the Roman Geographical Society. Licata's scant meteorological data were analyzed by the Director of the Italian Meteorological Society Francesco Denza.[148] Denza did his best to make sense of the climate of Assab without having ever been there, but raised some skepticism about Licata's claim that "Assab has a delightful climate compared to other places in the Red Sea" and called for the establishment of a meteorological station "meeting the requirements of modern science" in order to confirm such statements.[149] Domenico Ragona, meteorologist at the observatory of Modena, also questioned the credibility of Licata's data.[150] In short, Italian controversies could not be blackboxed by a divided community at home.

The climate of the region of Assab was an even more concerning issue for colonial officers on the spot, but even they disagreed on the salubrity of the climate of Assab. Raffaele Volpe, the commander of the military ship Ischia, was sent to Assab in 1879 to carry out an hydrographic survey. He had radically negative views about Assab and critiqued Italian armchair geographers.[151] His report described the volcanic nature of the soil, the scant vegetation, and the torrid climatic conditions: "When I arrived in Assab in January, the temperature was 29C [84.2F] and when I left in December it was again 29C… But between February and August the raising of the heat does not have a break… and in August there is unbearable maximum temperature of 47C [116.6 F] in the shade!"[152] The navy officer and director of the hospital of Assab Cesare Nerazzini (1849-1912) was mildly encouraging, as long as Assab was was just a coastal base for

[147] He later paid with his life his excitement for the colonization of East Africa when he died in April 1886 in a second expedition organized by the Società di Esplorazione Commerciale to Harrar. Carazzi, *La Società Geografica Italiana*, 92.

[148] Francesco Denza, "Osservazioni Meteorologiche eseguite nella Colonia Italiana di Buja nella Baja di Assab nei sei mesi Aprile-Settembre 1883," in *Società Meteorologica Italiana - Bollettino Mensuale pubblicato per cura dell'Osservatorio Centrale del Real Collegio Carlo Alberto in Moncalieri* (1883-1884), s. II, vol. II, no. 9: 139-43.

[149] Denza, "Osservazioni Meteorologiche,", 143. He compared Licata's lecture in Rome with the few data he had collected: "According to Licata, the thermometer under the sun reached 102C (215F) ... Based on that, the climate in Assab should be intolerable to any Italian, even from the South," but the wind—based on Licata's words—made things better": 142.

[150] See Domenico Ragona, *Sul Clima di Assab*, 2 vv. (Modena: Monetti e Namias, 1885), 25.

[151] Raffaele Volpe, "Assab sotto il rapporto geografico," in *Atti dell'Accademia Pontaniana* 14 (1881): 103-147. On Volpe, see Antonio Gallizioli, *Cronistoria del Naviglio Nazionale di Guerra (1860-1906)* (Rome: Officina Poligrafica Italiana, 1907), 265; Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 109 and 121. The attack is meant explicitly for the armchair geographer Guido Cora for charting on the map of Assab a non-existent river whose mouth was allegedly supposed to be in the bay. Such mistakes—Volpe argued—were due to several errors of travellers that "are not led by scientific interest" Volpe, "Assab sotto il rapporto geografico": 104.

[152] Volpe, "Assab sotto il rapporto geografico": 125.

political influence in Abyssinia, not for inland expansion.[153] Nerazzini's essay of "medical geography" recognized that East Africa was not a luxurious land. However, he explained that Assab was in a special climatological condition, because the lack of humidity did not make the region insalubrious like other tropical climates, especially if compared to British Moka in Yemen and the French port of Obock in Djibouti. The mountains of the Horn of Africa shielded Assab, which was so dry that it was protected from an excess of humidity, otherwise "the acclimatization of Europeans would be an even more challenging issue."[154] To summarize, the fragmentation of the Italian scientific community and divisions between supporters of Italian expansion toward the southern Shewa region or the Tigray made Italian geographical exploration and the production of scientific data about Africa a highly controversial topic. This is the social explanation for the controversial nature of Italian colonialism in this period.

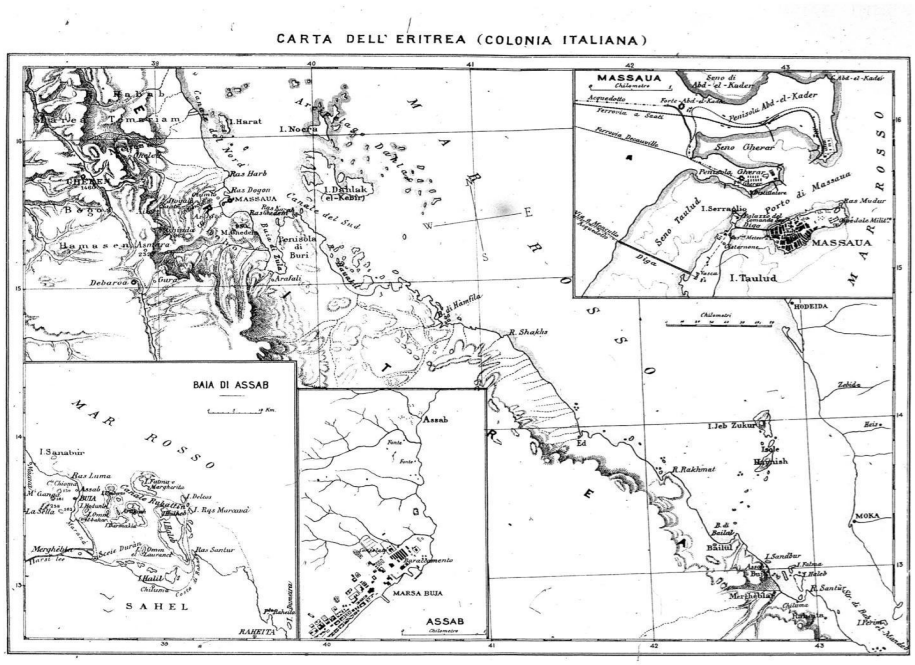


Fig. 1.11: Map of Italian settlements in Eritrea in 1894. In the North, Italians controlled the port of Massawa (enlarged on the upper right corner). This would become the northern access route to Ethiopia. In the South, the bay

[153] Nerazzini graduated as a doctor in obstetrics at the university of Pisa in 1872. Even if he was educated, he must not have come from a wealthy background, since he paid for his studies at the university by working as a scribe for a notary in Pisa. He worked between 1876 and 1877 as surgeon on the ship Batavia for the company Rubattino on the route to Singapore. Between 1879 and 1881 he joined the navy for an expedition reaching the Philippines, the South Chinese Sea, and Indonesia under the leadership of the Prince Admiral Tommaso di Savoia on the cruiser Vettor Pisani. On the way back, Nerazzini stopped in Assab for the first time in 1881 and upon his return he was put in charge of the establishment of the sanitary service of the colony on January 15, 1883.

[154] Cesare Nerazzini, "Osservazioni Mediche sulla Baja di Assab," in *Giornale di Medicina Militare* (1884): 22-44.

of Assab (enlarged in the lower left corner) remained isolated because of the Danakil Desert. It is possible to see that, still in 1894, Italians knew only the coast and ignored most of the interior of the region.[155]

1.4 Drought, Disease, and Famine (1885-1890)

I have so far described *how* Italians produced environmental knowledge at the very beginning of Italian colonialism. Here, I suggest that Italian reports did not take into account either contemporary climate changes or the ecological transformations that Italian colonialism produced. I focus in particular on the transformations triggered by the Italian invasion of Massawa, Eritrea's major port in the Red Sea. The Italian invasion overlapped with and ultimately tried to exploit a devastating drought and famine that shook the foundations of Ethiopia's economy and society. Despite the challenge of acclimatization of Italian troops, Italians funded the colony of Eritrea amid expectations that a thirsty and starving Ethiopia would fall under their protectorate.

The 1885 occupation of Massawa, several miles north of Assab and the traditional access port to the northern Ethiopian Tigray region, and the Sudan, changed dramatically the scale and impact of Italian colonialism in Africa. The 1884 Berlin Conference for the partition of Africa and the defeat of British troops against the Mahdist Revolution encouraged Italians to launch a military campaign in the Red Sea. The British did not want the French to fill the vacuum left by their defeat and spurred Italians to occupy Massawa before the French or the Ethiopians did. The Italian military officer did not even have a map of the city before landing and his British counterpart displayed one to him for the first time. As in Assab, Italians landed in Massawa without previous intelligence of the region.[156]

Despite the fact that these travel accounts warned about the lack of good water supplies in the city, the Italian expedition did not seem aware of its environmental conditions. 2500 soldiers and about 700 seamen landed in the small town between February and March 1885 and sparked a sanitary crisis. All of a sudden, Italians had to learn the lessons of tropical medicine that the British and French had developed over centuries. Military doctors launched the alarm about the hygiene of the troops.[157] Among the 700 sailors that constituted the navy's crews, 435

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[155] Map from Giovanni Petella, Filippo Rho e Alessandro Pasquale, *Massaua: Clima e Malattie – Studii* (Rome: Tipografia Nazionale di G. Bertero, 1894).

[156] Several European travelers had used this port to enter Ethiopia in the past, but the information they produced was translated into Italian only in 1885 by Attilio Brunialti with the publication of Élisée Reclus' "The Earth and its Inhabitants." See Eliseo Reclus, *Nuova geografia universale: la Terra e gli uomini* (Naples: Vallardi, 1885).

[157] The Navy Doctor Fiorani collected sanitary statistics for the year 1885 after Italians landed in Massawa. See also letter from Baratieri to Tacchini, Massawa May 19 s.d. (C.R.A.-C.M.A, Fondo Tacchini). See Petella, Rho and Pasquale, *Massaua: Clima e Malattie – Studii*. Alessandro Pasquale continued studying other diseases in Massawa: see Alessandro Pasquale, *Nota Preventiva sulle Febbri di Massaua: Studi e Ricerche* (Rome: Tip. Carlo Voghera, 1889); Id., *Ricerche Batteriologiche sul Colera a Massaua e Considerazioni Igieniche*, (Rome: Tip. Enrico Voghera, 1891); Id., *Sul Tifo a Massaua: Studio Clinico ed Osservazioni Batteriologiche* (Rome: Tip. Enrico Voghera, 1891); Id., *Sulla Presenza di larve di ditteri nell'intestino di alcuni febbricitanti di Massaua* (Naples: E. Detken, 1890). Filippo Rho (1856-1935) wrote an extensive bibliography about tropical medicine and later became the director of the journal *Annali di Medicina Navale e Coloniale*.

needed medical assistance after only six months in Massawa in 1885.[158] Fever outbreaks occurred suddenly and military doctors had a hard time distinguishing between malaria, typhoid and miasmatic fevers. Doctor Faralli, who still operated within the scientific paradigm of miasma theory, reported that "a lot of older officers without even suffering fevers had to go back to Italy, because of the enervating effects of the hot and humid climate." He saw the temperature and humidity of the atmosphere as powerful sources of disease and believed in the influence of meteorological phenomena on public health and hygiene.[159] The doctor Forti Pirro investigated for the medical journal of the army whether the treatment of several diseases through climatic treatment was possible.[160] Doctor Panara collected statistics displaying the correspondence between months of the year and rates of fever and concluded that their origin was due to Massawa's environment.[161] In other words, Italian doctors immediately blamed Massawa's climate for its vicious effects on European populations.

The influence of climate on human diseases was considered normal in the medical literature of the time. Yet the magnitude of Italian complaints about the climate of Massawa leads one to suspect that they landed during a particularly hot series of years between 1885 and 1888, before the "cruel years" of the "Great Famine" (1888-1892) that Mike Davis has attributed to an El Niño cycle.[162] El Niño is known for altering the rainfall regimen of the Horn of Africa and provoking extensive droughts in the region. The complaints of Italians soldiers and doctors might be caused by a prolonged and severe drought.

The emergency drove the production of an increasing amount of weather data. Italian doctors started the analysis of the meteorology of Massawa in the second decade of May 1885.[163] The summer 1885 was unbearable with temperatures "above those of every known foreign colony."[164] Under the tents of Italian army hospitals, the temperature reached 43C (109.4F). The Italian geographer Luigi Pennazzi wrote that "if Dante had known Massawa, [...] his *Inferno* would count an extra ditch where the poet would put the most sinful and damned souls."[165] The Director of the Central Meteorological Office Tacchini recommended the doctor of the navy Giovanni Petella to the General Baratieri as director of the meteorological measurements in the

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[158] Giovanni Fiorani, "Statistica Sanitaria della Divisione Navale del Mar Rosso pel primo semestre 1885", *Giornale Medico del R. Esercito e della R. Marina*, 1885; "Statistica Sanitaria della Divisione Navale del Mar Rosso pel secondo semestre 1885," in *Giornale Medico del R. Esercito e della R. Marina*, no. 3 (1886): 365-72.
[159] Giovanni Faralli, *Rapporti tra la meteorologia e l'igiene* (Florence, Tipografia Cooperativa, 1886).
[160] Forti Pirro, "Cenni sul Trattamento Climatico del Dottore Forti Pirro," in *Giornale Medico del R. Esercito e della R. Marina* (1886): 671-693.
[161] Panfilo Panara, "L'Ospedale Da Campo in Massaua e Le Vicende Sanitarie Del Corpo Di Spedizione Dal Febbraio Al Settembre 1885," in *Giornale Medico Del Regio Esercito E Della Regia Marina*, no. 4 (1886): 439–69.
[162] Mike Davis, *Late Victorian Holocausts: El Niño Famines and the Making of the Third World* (London and New York: Verso, 2001), 264. Davis relied on Degefu, "Some aspects of Meteorological Drought in Ethiopia" in Michael H. Glantz, ed., *Drought and Hunger in Africa: Denying Famine a Future* (Cambridge and New York: Cambridge University Press, 1987), 30.
[163] Lieutenant Lavallea was in charge of the obeservations, but they were not published under his name.
[164] Panara remembered Nerazzini's analysis of Assab's climate, which was dry at least. Panara, "L'Ospedale Da Campo in Massaua," 459.
[165] Luigi Pennazzi, *Dal Po ai due Nili: Massaua, Keren, Kassala* (Modena: Antica Tipografia Soliani, 1887), 6 and 29. See also Luigi Pennazzi, *Sudan Orientale* (Naples: Detken, 1881); Id., *A Dorso di Cammello. Dal Po ai Due Nili* (Milan: Treves, 1882).

colony.[166] Tacchini analyzed the data collected from the period between May 1885 and May 1886, and his special report about the climate of Massawa was published by the *Rivista Militare Italiana* (Italian Military Review).[167] The challenges of African climate spurred the collaboration between science and the State to produce more climatological information.

Italian meteorologists did not have any previous data to compare between their current observations and could not understand whether Massawa's climate was normally so hot or whether it was facing an exceptionally severe drought. One might think that Italians' lack of experience in tropical climates might be the cause of so much anxiety about the climate. Yet even the British navy captain David Wilson-Barker, who was skeptical of the high temperatures recorded by Italians and collected temperature data between December 1887 and February 1888, concluded that "Massawa is one of the hottest places in the world."[168] The Italian doctor Cesare Nerazzini, reporting in 1888 about a trip from Massawa into Ethiopia in 1885, noted that "the season was exceptionally hot, because the rains of the Kremt were late; therefore all water streams were dry."[169] The drought in the Tigray was probably already visible in 1885.

News about the hot climate of Massawa and the poor health of Italian troops in Africa was discussed in Parliament to critique the Government's unpopular war in Africa. Temperature figures became so controversial that the Chief of Staff started manipulating the data. On March 4, 1888, the journalist Vico Mantegazza reported that the numbers of soldiers hospitalized outnumbered official figures. Moreover, he accused the colonial Military Government in Africa of faking the temperatures by informing the troops of only those recorded at the port "in a very windy station." Mantegazza pointed out that "the Command does not recognize any other thermometer than the one located in this station. It will probably be placed soon in a [cool] underground location."[170] Ironically, Mantegazza noted: "The Command said: 'You shall have no other thermometer before the one of the *Capitaneria*, and you will thank God for the mild temperature recorded by the official thermometer even if you are about to die for the heat."[171]

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[166] Giovanni Petella, *Massaua ed Assab, saggio di topo-idrografia e climatologia comparate. Con una carta climatologica dell'Eritrea, varii quadri meteorologici e due specchietti termo-grafici intercalati nel testo* (Rome: Tipografia Nazionale di G. Bertero, 1894). Baratieri was not willing to devote much money to the meteorological service: in the same letter, he suggested that Petella's trip should be funded by the navy and asked for some instruments for the meteorological service of the colony for free or at a very low price.

[167] Ministero della Guerra to Pietro Tacchini, Letter dated January 25, 1888 (C.R.A.-C.M.A. Fondo Tacchini). Pietro Tacchini, "Sul Clima di Massaua," in *Annali del R. Ufficio Centrale di Meteorologia e Geodinamica* XVIII, Part I, (1886), Roma; Id., "Temperatura ed Evaporazione a Massaua," in *Rendiconti R. Accademia dei Lincei*, s. IV, vol. V (1889) 329-330.

[168] He added: "What is really so trying in a place of this sort in summer is the continual heat day and night, when the air is heated up to a temperature above that of the blood, making it difficult to breathe." David Wilson-Barker, "A winter's weather in Massowah," in *Quarterly Journal of the Meteorological Society*, v. 15-16 (1889-1890), 35-42, 38. Id., "Sul Clima di Massaua," in *Bollettino Mensuale pubblicato per Cura dell'Osservatorio Centrale del Real Collegio Carlo Alberto in Moncalieri*, s. II, v. X (1890): 47-48.

[169] Cesare Nerazzini, "Memorie e Relazioni - Itinerario in Etiopia (1885)," in B. S. G. I. 23 (1888): 140.

[170] Vico Mantegazza, *Da Massaua a Saati; narrazione Della Spedizione Italiana Del 1888 in Abissinia* (Milan: Treves, 1888), 205 He reports that the temperature reached 42-43 degrees Celsius under the tents, 35-36 in the shade.

[171] *Ibid*.

The military and political establishment did not want the public to question whether Italians could survive in the climate of Massawa.

Acclimatization and race were tightly related in the medical discourse of the time.[172] "Most medical authorities and social theorists in the nineteenth century held that the boundaries within which an individual could stay healthy and comfortable coincided with the region in which his race had long been situated. For the past century, medical geographers had discussed whether Europeans might adapt themselves, or acclimatize, to a tropical environment—and the answer was still, even in the 1890s, unsettled."[173] Alongside the divisions between local scientific and geographical communities, a further sign of Italy's recent nationhood was the perception that Italians from the North and South would withstand to African climate differently.

While British, French, German, and American doctors highlighted the difference of resistance to tropical climates between white Europeans and colonial subjects, Italians turned the race-climate question inward and inquired about whether Southerners and Northerners endured Massawa's climate differently. The Italian Doctor Panara suggested to "select the individuals to be sent to Africa" and asked: "Could we find a reason to send to Africa troops originally from a certain region of Italy rather than another one, among the ethnic and anthropological differences of our own country? In other words, what is the degree of adaptability to the climate among different Italic peoples (*popoli italici*)?"[174]

Panara himself tried to produce approximate statistics by dividing his patients between Northern, Central, and Southern Italians.[175] In December 1887, the journalist Mantegazza noted that "Abyssinians have time, climate, and the great challenges of the terrain as allies."[176] Amid such environmental challenges, Italians focused on their internal divisions and made very little headway from the coast into Ethiopia between 1885 and 1888.

What was the ecological impact of the arrival of Italian troops on Ethiopian population? At first, Emperor Johannes managed to halt the Italian invasion. Ethiopians defeated Italian troops in the battle of Dogali (1887) and forced Rome to send reinforcements. The arrival of human diseases with Italian troops occurred, but overall Ethiopians had a long history of exposure to European infections and were ready to rely on foreign personnel to treat them.[177] For example, smallpox spread inland from Massawa to Adwa between 1885 and 1886, but the Greek

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[172] Philip D. Curtin, *Death by Migration: Europe's Encounter with the Tropical World in the Nineteenth Century* (Cambridge and New York: Cambridge University Press, 1989).

[173] Warwick Anderson, *Colonial Pathologies: American Tropical Medicine, Race, and Hygiene in the Philippines* (Durham: Duke University Press, 2006), 41.

[174] Panfilo Panara, "L'Ospedale Da Campo in Massaua e Le Vicende Sanitarie Del Corpo Di Spedizione Dal Febbraio Al Settembre 1885, parte II," in *Giornale Medico Del Regio Esercito E Della Regia Marina*, no. 5 (1886): 560.

[175] Following the ethnographic studies of the anthropologist Raffaello Zampa, Panara divided 976 Northerners, 708 Central Italians, and 977 Southerners, where he included soldiers from Apulia and Campania "with torrid climate compared to Tuscany and the Abruzzi" *Ibid.*, 561.

[176] Mantegazza. *Da Massaua a Saati*, 51.

[177] See Richard Pankhurst, *An Introduction to the Medical History of Ethiopia* (Trenton: The Red Sea Press, 1990).

doctor Nicola Parisis vaccinated the Emperor Johannes, Menelik, and all their generals.[178] Yet Italians brought with them an invisible and devastating enemy: the cattle plague.

The cattle plague that natives called *Gulhai* was unknown in East Africa before the arrival of Italian troops. Animal diseases existed before, of course (the natives called them *Sambù, Boò, Mendef, Nefrì, Abrich, Ezrò,* and *Zenzià Ghemel*), but most of them disappeared with the rise of the *Gulhai* outbreak. In order to feed their troops, Italians purchased infected cattle from British India as early as November 1887.[179] In the second half of January 1888 the epidemics had already killed 570 cows in five days, but Italians thought at first that they died due to lack of water.[180] Contacts between Italian and Ethiopian troops brought about the contagion of the disease across camps in March 1888, when the Emperor Johannes confronted the Italian army at Saati. Johannes' march back into Abyssinia spread the disease even further throughout the Horn of Africa. The disease spread even further in the following years, reaching German South-West Africa in the early twentieth century.

In the past, Ethiopians had always managed to keep animal diseases under control. The deserts south and east of the highlands were a powerful ecological barrier, because travelers were forced to switch means of transportation from camels to mules when they reached the highlands from the coast. In the north, Ethiopians stopped the transit of cattle from Massawa into the highlands around Asmara whenever diseases circulated in the Red Sea. The Italian invasion suspended indigenous public health practices, violated the ecological boundaries of Ethiopia, and contaminated the ecological system of the highlands by carelessly bringing infected animals.

The disease had a huge impact and was lethal for 80-90% of the livestock in Ethiopia. It spread rapidly through the country, from the north to the south, and killed in an average of ten days. Contagion spread faster whenever animals shared pastures and water. Since the drought pushed herds to migrate further and further in search of the few remaining streams of running water, it paved the way for a disastrous spread of the disease.

The drought weakened the country, prepared the terrain for the annihilation of Ethiopia's livestock, and ultimately affected the ability of the population to feed itself. The doctor-diplomat Cesare Nerazzini was the first to notice the signs of the incipient famine in the northern Tigray region:

> The whole of Abyssinia and particularly the Tigray look very poor and miserable. Despite the fact that the soil looks very fertile and easy to cultivate, there are no agricultural resources. Wheat and fodder are barely enough for local consumers. Pastures are generally abundant up until March, but afterwards everything is arid and dry. Hungry and scrawny herds of animals wander around

[178] See Del Boca, *Italiani in Africa Orientale*, v. 1, 217. See also Nicola Parisis, *L' Abissinia* (Milan: A. Brigola, 1888), 130.
[179] Mantegazza, *Da Massaua a Saati*, 26.
[180] *Ibid.*, 124.

> looking for food. This is probably a reason for the frequent animal epidemics that often slaughter the livestock in Abyssinia.[181]

The animal disease persisted for several years (1888-1892), because it followed a seasonal rhythm. A series of rain failures in 1888 and the complete lack of animal power pushed Ethiopia to the edge in what are called "the Cruel Days" between 1888 and 1892.[182] French Catholic missionaries reported the failure of their missions' crops by November 1888. The spread of the disease accelerated after the dry period between the small and big rains (end of February- May), when cows were weaker and underfed, and migrated in search of water.[183] Nerazzini observed that water was often contaminated by the livestock. Ethiopian herdsmen tried to isolate sick animals to prevent contagion, but the general drought forced them to choose between letting their livestock die without water or letting them drink and risk spreading the disease further.[184] They often chose the latter. The combination of drought and lack of animal power produced the worst famine ever recorded in Ethiopian history.

The famine was a social as much as a natural disaster. While the heat of the drought affected Italians in Massawa and Ethiopians in Tigray alike, the famine was the product of the Italian invasion. By killing the entire livestock of the region, Italians had unhinged the "plow-oxen" complex, namely the fundamental structure of agricultural production in the Ethiopian highlands.[185] Ethiopians used only oxen to plough their fields, because mules and horses were not heavy enough to work on muddy soil during the two rainfall seasons. The plow-oxen complex was the base of a politically centralized system in the northern highlands throughout Ethiopian history, because taxes were paid in annual crops that depended on the regimen of rainfalls: "While the ox-plow complex and the imperial state were not synonymous, this agricultural system seems to have been almost a *sine qua non* of [Ethiopian] imperial hegemony."[186] Deprived of animal power to cultivate fields and afflicted by the drought, the social fabric of Ethiopia collapsed, crippled by famine.

Estimates of demographic decline due to the famine point to a decrease in population from about seven to three million people. During his trips, Nerazzini noted: "So much solitude

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[181] Nerazzini was traveling before the major outbreak of rinderpest that decimated Ethiopia's livestock. Cesare Nerazzini, "Itinerario in Etiopia (1885)," in B.S.G.I., s. III, v. II (1889): 985 and 170.

[182] The best account of the "Cruel Days" is by Richard Pankhurst, "The Great Ethiopian Famine of 1888–1892: A New Assessment," in *Journal of the History of Medicine and Allied Sciences* XXI, no. 2 (1966): 95–124; Id., "The Great Ethiopian Famine of 1888-1892: A New Assessment: Part Two," in *Journal of the History of Medicine and Allied Sciences* 21, no. 3 (1966): 271–94. Id., *The History of Famine and Epidemics in Ethiopia prior to the Twentieth Century* (Addis Ababa: Relief and Rehabilitation Commission, 1985).

[183] Giovanni Memmo, Ferdinando Martoglio and Carlo Adani, "Peste Bovina," in *Annali d'Igiene Sperimentale* XIV (1904): 235-93.

[184] Teodorani, "Brevi Appunti sulla Peste Bovina (Gulhai) e sulle altre malattie del bestiame," in *Bollettino agricolo e commerciale della colonia Eritrea* 3 (1905): 484-89.

[185] James McCann, *People of the Plow: An Agricultural History of Ethiopia,1800-1990* (Madison: University of Wisconsin Press, 1995).

[186] *Ibid.*, 81. McCann explains that "Incorporation of new areas [into the Ethiopian empire], particularly along the frontier between agricultural and pastoral highlands, involved military conquest and also the expansion of Christianity, language, and social institutions, and plow agriculture." *Ibid.*, 42.

and lack of life in such vast parts of Abyssinia have always made me wonder what is the amount of population in Ethiopia. Anytime I read in geography books and travel accounts the figures of the total population of the kingdom, I instinctively feel like reducing them from ten to one."[187] The journalist and member of Parliament Achille Plebano noted that "indigenous population is very scant and it keeps dropping every year [...]. Twenty years ago, travelers and missionaries agreed on numbering the population at 7 million people. Today it is calculated that they are reduced to 3 million. It happened to me to travel for entire days without meeting anyone along the way. "[188] He saw idle population affected by misery, even people trying to collect seeds from animal excrements.[189] Ethiopians died in vast numbers or tried to escape by migrating towards the coast. But the isolation that had protected Ethiopia for centuries turned into a trap now that the country was surrounded by Italian forces along the coast of Eritrea and Somalia.

The famine attacked a weakened population and spread from the northern Tigray region to the southern Shewa. Already in 1888, the Doctor Traversi informed the government that Ethiopians would not be able to continue the war against the Italians: "Weary, exhausted, hungry, and unhappy after the last campaign, I am almost certain that Ethiopians would not respond to a new call to arms from the emperor if our actions will force him to go back to war. We could not wish any better!"[190] Despite the fact that very little information about the famine arrived in Italy, Italians started operating with the assumption that Ethiopians would not be able to defend themselves in the long term.

The Italian scientific station of Let-Marefià launched the alarm of the beginning of the famine in the South in early 1889. "The Shewa country and in general the whole of Abyssinia is going through a serious crisis. A lethal epidemic has almost completely destroyed the livestock and now is wreaking havoc among the people, due to forms of dysentery."[191] In 1890, Traversi informed the Italian Geographical Society of the worsening of the famine from Let-Marefià. "The country is going through a severe crisis. The harvest of the *belg* rains that is coming in now to storage is very poor, and we cannot rely on the next one in December because of the lack of animals to work the land. In such a country, where the plow is used everywhere and the people are lazy and do not want to use the hoe, the animal disease has brought misery and hunger,

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[187] Cesare Nerazzini, "Itinerario in Etiopia (1885)," in B.S.G.I. III, s. III (1890): 64-5. Nerazzini traveled to Abyssinia after reading both James Bruce and Élise Reclus' geographical narratives and noted that the landscape was wild and abandoned because of the local civil war, rather than because of its nature. *Ibid*., p. 71.

[188] *Ibid.*, 59 and 62.

[189] Achille Plebano, *I Possedimenti Italiani in Africa. Impressioni e Note di Viaggio* (Rome: Tipografia Giotola, 1889). Supporting the idea of a commercial colony, he recognized that the climate was not bad despite what he had previously heard in Italy "For what concerns the climate, I do not think that you can say anything bad about it" (71) but when he crossed the Anseba river "it was always dry" (77).

[190] Traversi's letter from Let Marefià to the Civilian Commissary in Assab, July 22, 1888, A.S.M.A.E., Archivio Eritrea, 19, f. 2, "Carteggio Antonelli 1886-1889."

[191] "Memorie e Relazioni. Lettere del Dott. Vincenzo Ragazzi alla Società Geografica Italiana," Let-Marefià, 14 August 14 1889, B.S.G.I. II, s. III, (1889): 964-67. On February 20, 1889, Antonelli wrote from Addis Ababa to the Italian Civilian Commissary in Assab that "The Shewa lost all its livestock after an epidemic that is still slaughtering animals. After the war, one can forecast a famine. Indeed, Abyssinia cannot expect fortunate days" in A.S.M.A.E., Archivio Eritrea, f.2, "Carteggio Antonelli 1886-1889."

raising the price of food in extraordinary proportion."[192] The first Italian doctor studying the disease was unsuccessful when he tried to find a vaccine and denied Italian involvement in its origin, but it was widespread opinion among Ethiopians that Italians brought the epidemics.[193]

Meanwhile, the famine caused a dramatic shift of power from the northern Tigray region to Southern Shewa. After the death of Emperor Johannes in battle, Menelik, the Shewa king, was crowned Emperor of Ethiopia on November 3, 1889. This was a significant victory for the Italian supporters of the Shewa policy, since their champion had finally ascended to the imperial throne. Yet Menelik was powerless when it came to controlling the northern Tigray region, which remained in turmoil under independent local chiefs because he could not put together any army in a starving and demographically collapsing country. Political anarchy, raids and lootings among Ethiopians to steal remaining resources from one another, even cases of cannibalism complete the picture of the absolute chaos produced by the environmental domino effect originated by the Italian introduction of *Gulhai* to East Africa.

With the Ethiopian Empire paralyzed, Italians were ready to exploit the events finally turning in their favor in Tigray as early as April 1889, when they received the news of the death in battle of Emperor Johannes.[194] In a confidential report from Let-Marefià that was forwarded to the Ministry of Foreign Affairs and the Chief of Staff, Traversi examined the political implications of the famine for Italian expansion in Africa:

> The economic condition of the country is the most miserable. The famine gets worse day by day and typhoid fevers are slaughtering the Abyssinians. I do not exaggerate when I say that at least one fourth of the population has perished. Nobody lives in the regions of the *Quolla* and the *Degà*, where there was still food, now it is assaulted by diseases. I will spare you the horrible stories occurring every day in the country, where people fight with wild beasts to eat carcasses and dead bodies. Life here is the most expensive ever and prices continue to rise. In such state of affairs, of course the country is [militarily] quiet… Today any rebel with some strength and especially some food could easily become the king of Abyssinia, especially since Menelik is not popular, because people think that he is responsible for the famine and the disease, as well as for good and bad weather. Concerning our relations with

[192] Traversi took control of the station in mid-April 1890 and noted that the summer rains had arrived early. B.S.G.I. III, serie III (1890): 771. Lettera del Dott. Traversi da Let Marefià, June 10, 1890, in B.S.G.I. III, s. III 1890: 719.
[193] G. Conti, "La peste bovina nella colonia Eritrea: studi e ricerche," in *Il Nuovo Ercolani* VII (1902-1903): 121-126. Giovanni Memmo, Ferdinando Martoglio, and Carlo Adani critiqued Conti in "Peste Bovina," in *Annali d'Igiene Sperimentale* XIV (1904): 263.
[194] General Antonio Baldissera to the Ministry of War, Massawa, April 3, 1889: "The death of the Negus has been confirmed. His army is completely dissolving. There is complete anarchy, aggravated by great general misery. The current situation in Abyssinia is not temporary; it will last years. We do not lose anything by waiting [to occupy the highlands]. Everyone, sooner or later, will ask for our help." In *Documenti Diplomatici Presentati Al Parlamento Italiano Dal Presidente Del Consiglio Ministro Ad Interim Degli Affari Esteri (Crispi) Etiopia* no. 46 (1890): 39-40.

> Abyssinia, all these disasters can turn out to be favorable to us. Today our work is very difficult, because these latest events made Abyssinians suspicious. Today we work like missionaries. We have to be patient, patient, patient [*sic*]. When patience will no longer be useful and any other effort [to establish Italian protectorate over Ethiopia] will result useless, then we will have to do with Menelik what we did with Johannes [namely, go to war]."[195]

Meanwhile, the Ministry of Foreign Affairs pushed for the conquest of Asmara thanks to these new favorable circumstances, such as the fact that "the people are exhausted by years of war [...] and hungry."[196] The Italian military command in Africa hoped to capitalize on the anarchy that followed the death of the Negus and intended to take advantage of the great misery of the country in due time: "The appropriate time of action will come when Abyssinians will have finished their ammunition and the population, increasingly in need of peace, will implore our intervention."[197] As the authority of the emperor dissolved, especially at the northern border of the empire, more tribes accepted Italian authority in order to obtain some safety and protection. In the middle of the Ethiopian famine, Italians tried to take advantage of the Ethiopian crisis to establish their colony in Eritrea, seal the coast of the Horn with the conquest of Somalia, and establish their protectorate over the entire region.

Italians bullied Menelik to give up as much territory as to reach the Mareb river, the current border between Eritrea and Ethiopia. Augusto Salimbeni, the special envoy of Italian Prime Minister Crispi at Menelik's court starting in November 1889 and a direct witness of the famine, was ready to use it as a pretext for Italian occupation. He claimed that the appalling conditions of the population made Italian occupation of the region up until the Mareb necessary, since a number of refugees travelled across the river to find refuge, food, and work into what was becoming Italian Eritrea.[198]

Yet there was nothing humanitarian in Italian colonialism. The port of Massawa had plenty of imported grains from India, but "what looked like abundance was actually a sign of misery," since a bag of sorghum cost 14 lire in Massawa, 43 inland in Keren, and around 100 in Adwa, the first major city in Ethiopia.[199] Witnessing the miserable spectacle of starving and dying environmental refugees in the outskirts of Massawa, the Senator and future Governor of

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[195] Letter from Traversi, Let-Marefià, October 26, 1891, in A.S.M.A.E., *Archivio Eritrea* 19, f. 4, "Let Marefià."
[196] The Ministry of Foreign Affairs to the Ministry of War, Rome, February 12, 1889, in *L'Africa Italiana Al Parlamento Nazionale. 1882-1905. Riassunto Delle Discussioni Avvenute Al Parlamento, E Delle Interpellanze, Interrogazioni, Disegni Di Legge, Bilanci, Relazioni, Documenti, Su Argomenti Riguardanti Le Colonie Italiane d'Africa* (Rome: 1907), 31.
[197] Letter from Baldissera, Massawa, April 20, 1889, in *L'Africa Italiana Al Parlamento Nazionale* 43.
[198] "Mercoledì 12 luglio 1890: [...] Ora il paese fino al Mareb è deserto, affamato e non può essere tenuto né da Mangascià, né da Alula e perciò è infestato da ladroni e ribelli, che ci hanno costretti ad avanzare fino al Mareb e al Belesa." Augusto Salimbeni, *Crispi e Menelich nel diario inedito del conte Augusto Salimbeni* (Turin: Industria Libraria Tipografica Editrice, 1956), 112.
[199] Ferdinando Martini, *Nell'Affrica Italiana: Impressioni e Ricordi*, 5th ed., (Milan: Fratelli Treves, 1895), 38.

Eritrea Ferdinando Martini, commented: "From the Tigray an exodus of families started across the Mareb and continued for months and months, turning to Massawa as if it was the Promised Land… Every day hundreds of beaten and sick people arrived exhausted by the long trip from the Tigray. Additionally, they came from infected regions and there was fear that they would cause an outbreak of some diseases in those conditions. Thus, the Governor [Gandolfi] ordered the eviction of the unemployed beyond Massawa's dam. Chased away from the asylum they had desired for so long and in the worst misery, they set tents in the flat area of *Otumlo*. [...] There were abandoned dead bodies everywhere. The dead were waiting for the hyenas, those alive for death. [...] I know, there is no possible relief that would be enough. If we provided any aid, the entire Abyssinia would pour in here tomorrow."[200] Utter disregard of such refugees had become normal among white officers in Massawa, "to the point that people stopped talking about them." "In the plain of *Otumlo* moribund persons died. In Massawa instead there was music, lights and fireworks."[201]

In 1890, the doctor in charge of collecting sanitary statistics in the city added a heading to his table for deaths caused by starvation and commented: "With the opening of routes to the interior, the occupation of Asmara and Keren, and the expedition to Adwa, it was natural that a multitude of miserable people, left without anything by fortune and raids, etc., turned wherever hoped to find something better."[202] Of course there was nothing "natural" in this man-made chain of ecological and social disasters.

While these environmental refugees from the Tigray fled to Massawa, those affected by the famine tried to migrate to the eastern city of Harar that had only recently been conquered by Menelik's army. Menelik reacted to the famine first with edicts urging his people to pray God for the end of the rinderpest, then by giving himself the example of plowing his fields without the plow, and finally by conquering other regions further South. With the weapons gained by the Italians and the French, Menelik exported the crisis of Ethiopia by attacking weaker polities such as Harrar and the more underdeveloped Oromo tribes. Thus, Menelik is still considered the founder of modern Ethiopia, as he expanded the boundaries of ancient Abyssinia into the current area of Ethiopia.

The Italian journalist Edoardo Scarfoglio, a sharp critic of the Italian Government's support for Menelik, travelled to Harar and condemned the situation from the columns of the Italian newspaper *Corriere di Napoli*, mentioning "the agricultural and commercial destruction of Harar that the Amhara [Menelik's people] have accomplished in such a short time."[203] Without realizing that he was describing the effects of the famine produced by the Italian invasion further north, he attributed to Menelik's conquest—and his Italian supporters—the current misery of the city: "The conquest of the Amhara brought to this country between two and three hundred thousand hungry people, soldiers, servants, women, adventurers, beggars, and thieves. The more misery grows within Ethiopia, the bigger is the flow of people to this densely

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[200] *Ibid.*, 38-40.
[201] *Ibid.*, 43.
[202] Report from February 28, 1891 and sanitary statistics for the year 1890 in A.S.M.A.E., Africa I, 32/1 (1891), "Servizio Sanitario."
[203] Edoardo Scarfoglio, "L'Harrar dopo la conquista Amhara: quel che era e quel che è," in *Corriere di Napoli*, June 4, 1891. Reported in Id., *Viaggio in Abissinia: nascita del colonialismo italiano* (Palermo: L'Epos, 2003), 119.

populated and legendary rich country… Before the invasion came from the start the famine, made even worse by the epizootic disease that has almost entirely destroyed all the livestock, so that it is forbidden to kill oxen by law, and people have been eating only goat and ram meat for years."[204] In short, Scarfoglio reported on Italian newspapers about the famine not to represent local conditions faithfully, but as a polemical tool against Menelik and the Italian Government supporting the Shewa policy.

Nevertheless, he revealed the domino effect of natural and social disasters produced by the famine, the migration of starving refugees, the violence of soldiers trying to pillage local resources, and the dissolution of public order. "In the city of Harar alone, with a population of more than 50,000 people, the number of people dying every day is horrifying. In front of the door, every morning, you can find dead people, most of them reduced to their skin and bones. At sunrise, thirty or forty dead bodies are brought away from the Faras-Magalà [the Market], most of them due to starvation. They are poor wretched without a roof or bread that enter the city when they are already in agony, throw themselves in front of a door, and wait over there for death to come."[205] Of course, the flourishing coffee trade in the region collapsed, public order declined, and "resources increasingly disappear, there are no grains to sow, and depopulation continues at a disastrous rate. It looks like one of those colossal famines from the Middle Ages that are still remembered in Europe."[206] In another episode, he reports seeing dead bodies being abandoned in the street at the mercy of wild dogs.[207] Clearly, denouncing the famine was instrumental to Scarfoglio's attack against Antonelli's support to Menelik, not to actually shed light on natural and social events in Ethiopia and inform the Italian public.

Rather than providing help, Italian officers hoped that the Ethiopian crisis would benefit them. Salimbeni did not believe in the alliance with Menelik suggested by Antonelli and the supporters of the Shewa policy. He argued that "as soon as Italians left from Massawa [to conquer the highlands], any negotiation with the Ethiopians became impossible" and believed that it was the right moment to inflict a punishment against Ethiopians once and for all.[208] "What are we waiting for? That the [Ethiopian] Empire will become strong again? That the livestock will multiply again? That the famine will end?"[209] Without being an ecologist, Salimbeni was chillingly aware of the interconnected chain of natural disasters produced by Italian colonialism.

He rejoiced that nature had achieved what the Italian army had failed to do: "Who would have ever imagined? The actual revenge of the massacre of Dogali was accomplished by a shipment of infected cattle that came from India when General Di San Marzano marched to Saati. We lost horses, oxen and camels; but the real wealth of Ethiopia, namely its vast livestock,

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[204] "Ancora l'Harrar dopo la conquista Amhara: carestia, miserie e mortalità," in *Corriere di Napoli*, June 10, 1891. Reported in *Ibid.*, *Viaggio in Abissinia*,120-21.
[205] *Ibid*., 122.
[206] Scarfoglio from Harar, May 31, 1891, in *Corriere di Napoli*, July 1-2,1891, Reported in *Ibid*., 157.
[207] Scarfoglio from Harar, May 18, 1891, in *Corriere di Napoli*, June 17, 1891.
[208] Entry from Friday, July 25, 1889. Augusto Salimbeni, *Crispi e Menelich nel diario inedito del conte Augusto Salimbeni* (Turin: Industria libraria tipografica editrice, 1956).
[209] *Ibid*., 161. Entry from Saturday, September 6, 1889.

has disappeared, thus throwing the country into despair."[210] The prospect of an Italian empire in East Africa was made possible by the ecological disruption of Ethiopia.

Even supporters of the alliance with Menelik believed by this point that Ethiopia would sooner or later fall into Italians' hands through a form of protectorate. In Antonelli's words: "Wars, epidemics and cattle plagues have exhausted all of Ethiopia. It has absolute need of recovery and a period of peace that will last at least ten years. Why not take advantage of this forced pause and organize ourselves?"[211] Antonelli promoted in 1889 the Treaty of Wuchale that forced Menelik to give up territories at the northern border of Ethiopia and—in the Italians' minds—established an Italian protectorate over Abyssinia.

Amid Ethiopia's collapse, the Italian Prime Minister Francesco Crispi proclaimed the birth of Italy's first colony, Eritrea, between the Red Sea and the northern border of Ethiopia, on January 1, 1890. In 1891 Italy and England partitioned the Horn of Africa in spheres of influence and until Adwa Italians acted with the expectation that the entire Horn of Africa would be their "sphere of influence" (see fig. 1.12). Yet controversies and divisions among Italians—as we will see in the next section—arrested Italian expansion into Ethiopia until the fascist invasion of 1935.

[210] *Ibid*., 216. Letter to General Orero from Let Marefià, Sunday November 16, 1889.
[211] Pietro Antonelli, *Nell'Africa Italiana* (Rome: Tipografia Camera dei Deputati, 1891) 26.

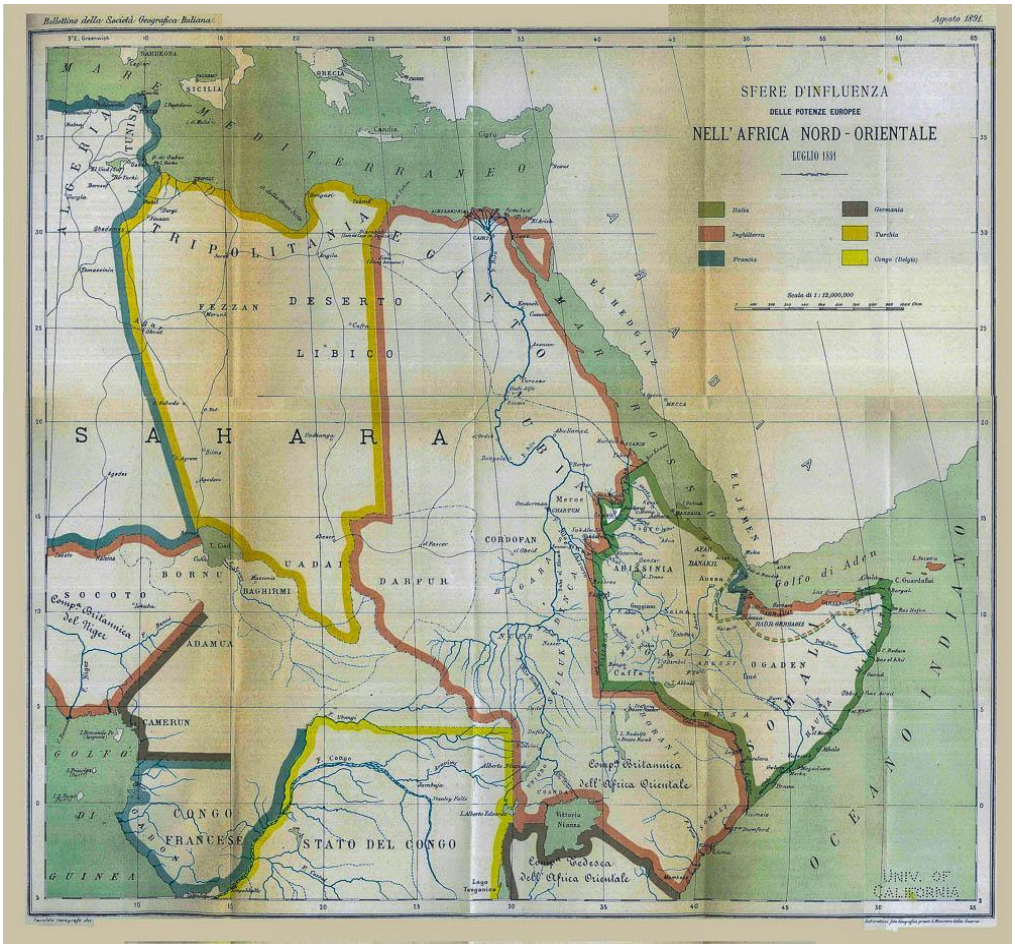

Fig. 1.12: Spheres of Influence in Africa partitioned between Italy and the British Empire in 1891, when Italy was set to extend its protectorate over the entire Horn of Africa before the battle of Adwa. The map did not correspond to any political reality on the ground, since Menelik contested the Treaty of Wuchale that—in the Italians' minds—placed Ethiopia under Italian protectorate. The map well represents the continuity between the intention of the liberal state before Adwa and the future empire of the fascist regime in 1935.[212]

[212] From the *B.S.G.I.*, 1891, Appendix.

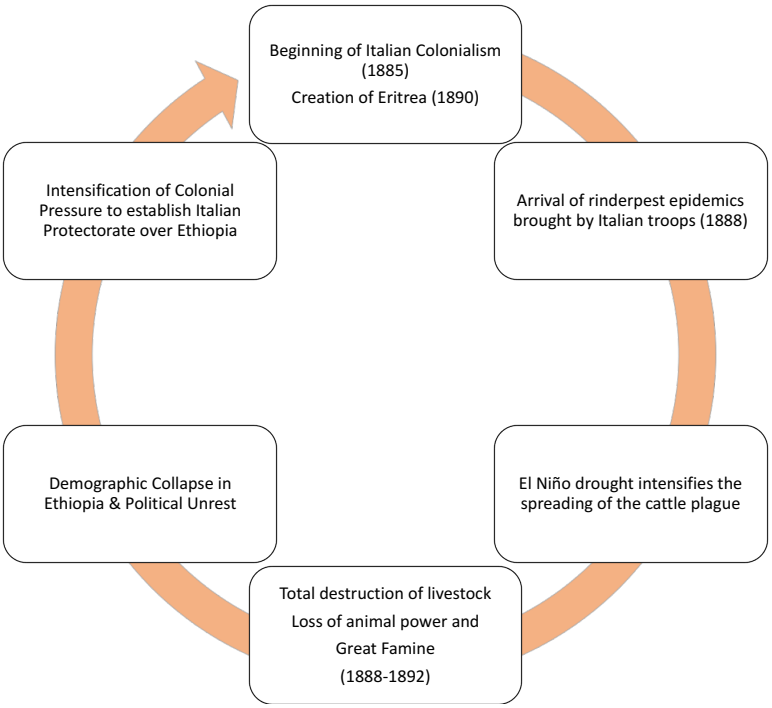

Fig. 1.13: The ecocidal loop that took allowed Italians to establish the colony of Eritrea between 1888 and 1892. The beginning of Italian colonialism in Massawa brought with it a rinderpest epidemics that spread through the livestock of the Horn of Africa. The drought intensified the spreading of the disease, unraveling the economic structure of Ethiopia, namely the "plow-oxen" complex. Demographic collapse and political unrest reinforced Italy's grip on Ethiopia and allowed the creation of Eritrea in 1890.

1.5 Colonizing Eritrea (1890-1896): Competing Projects

In this section, I demonstrate that conflicts among Italian projects for the colonization of Eritrea hindered a coherent policy of colonization. The myth that the Horn of Africa could become a settlement colony originated from the ecological unraveling of the Ethiopian empire and the perception of vast available land, whereas in fact such empty landscape was the environmental product of the Italian invasion. Both the fascist project of rural colonization for Italian peasants and the liberal myth that Ethiopia was a sterile country had their origins in the discourses and practices originated by the ecological crisis of Ethiopia before Adwa. Moreover, conflicts between competing colonial projects blocked the development of Italian geographical knowledge and created the conditions for the Italian defeat in 1896.

The depopulation of East Africa caused by the chain of ecological disasters examined in the previous paragraph was the fundamental premise of Italian colonization plans. Reports about Ethiopia's empty spaces and unexploited resources dated back to the time of the drought, cattle plague and famine, but they always failed to examine the *causes* of such a devastation. Italians had contaminated the landscape they described before even seeing it.

Italian colonial officers saw *potential* for the development of Italian agriculture amid the devastation of Ethiopia's environment. During his 1888 account of a trip through regions

devastated by drought and cattle plague, the doctor Cesare Nerazzini wrote: "Going through these regions one usually feels a pitiful sense of desert solitude, because there are no huts, no villages, but only scant and starving cows guided by a few shepherds. Such impression is the fundamental feature of the landscape. Ethiopia is generally lacking in population. Vast expanses of land would be potentially rich and productive, because nature does not seem poor of the most fundamental elements that are necessary for the production of the soil. *But the land remains at the sheer state of potential productivity*, because no human hands come to demand the results of such potential. That is probably the reason why the agricultural products of Abyssinia are barely enough for local consumption, without any surplus for private wealth that constitutes the wealth of a nation. Thus, the traveler in Ethiopia mainly feels a sense of misery and dreariness, whereas if the indigenous were four times more numerous, or if there were a new element of immigration, such general look of desolation and poverty would essentially change."[213] With the import of the cattle plague to East Africa, Italians had *produced* the empty landscape that they described as natural.

The cycle of agricultural misery, famine, and displacement that was feeding the colonial machine with local impoverished soldiers is best described by Major Ruffilio Perini, who travelled in 1893 through the same region where Italian colonization was under way. He found the fertile area at the border between Eritrea and Ethiopia empty and devastated.[214] "The majority of the villages in the *Seraè* [*Debub*] region is abandoned, and those that are still inhabited have very little population [...] There are 5 families where there could be 30." The *Seraè* [*Debub*] was also "among all the provinces of the Colony one of those providing most of our indigenous troops [...]. The miserable state of the province after war, factions, famine, and epidemics, provides us with numerous good soldiers that live with very little and use their savings to buy livestock that they send to their home countries."[215] Perini suggested reclaiming to the State the right to assign abandoned land after declaring it public domain (*medri negùs*) and even the concentration of scattered local population in a few locations.[216] The land of the highlands in the Tigray was empty and uncultivated "not just momentarily, because of the famine and epidemics, but always due to the restlessness of its chiefs."[217] In 1890, the region was covered with skulls and bones of the oxen killed by the rinderpest epidemic. When Italians would ask locals why such good land was left untilled, indigenous people replied that oxen and manpower were missing.[218]

Yet Italians were more willing to blame Ethiopians for the political unrest caused by the famine than to admit that they had triggered the collapse of Ethiopia's ecology and society. Misunderstanding the importance of the oxen-plow complex in Ethiopian agriculture, they called

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[213] Cesare Nerazzini, "Memorie e Relazioni - Itinerario in Etiopia (1885)," in *B. S. G. I.* 27 (1890): 165-66.
[214] Ruffilio Perini, *Di Qua dal Marèb* (Florence: Tipografia Cooperativa, 1905).
[215] Id. "Sulla Proprietà Fondiaria Nel Seraè," in *La Nuova Antologia di Scienze, Lettere e Arti* 129, no. 1 (1893): 690.
[216] *Ibid*., 691. The article was published with support by Franchetti, the Civilian Commissary. His work about local families and ethnic groups must be seen as part of his goal of resettling local population by keeping into account the number and ethnic type of the people to put together (*assembrare*). A plan that did not take place in the end.
[217] Leopoldo Franchetti, *L'Italia e la sua Colonia Africana* (Città di Castello: S. Lapi Tipografo-Editore, 1891), 4.
[218] Martini, *Nell'Affrica Italiana*, 181.

the indigenous population lazy. Uncultivated land called for new—Italian—workers and scientific experts to study the prospects of agricultural development. Nerazzini commented: "Everywhere, there is such disproportion between people and land that one could exploit. If the population grew five times, there would be enough work to make the soil yield to its full."[219] Martini agreed: "It does not take a chemist or an agronomist to see that the land [of the *Seraè*] is excellent. You just need to have left city-life behind sometimes."[220] The conquest of Asmara on the Eritrean highlands turned a temporary military expedition into the opportunity of settling in Africa for good.

The official proclamation of the Colony of Eritrea in 1890 required a change in the nature of Italian colonial knowledge from expeditionary science to stable infrastructure for the study of the country. With such transition, parliament decided to send a Commission of Inquiry to Eritrea after many decades of secret deals and geographical missions organized with the support of the military and the executive branch, without parliamentary oversight on Italian involvement in Africa.[221]

The civilian Commission made the most transparent public attempt yet to collect extensive knowledge about Eritrea. It was composed of seven anti-colonialist members of parliament, including the future governor of Eritrea Ferdinando Martini who changed his mind about Italian colonialism after that experience.[222] They travelled to Asmara, Debároa, Godofelassi, Agordat, and back to Massawa. Traveling at a time when the land looked empty, the outlook of the Commission was quite positive: "the colony can possibly absorb in the future part of Italian emigration and there are elements that make one hope that it will be eventually financially independent."[223]

Based on the latest research available, such as the study of the German geographer Karl Dove (see fig. 14), the Commission recognized that Italians were at the edge of the potentially rich Ethiopian highlands despite the fact that it would take years "to erase the effects of wars, epidemics, and cattle plague and populate again fields and villages with people and cows… The calamity is exceptionally serious."[224] They concluded that "great is the potential wealth of Abyssinia, but a different people should live here."[225]

For a few years between 1890 and 1896 Italians could be explicit about the intentions of their "civilizing mission" directed to the Italian lower classes, not to African peoples. Martini commented: "We are liars: it is not true that we went to Abyssinia to spread civilization… It is necessary to replace race with race… Indigenous people are an impediment to our work. We have to help them disappear, like Native Americans elsewhere." Martini concluded that "slowly

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[219] Cesare Nerazzini, "Memorie e Relazioni - Itinerario in Etiopia (1885). Continuazione," in *B. S. G. I.* 27 (1890): 80.
[220] Martini, *Nell'Affrica Italiana*, 182.
[221] See Del Boca, *Gli Italiani in Africa Orientale*, v.1, 443-57; Rainero, *I Primi Tentativi Di Colonizzazione Agricola*, 82.
[222] Del Boca, *Gli Italiani in Africa Orientale*, v.1, 450.
[223] *Ibid.*, 451.
[224] Giuseppe Borghini, Ferdinando Martini, Giulio Bianchi, Luigi Ferrari, Tommaso de Cambray-Digny, Eduardo Driquet, Antoninio di San Giuliano, *Relazione Generale Della R. Commissione d'Inchiesta Sulla Colonia Eritrea.* (Rome: Tipografia delle Mantellate, 1891): 59.
[225] *Ibid*.

but steadily, our race will replace theirs: there is no remedy… Thus, let us leave civilization aside. Our occupation in Africa has only one goal: to slowly direct here our emigrants."[226] As we will see in the next chapter, Martini changed radically approach when he became governor of Eritrea after the battle of Adwa.

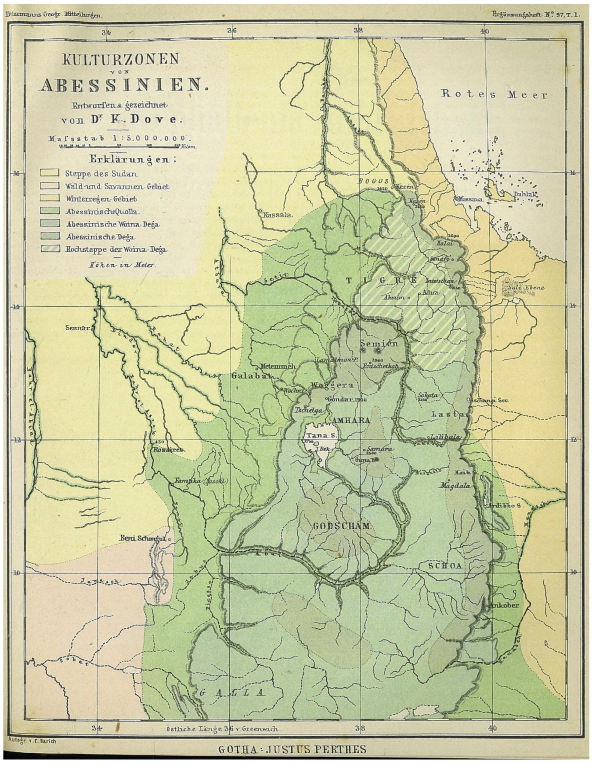

Fig. 1.14: This map of agricultural zones in Abyssinia, used by the Parliamentary Commission, shows how Massawa and the coast of Eritrea (in the north-eastern corner) was just outside of the temperate Ethiopian area centered on Lake Thana.[227]

It was at this stage that an epistemic community of scientific experts would have been crucial to actually promote the study of the region. Rather than offering a detailed colonization plan, the Commission suggested that the state promote more research about the climate, natural resources, and future development of the colony. When interrogated about the flora of Eritrea by Ferdinando Martini, when he was a member of the parliamentary commission, the German botanist Georg Schweinfurth commented that if Italians had spent more money on the study of the region, "I would have come to ask information from you, rather than the opposite."[228] Colonialism required scientific experts working with the colonial State.

[226] Martini, *Nell'Affrica Italiana,* 52-54 and 61.
[227] Karl Dove. *Kulturzonen von Nord-Abessinien (*Gotha: Justus Perthes, 1890), p. 35.
[228] *Ibid*., 50. Georg August Schweinfurth, *Le Piante Utili Dell' Eritrea* (Napoli: Società Africana d'Italia, 1891)

With the creation of a civilian government in the colony, a systematic approach should have replaced the contingent and emergency-prompted requests of information from the army.[229] As we have seen, Italian scientific experts like Tacchini and the Central Meteorological Office were occasionally consulted to produce data about the climate of Assab and Massawa under military rule. The commission recommended the creation of more meteorological observatories in order to study temperature and rainfalls of the plateau and "challenge the rumors of [...] a lethal climate and hot sand."[230] In other words, the Commission tried to debunk the complaints about Massawa and Assab's climates that circulated a few years before. Some scientific studies about the botany and climate of the region began in this period, but they remained isolated contributions.[231] Yet conflicting colonization plans would hamper the development of Italian scientific knowledge about Ethiopia and Eritrea.

Planning the study and settlement of Italy's first colony was uncharted territory for the Italian state. A clear example is offered by the first geological and meteorological study of Eritrea. The idea of hiring a scientific expert to study the geology and hydrology of the colony came up first in 1888, when the army realized that it was better to use local soil to produce bricks rather than getting them from abroad for construction. However, lack of funding delayed the project until the conquest of Asmara in 1890, when the Ministry of War requested a geologist "because we have conquered Asmara and we intend to colonize that territory."[232] The engineer Luigi Baldacci (1850-1927) was the first Italian scientific expert ever selected not for expeditionary purposes, but to undertake the geological study of the region and establish permanent meteorological observatories.[233]

Yet hiring Italy's first colonial scientific expert proved more complicated than expected. Baldacci had a new role that Italians bureaucrats had never seen before. The negotiations between the Ministry of Agriculture and the Ministry of War to create a bureaucratic framework to employ and pay him took months, because Italy did not have a colonial scientific civil service

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[229] The Military Geographical Institute started a series of surveys of the area around Massawa in 1885 and again between 1888 and 1890. However, this activity stopped with the transition from military to civilian rule until Adwa, so that Italians had produced just one map, the *Carta della Colonia Eritrea in 18 fogli*, 1890. See Ministero degli Affari Esteri, Comitato per la Documentazione dell'Opera Italiana in Africa, *L'Italia in Africa: Storia della Cartografia Coloniale Italiana*, 10-14.

[230] Giuseppe Borghini, Ferdinando Martini, Giulio Bianchi, Luigi Ferrari, Tommaso de Cambray-Digny, Eduardo Driquet, Antoninio di San Giuliano, *Relazione Generale Della R. Commissione d'Inchiesta Sulla Colonia Eritrea*, 191.

[231] See Ennio Quirino Mario Alamanni, *La Colonia Eritrea e i Suoi Commerci* (Turin: F. Bocca, 1891); Cesare Cerruti, *Brevi osservazioni sul clima e temperatura della colonia Eritrea* (Genova: Tip del R. Istituto Sordo-Muti, 1892); Achille Terracciano, *Escursioni Botaniche Nelle Terre E Nelle Isole Della Colonia Eritrea. Vol. I* (Rome: Società Geografica Italiana, 1893).

[232] The army used the expertise of the American engineer Russ who had lived for 18 years in Ethiopia, but he died on October 11, 1889 before undertaking the study of the geology of the highlands. See Ministero della Guerra, November 9, 1889 to Ministero dell'Agricoltura, A.C.S., M.A.I.C., V vers., b. 1001, f. 4357 "Possedimenti Italiani in Africa. Geologia."

[233] Luigi Baldacci, *Osservazioni fatte nella colonia Eritrea: Memorie descrittive della carta geologica d'Italia*, v. 6 (Rome: Baldacci, 1891).

yet. The Italian Ministry of the Colonies did not exist until the 1911 war in Libya. Baldacci was no longer an explorer, but the first scientific employee of the infant colonial state.[234]

Fig. 1.15: Draft of the first geological map of Eritrea produced by the engineer Luigi Baldacci.[235]

The most significant plan to combine scientific knowledge with agricultural colonization plans was attempted by Leopoldo Franchetti (1847-1917), civilian commissary of Eritrea. Franchetti was a positivist intellectual and politician who had become hugely famous for his parliamentary inquiries about the social and economic conditions of the Italian South. The surge

[234] A.C.S., M.A.I.C., V vers., b. 1001, f. 4357 "Possedimenti Italiani in Africa. Geologia."
[235] A.C.S., M.A.I.C., V vers., b. 1001, f. 4357 "Possedimenti Italiani in Africa. Geologia."

of Italian emigration and the crisis of Italian agriculture in the 1880s led him to believe that colonial expansion would be the solution of Italy's so-called Southern Question.[236]

Franchetti's populist approach to Eritrean agriculture was largely informed by his studies about the Italian South. In his mind, Italian peasants were victims of the crisis of the backward extensive agriculture that characterized Southern Italy's large estates during the Great Depression of the late nineteenth century. The plummeting of wheat prices in the face of the global competition with industrialized agriculture in America and Russia turned poor Italian peasants into emigrants. Thus, he envisioned the creation in Eritrea of small concessions for Italian peasants and their families, rather than large estates for Italian capitalists employing local labor. This was a project that became later mythologized and resurrected under Mussolini as a key feature of the techno-political regime of Fascist imperialism.

Backed by the Sicilian Prime Minister Francesco Crispi, Franchetti set himself to turn the idea of an African settlement colony for Southern Italian peasants into reality. This was the most ambitious plan of European colonization of the tropics attempted by any imperial power in the 1890s and was entirely focused on Italians, rather than indigenous population. Rather than learning about local agriculture and culture and coopting Ethiopian actors, Franchetti planned to transfer to Africa Italian peasants, seeds, and even animals. He created three agricultural experimental stations: in February 1891 at Asmara, and in March and April 1892 at Godofelassi and Gura, not far from the military fort of *Adi Ugri* [Mendefera]. In December 1893, Franchetti had managed to relocate to Eritrea ten peasant families (in total 29 men, 15 women, and 17 kids) for his plan of State-directed demographic colonization.[237]Before the arrival of Italian families of settlers, Franchetti's office employed thirty-one Italian workers. Franchetti selected families of peasants to turn them into future land-owners and created a special contract for their settlement.

Meteorology was fundamental to Franchetti for the development of agriculture in Eritrea. On December 4th, 1889, Franchetti informed Crispi of the good chances for the settlement of Italian colonists on the highlands near Asmara. On the same day, he sent to Pietro Tacchini, the Director of the Central Meteorological Office, an enthusiastic report asking to "establish a meteorological observatory in Asmara, in order to have guidance for agricultural experiments in a few months."[238] Pressure from Franchetti and Tacchini with the Ministry of Agriculture

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[236] Banti, *Storia della Borghesia Italiana*, 86. See also Rhiannon Noel Welch, *Vital Subjects: Race and Biopolitics in Italy* (Liverpool: Liverpool University Press, 2016).

[237] Franchetti selected carefully the information that he circulated in Italy, almost to the point of lying to the public. For example, in the letter to Tacchini he wrote that despite the fact that the yield had not been excellent and the crops were experimental, "the harvest is almost over and confirmed the results of the previous year, providing even more than necessary to support the nine families that are here and the tenth that is about to come." Franchetti downplayed the fact—reported in the same letter—that meteorological observations had been discontinuous because some of the thermometers were partially damaged. He was sorry for the interruptions of a service that "worked well" and promised to reimburse—when in Rome—the price of thermometers sent to Eritrea (Asmara, December 3, 1893, Archive C.R.A.- C.M.A., Fondo Tacchini). Still in 1894 Franchetti was collecting weather data, since he asked Tacchini forms of the registration data while in Rome (Rome, March 8, 1894, C.R.A.-C.M.A., Fondo Tacchini) to present to parliament his report on the success of the colonization. See *Relazione dell'on. Barone Franchetti, dep. al Parlamento, sull'operato dell'Ufficio di agricoltura e colonizzazione dell'Eritrea, presentata alla Camera dal Ministro degli Esteri Blanc nella seduta del 28 Aprile 1894*, XVIII legl., sess. 1892-1893, no. XXX, reported in Rainero. *I primi tentativi di colonizzazione,*120.

[238] Letter from Franchetti to Tacchini, in C.R.A.-C.M.A., Fondo Tacchini, Massawa, March 8, 1894.

provided the 1567 *lire* necessary for the purchase of meteorological instruments. Tacchini instructed the engineer Baldacci, in charge of the geological study of the region, to also set up weather stations.[239] The new Governor of Eritrea Antonio Gandolfi (1835-1902) promised to support the meteorological service of the colony for agricultural development.[240] In short, meteorology was set to become a crucial infrastructure of knowledge for Italian imperialism.

Ensuring that the climate of the highlands was suitable for such a project of demographic colonization was critical. Since the rainfall season was approaching, in 1892 Franchetti requested from Tacchini a number of pluviometers for his collaborator Mario Compagnoni, director of the first experimental stations.[241] In 1893, Franchetti informed the Director of the Meteorological Office that "things are going very well, much better than I hoped. The families of colonists that arrived to their destination last November 16 have already started clearing their plots of land. They are full of confidence and hope in the future, and they already appreciate the quality of the land and the climate." He requested books about tropical agriculture and animal husbandry, colonization practices in other parts of the world, and so on. The extraordinary and controversial element of Franchetti's colonization plan was the idea of creating an "Italy overseas."[242]

While the fascist regime later exalted Franchetti's efforts to use the power of the State to solve specifically Italian demographic problems, at that time his projects were extremely controversial. Through the lens of a liberal techno-political regime, many argued that Franchetti's program was expensive and unable to provide any economic return in the short term. Others argued that a poor Italy could not afford expensive agricultural experiments in Africa whose results would take years. In other words, the history of Franchetti's experiment encapsulates the roots and clash between liberal and fascist techno-political colonization projects, focusing on whether demography or the economy should come first.

Franchetti's plan privileged an economic model (State-sponsored colonization) and a regional approach to colonial agriculture (inspired by the demographic and economic needs of the South) that rivalled capitalist projects of large estates preferred by northern Italian entrepreneurs. Italian divisions between North and South emerged again amid disparate colonization plans. For example, he spent a great deal of time opposing the northern Italian

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[239] A.C.S., M.A.I.C., V versamento, b. 1001, f. 4357.

[240] Gandolfi was born in Carpi, in the same region where Tacchini was from. His friendship with Tacchini dated back to their time at the University of Modena, as confirmed by a letter dated March 27, 1876, where Gandolfi thanked Tacchini for sending him a publication of his observations of the transit of Venus and promised to read it "with all the interest, actually with all the love of someone who remembers how much interesting were the astronomical studies carried out together at the University of Modena, even if I dedicated myself to a different career," Archive C.R.A.- C.M.A., Fondo Tacchini. On June 5th he wrote: "Dear Tacchini, I wish we had talked before my departure about the establishment of a meteorological service in our colony. It is a service of the greatest importance that I will support as an essential element for the cultivation of the land. We will be in correspondence. I pray you to promote the improvement of that service over there. Yours, Gandolfi," Archive C.R.A.- C.M.A., Fondo Tacchini." For the data collected in this period, see A.C.S., M.A.I.C., V versamento, b. 1001, f. 4355 "Possedimenti Italiani in Africa. Meteorologia."

[241] Archive C.R.A.- C.M.A., Fondo Tacchini, letter dated June 4, 1892. See also archive A.S.M.A.E., Africa 1, 31/1, f. 19 "Colonizzazione. Bestiame. Vendita o donazione di terreni. Strumenti meteorologici" (I trimestre 1891).

[242] In this respect, Franchetti is responsible for turning the anxiety over Italian emigration into a foundational myth of Italian colonialism. See Mark I. Choate, *Emigrant Nation: The Making of Italy Abroad* (Cambridge: Harvard University Press, 2008).

Società Reggiana per l'Africa, Italy's first capitalist enterprise to begin the colonization of Africa. Franchetti's problem was that Italians did not have a single plan of colonization. They had too many.

The Società was supported by a member of parliament from the city of Reggio Emilia, the Jewish banker Ulderico Levi (1843-1922).[243] The Società cleared 200 hectares in fifty days near the village of Bab-Giangherèn, six hours outside Cheren, and submitted a proposal to the Ministry of Foreign Affairs for a concession of five thousand hectares on February 28, 1890, after the first agricultural studies. The goal was the cultivation of sorghum, a main staple for Africans.

In a country struggling with famine, cultivating sorghum promised economic profit and political benefits: "Here indigenous people can be dominated more by *sorghum* than by force, because that grain is everything for them. Give them a handful of that wheat and they will kowtow to you, they will worship you."[244] In other words, the Società employed local labor, a far cheaper solution than bringing Italian peasant families from Italy. Franchetti abhorred the idea of using "indigenous plows, cattle, workers, and systems" and rejected the concession of the plantation.[245] The experiment of extensive agriculture colonization of the Società Reggiana was already over in November 1890. Even supporters of the colonization, such as the German geographer Schweinfurth, critiqued Franchetti's stubborn disregard for local plants, indigenous agricultural techniques, and population.[246] Ultimately, Franchetti intended to radically replace local society with the transfer of an Italian ecology.

Ironically, news about the same drought and famine that had made Italian success possible also made information about the environment controversial once again. The lawyer Mario Michela wrote in favor of a commercial rather than a settlement colony because he did not believe that Eritrea and Ethiopia were "fertile regions with good climate, healthy air, enough water, with only a few people [...]." He was skeptical of reports that "in the Shewa, on the Ethiopian highlands [...] there are immense regions of temperate climate pretty much depopulated that are known for their unparalleled fertility" [247]After a trip to Africa, the journalist and member of parliament Achille Plebano argued that Italians would never become rich in such a miserable country. How could Italians trade and make profit from such a miserable and

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[243] In December 1889, the captain Vincenzo Ferrari, the paleontologist and improvised agricultural expert Giovanni Bandieri, the geologist and chemical engineer Angelo Spallanzani, and the painter and director of the school of arts of Reggio Emilia Professor Gaetano Chierici, along with the latter's sixteen-year-old nephew, left the northern city of Reggio Emilia for the area of Cheren in Eritrea to reach the lieutenant of colonial troops Alfonso Chierici, Gaetano's son. Nine letters from Levi to Tacchini—spanning from 1883 to 1897—are preserved, and they are all related to the failed attempt to establishment the monument to Secchi and their common scientific interests (Archive C.R.A.- C.M.A., Fondo Tacchini).

[244] Nello Quilici, "Il Primo Esperimento Di Colonizzazione Italiana in Africa: la 'Società Reggiana' (1889-1890) - Da Documenti Inediti" *Nuova Antologia* 74, no. 1614 (June 16 1939): 429–48, 436.

[245] Rainero, *I Primi Tentativi Di Colonizzazione Agricola*, 50.

[246] *Ibid.*, 120, n. 144; quoted from the *Corriere Eritreo* – Massawa, December 18, 1892, no. 51.

[247] See for example Mario Michela, *L'Avvenire dei Possedimenti Italiani in Africa* (Turin: L. Roux Editori, 1889), 8-9.

starving nation?[248] Anti-colonialist economists such as Napoleone Colajanni led the charge, arguing that "climate and water are adversaries to human beings and their work in the regions of Ethiopia under our influence."[249] Infighting among Italians undermined the success of any early Italian colonial efforts once again, as we have seen in Assab in 1880 and Massawa in 1885.

The breaking point for Franchetti's project became the opposition of the military and conflict between civilian and military authorities in the colony. Military-agricultural settlements were considered cheaper and easier to implement and defend from local attacks.[250] Military objections against Franchetti's plan argued that it was costly both in economic and political terms. Despite defending his effort in a duel with the Governor of Eritrea Gandolfi, Franchetti was forced to resign by the end of 1894 due to the hostility with General Oreste Baratieri.

Baratieri (1841-1901) suppressed Franchetti's agricultural stations and transferred them to the army. Yet Baratieri persevered in the most crucial mistake that Franchetti had already made, namely the alienation from the indigenous population. The premise of Franchetti's plan was the free availability of land at a time when locals had been killed by the famine or lacked the tools to plough the soil. By 1893-1894, the effects of the drought, cattle plague and famine had finished. Already in 1894, Franchetti launched the alarm to Prime Minister Crispi, citing the "disorderly expansion of indigenous agriculture" that threatened his colonial projects. Of course, what Franchetti described as an "invasion" was the return of African population back to their land.

Prompted by Crispi, Baratieri reacted by expropriating indigenous land on a vast scale, adding to 19,020 hectares of public land in 1893, 280,039 hectares in 1894, and another 113,833 in 1895.[251] Baratieri's extortion of the best land from local population marked the beginning of the end of this phase of Italian expansionism in Africa and provoked massive discontent and revolt. In this section, I have highlighted how Italian plans of colonization after the establishment of Eritrea as a colony show the conflict and divisions among Italian camps that prevented the study of the colony and the implementation of any consistent plan. The origins of economic-oriented liberal techno-politics as well as the fascist project of settling Italian emigrants in Africa can be attributed to the perception of Ethiopia as an empty, potentially rich land, despite the fact that Italians had contaminated the region with their ecological invasion before even plowing the soil.

1.6 Conclusion: Adwa and the Origins of Liberal and Fascist Imperialism

The expropriation of land and the actual settlement of Italian colonists was an unprecedented threat to the Ethiopian Empire from other European powers. Today, Franchetti's colonization with a few families might not seem particularly threatening. But Ethiopians had historical memory of the time when fierce fighting between the Medieval Ethiopian State and Muslim

[248] Achille Plebano, *I Possedimenti Italiani in Africa. Impressioni e Note di Viaggio* (Rome: Tipografia Giotola, 1889).
[249] Napoleone Colajanni, *Politica Coloniale* (Palermo: C. Clausen, 1891), 75.
[250] See Giovanni Battista Luciano, *Colonizzazione e Ordinamento Militare nell'Eritrea* (Rome: Tip. Della Casa Edit. Libraria Italiana, 1891).
[251] See Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 519.

Somalis produced massive depopulation in the Horn of Africa and allowed the pastoral Oromo people to migrate north and conquer wide swaths of Ethiopian territory in the 16th century.[252] Similarly, the modern Ethiopian Empire had been struggling against the Muslim Egyptian Government and the Sudanese Dervish since the middle of the nineteenth century. Menelik had just completed the subjugation of the Oromo and the conquest of Southern Ethiopia, largely thanks to Europeans' weapons and support, including the Italians. Seeing another people coming in and exploiting the depopulation and famine of the Northern Highlands must have been a déjà vu to many Ethiopians.

The magnitude of the threat and the fact that land-grabbing legislation paradoxically punished indigenous tribes that had previously joined the Italians spurred Ethiopians to find unity under the leadership of Menelik II. The first sign of the revolt came from the rebellion of Batha Agos, one of the local leaders that had previously sided with the Italians. Despite such symptoms, Italians remained divided as we have seen in the previous section.

In his call to arms, Menelik mentioned explicitly the cattle plague as the reason why Ethiopians had been unable to reject Italian invasion and Italian settlements as the main spur to action: "Considering that the livestock was destroyed and the people were exhausted by the famine, I did not want to act before. But this enemy comes forward, digging the land like moles. With the help of God, I will not abandon my country to them."[253] After the ecological challenges of the "Great Famine," Ethiopians found unity against a divided foreign enemy.

As the famine came to an end in 1892, Menelik strengthened his power and rejected the Treaty of Wuchale that had granted the Italian protectorate over Ethiopia, at least in the Italians' interpretation of the text. The famous reason of the ensuing conflict between Italy and its former Ethiopian protégé was the interpretation of the Article 17 of the Treaty. From Menelik's point of view, the offer of using Italy as an intermediary with other European powers was just an option, not an obligation. A difference in the translations of the Treaty in the Italian and Amharic texts was not detected by Antonelli, the Italian negotiator, who did not speak the language and thus originated the diplomatic misunderstanding. In other words, ignorance of Ethiopia's culture drove Italians into the delusional belief that they controlled East Africa.

On March 1, 1896, the Ethiopian Empire of Menelik II defeated the Italian army of General Baratieri in the battle of Adwa and halted Italy's attempt to create a colonial empire in East Africa until the fascist invasion of 1935.[254] For the first time in world history, an African country managed to stop a European invasion and preserve its independence.

Repeating a critique first conceived in the immediate aftermath of Adwa, political and military historians have blamed internal divisions and "the absolute ignorance of African reality" to explain the failure of Adwa. Famously, Italian troops did not even have maps of the region of

[252] Mohammed Hassen, *The Oromo and the Christian Kingdom of Ethiopia: 1300-1700* (Woodbridge: James Currey, 2015); Id., *The Oromo of Ethiopia: A History, 1570-1860* (Cambridge and New York: Cambridge University Press, 1990).
[253] Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 562.
[254] See Angelo Del Boca, ed., *Adua: le ragioni di una sconfitta* (Rome: Laterza, 1997); Raymond Anthony Jonas, *The Battle of Adwa: African Victory in the Age of Empire* (Cambridge: Belknap Press of Harvard University Press, 2011); Nicola Labanca, *In marcia verso Adua* (Turin: Einaudi, 1993).

the battlefield. Italians had failed to study the area amid their internal conflicts between military and civilian colonization plans.

"Ignorance" was immediately used to hide the inadequacies of Italians' cultural and political elites. There was a racist assumption in the justification of the time that "had Italians known better, they would have certainly won." Even historians who harshly critiqued Italian politicians and colonial officers, such as Angelo Del Boca and Nicola Labanca, have blamed the "ignorance" of colonial officers to disqualify their actions, without providing any convincing explanation of Italy's failures.[255] Yet "ignorance" is a cultural product, a socially constructed phenomenon that must be explained, not an explanation in itself. In this chapter, I have examined the politics of Italian colonial scientific knowledge and the making of such "ignorance."

Throughout the chapter, I have argued that internal division between the Italian state and Italy's three geographical societies, as well as fragmentation within the Italian scientific community, hampered Italian efforts to produce cumulative knowledge about the Horn of Africa. Whether about the scientific station of Let-Marefià, the climate of Assab, the temperature of Massawa, or the settlement of Italian colonists, controversy ruled the debate. Split between supporters of the exploration of the northern Tigray and the southern Shewa regions, Italians constantly argued about the climate, environment, and natural resources of Ethiopia. They spent all their efforts hindering each other's plan and invalidating each other's observations, rather than building an infrastructure of knowledge for the study—and control—of Ethiopia.

Adwa's failure was the result of such "ignorance" produced by Italy's lack of a national epistemic community of scientific experts operating with the State. This was especially true after 1890, when it became clear that a step up in scientific expertise was truly necessary in order to establish a colony in Eritrea. Instead, Italy's geographical societies continued to operate separately despite their first national congress in Genoa in 1894.

Between 1890 and 1896, the Italian Geographical Society shifted its focus from the famine-ridden Ethiopia to the exploration of Somalia, in order to support Italian colonial claims over the coast of Horn of Africa. The 1891 treaty with the British Empire to partition spheres of influence in the region triggered a rush of Italian colonial explorers to cover new regions in Somalia, claim the region *de facto*, and check what the promised "sphere of influence" might hold in store for them. This pressure forced Italian geographical societies to shelve the project of a school for the scientific preparation of colonial explorers for lack of funding.[256]

Yet their excess of confidence after their success in 1891 did not make them realize that a structural change of gear would have been necessary. Without a structural transformation in knowledge production practices and institutions, Italian colonial science was bound to fail. Five separate expeditions were sent to Somalia and Southern Ethiopia between the Treaty of Wuchale (1889) and Adwa (1896), often in the range of a few months and pretty much competing with one another. Such a lack of coordination proved lethal, as four out of five explorers failed to reach their goals or died.[257]

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[255] Proctor and Schiebinger, *Agnotology*, 1-10.

[256] Società Geografica Italiana, "Atti della Società. Seduta 22 Dicembre 1890" *B.S.G.I.*, s. 3, vol. IV, 1890, p. 3.

[257] The "competition" started with explorers Baudi di Vesme and Candeo in February 1891, followed in April by Robecchi-Bricchetti, in July by Ruspoli, and in August by Ferrandi. Baudi did not manage to go beyond the Shebelle River. Ruspoli's escort defected and was forced to return. Ferrandi did not manage to go beyond Mansur, from

The last expedition before Adwa, called the Second Bottego Expedition, perished because its members had not been warned about the outbreak of the war between Italy and Ethiopia. The expedition was a mix of political and scientific goals. One of its members was the Italian meteorologist Maurizio Sacchi (1864-1897).[258] The superficial attitude of Italian explorers, their lack of scientific preparation, and the blurred boundaries between science and politics stands out in a letter Sacchi wrote to placate his family's concerns for his decision to travel to Africa in a dangerous expedition:

> I am getting ready [for the expedition] by completing my education with those parts that are still missing in order to achieve my goals, namely [learning] the theory and practice of astronomic measurements to determine latitude and longitude. Professors Millosevich (a member of the Geographical Society) and his friend Reina who teaches here geodesy are helping me with that.
> It is not true that the goal of these travels are zoology, botany, or any other natural sciences [.] These are convenient to make the trip more useful, to find more means to organize it, to make it more popular, to decrease the number of short-sighted people that consider useless, reckless or ridiculous the exploration of little-known lands or, when known, lands not yet subjected to European nations. The natural sciences are the background [literally: "the garnish"] and sometimes the disguise of the expeditions whose final goal is the commercial expansion of the nation organizing them and the colonization or expansion of the race, in short power, [whereas] their short-term goals are the creation of topographical knowledge for the study of commercial routes, possible railroads, fertility, climate, populations and anything that can influence the relationship with diplomatic or military affairs. The State needs to know exactly what the regions that it could possibly occupy are worth, in order to know if it is necessary to involve ourselves with them more or less. The expeditions, believe me, are organized with these goals. Those meant only for the natural sciences will come later, more comfortably, when these countries will be in European hands already.
> If you examine our explorers, Antinori (amateur naturalist), Cecchi (navy captain), Martini (engineer, I believe), Chiarini (engineer),

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Brava in Somaliland. See Paolo Giudici, *Maurizio Sacchi e la seconda spedizione Bòttego* (Pavia: Ambaglio, 1935), 21.

[258] Besides working on hailstorms, he was interested in the origins of the rivers Omo and Baro. See Maurizio Sacchi, *Una legge sulla distribuzione della grandine* (Rome: Tip. dell'Unione cooperativa editrice, 1893); Maurizio Sacchi, "I fiumi Oro e Baro secondo una carta abissina," in *Bollettino della Società geografica italiana* 7, s. 3 (1894) 816-822.

> Ragazzi (doctor), Bottego (artillery officer), Grixoni (same), Bricchetti (engineer), Antonelli (politician), Baudi di Vesme (officer), Candeo (I just know that he is rich), Ruspoli (ex cavalry officer) and I do not know how many others, then you see that it is not at all essential to be a naturalist to be an explorer. There is [Elio] Modigliani, but he travels to the Dutch colonies of Sumatra and neighboring islands, not to a land of conquest. Thus, for what concerns my own education, I will complete it by learning how to make astronomic observations, because it is the more important than any other among the natural sciences in order to find direction, to chart maps and draw itineraries.[259]

Scientific explorations to Africa were still a dangerous political business and—for Sacchi—a way to get out of his boring job as a meteorologist at the Central Meteorological Office, not a way to make a scientific career in late nineteenth-century Italy. When he enrolled in the expedition without Tacchini's permission, the Director of the Central Meteorological Office protested with Giacomo Doria, the President of the Italian Geographical Society, despite his support of previous missions as member of the Society himself.[260] Tacchini's reaction and Sacchi's tragic death confirmed that being a colonial scientist in 1895 was not a safe and respectable job nor that it was considered a reputable career within the Italian scientific community.

The demand for better geographical information was real, but it went unheard by the State. In 1892, an employee of the Ministry of Agriculture submitted to the Ministry of Foreign Affairs a book manuscript synthesizing information about the colonies, asked the government's support for its publication, and explained that his book was necessary because "several volumes and many reports about African countries that have fallen under our sphere of influence have been published in a number geographical bulletins, so that one could put together a library with them. But for the same reason, the public is not able to access the information necessary [to know] them, because it is not easy to find them. Every traveler that visited Abyssinia and neighboring regions did not forget to write his own account, but they gave only information about the itinerary of their trip. A special book dealing with the countries under our sphere of action and their geography in Africa is still missing [...]. My work is essentially practical because I collected all the news concerning the fertility of the regions, their agricultural potential, and the usefulness that we could gain from them." Needless to say, the military officer considering the

[259] Paolo Giudici, *Maurizio Sacchi*, 26-7.

[260] Doria replied that Tacchini's regrets against him made no sense. He claimed that he tried to discourage Sacchi from joining the expedition, since he could not see what kind of advantage Sacchi would gain from it. He also claimed to have pointed out that the matter should have been discussed with Tacchini. In any event, he was not aware of any previous correspondence between Sacchi and Bottego, and therefore he had no role in the matter (Archive C.R.A.-C.M.A. Fondo Tacchini, letter dated May 24, 1895).

request denied the funding and the book was never published, thus frustrating a sincere demand of the public.[261]

Even Italy's bureaucratic, institutional and intellectual structure lagged behind the speed of its political involvement in Africa and the ecological transformations happening on the ground. As the Ministry of the Colonies was created only after the conquest of Libya in 1911, the Ministry of Foreign Affairs collected information about Africa bureaucratically by year, rather than by topic like the Ministry of Agriculture. As a result, letters and data about the most disparate subjects (botany, agriculture, etc.) were mixed together, making any scientific research quite challenging. Moreover, scientific specimens were scattered in disparate civic collections and data were published in a number of disorganized publications.[262] Without a national institutional framework to produce knowledge about Africa, it was impossible to pursue any research program about Africa.

Controversies about Ethiopia's climate were due to ecological as well as social factors. As I have demonstrated, Italians began the colonization of East Africa at the time of a devastating drought. They even contributed to the destruction of Ethiopia's fragile ecosystem by bringing with them a new strain of cattle plague. Differences in their travel accounts cannot simply be dismissed as political and inaccurate. The instability of the climate and the dynamic interaction between ecology and empire contributed to making Italy's entire colonial project highly controversial.

The hidden truth behind Italian "ignorance" was that Italians knew about the ecological disaster of Abyssinia of the "Cruel Days" (1888-1892); some even knew that they were responsible for it; and they certainly knew that they were ruthlessly trying to exploit the social, economic, and demographic collapse of their enemies. They marched to Adwa based on the assumption that a poor, divided, and depopulated Ethiopia could not fight after years of environmental disasters. Yet Ethiopians proved them wrong by finding unity against a divided enemy.

In *Late Victorian Holocausts*, Davis has used Ethiopia's cruel days as one of the examples of how European empires exploited climatic disasters to establish their colonial presence across the world.[263] Against such logic of environmental determinism, Ethiopia's story

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[261] Letter by Giorgio Matrarga, October 6, 1890, Rome, to the Ministry of Foreign Affairs, in AS.M.A.E., Africa 2, 170/1: "Bibliografia e cartografia dei possedimenti del Mar Rosso (1885-1900) Ottobre-Dicembre" (170/1, "Bibliografia e cartografia dei possedimenti del Mar Rosso).

[262] From the second Bottego expedition alone, the last before Adwa, a huge botanical and zoological collection was assembled in the Museo Civico in Genoa, Doria's hometown: see Carazzi. *La Società Geografica Italiana e L'esplorazione Coloniale in Africa*, 154. Instead, the geological and paleontological collections were held in the museum of geology and mineralogy of the University of Rome, where they were analyzed by Federico Millósevich and Gioacchino de Angelis d'Ossat: see Gioacchino De Andelis D'Ossat e Federico Millosevich, *Seconda Spedizione Bottego. Studio Geologico sul Materiale Raccolto da M. Sacchi* (Rome: Società Geografica Italiana, 1900). The ivory collected was eventually sold in Zanzibar: see Carazzi, *La Società Geografica* Italiana, 154-57). The results of Sacchi's meteorological and astronomical observations appeared in the volume of the last two survivors and were analyzed by Elia Millosevich and Domenico Peyra—scientists at the Central Meteorological Office: see Lamberto Vannutelli and Carlo Citerni, *Seconda Spedizione Bottego: l'Omo, viaggio di esplorazione nell'Africa Orientale, Sotto gli auspici della Società Geografica Italiana* (Milan: Hoepli 1899); Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 427-28.

[263] Davis, *Late Victorian Holocausts*, 119-140.

reveals a society's resistance against the inevitability of environmental determinism and Western imperialism. Adwa shocked the Italian State and Italy's scientific communities. It posed fundamental problems that Italians tried to solve in the following decades, first through a liberal and later through a fascist, techno-political regime to organize nature, science, and the state.

CHAPTER 2

Liberal Techno-Politics

2.1 Introduction

After the 1896 defeat of Adwa, colonial politics was a loathed topic in Rome. The Prime Minister Francesco Crispi resigned, but the Italian government was in denial about its African defeat and tried to "forget" its colonies. Supporters of the imperialist program in Africa lost political authority and Italy negotiated a peace treaty with Menelik's Ethiopian Empire. Meanwhile, Ethiopians had successfully arrested European expansion at the dry and semi-desert ecological peripheries of their empire, namely Eritrea and Somalia. How did Italians manage to recover and bounce back in their expansionist efforts to the point of invading Libya in 1911?

My argument in this chapter is that the spur for a new start of Italian scientific imperialism after Adwa came from the colonies and from the challenge of developing colonial environments, not from the metropole. The restructuring of Italian techno-politics according to new principles allowed Italians to rebound from their disarray. As the prospect of conquering the fertile Ethiopian highlands dissolved and creating any settlement colony in the hostile environments of Eritrea and Somalia turned out to be impossible, Italians had to invent from scratch a new colonial project. In this chapter, I describe the rise of a liberal techno-political regime that resembles the practices of the contemporary British and French empires.

The architect of Italy's liberal imperialism was the Governor of Eritrea Ferdinando Martini (1841-1928). We have already encountered Martini as member of the parliamentary commission in Eritrea in 1890. Despite his previous talk of "replacing race with race" during the demographic collapse of Ethiopia during the "Cruel Days," his familiarity with the mistakes of Italian colonialism before Adwa—in particular the indiscriminate land-grabbing policy aiming to prevent the return of indigenous farmers that triggered the rebellion leading to Adwa—positioned him well to change course. Only after their imperial ambitions were shattered did Italians force themselves to study and develop the challenging environments of Eritrea and Somalia, regions that they considered only coastal bridgeheads towards the Ethiopian highlands in their unfinished colonial project.

Fig. 2.1: Ferdinando Martini (1841-1928). Martini was a member of the Parliamentary Commission in Eritrea before Adwa (1890-1891), as well as Governor of Eritrea (1897-1907), and Minister of the Colonies (1914-1916).[264]

Martini's governorship is best understood as the creation of a liberal techno-political regime—namely a new coordination between scientists and the colonial administration—that was able to learn from the mistakes of the nineteenth century, orient Italian colonialism toward economic rather than demographic goals, and give the colonial state new means of cultural hegemony in order to project Italian power abroad again without recurring to military aggression. According to historian Angelo Del Boca, Martini's main success was his activity as a diplomat with the Ethiopian empire, rather than his work as a legislator or administrator in Eritrea.[265] Instead, I believe that his major achievements were in the realm of cultural politics, and scientific techno-politics in particular. Thanks to his paternalism and gigantic ego, Martini was a very successful cultural manager despite the limits of his economic results.

Martini's most important success was the creation and organization from Asmara of an imperial scientific community, namely a group of scientific experts that was directly involved in the production of environmental knowledge for the study and development of Italian colonies. Since Eritrea was not big enough to host a colonial scientific community, like British and French settlement colonies, organizing an Italian community of experts in Africa entailed remaking the Italian scientific community back home. The imperial process of producing an "Italy overseas" entailed the transformation of Italian science as well. The making of such a scientific community

[264] From Società di studi geografici e coloniali. *L'Eritrea economica: prima serie di conferenze tenute in Firenze sotto gli auspici della Società di Studi Geografici e Coloniali* (Novara and Rome: Istituto Geografico de Agostini, 1913), xvi.
[265] Del Boca, *Gli Italiani in Africa Orientale*, v. 1, 759.

working with the colonial state proved Martini's most important legacy, and prepared Italy for its next imperialist adventure in Libya.

Martini believed that Eritrea needed financial capital, the intellectual investment of scientific research, and technical expertise to make the colony profitable in the future. He harshly criticized Franchetti's project of demographic colonization, which had brought poor Italian emigrants and unskilled labor to the colonies in the 1890s.[266] His liberal techno-politics were shaped by three lessons learned from Adwa.

First, Martini believed that more knowledge was necessary to avoid the political mistakes that led to Adwa. This "enlightened" attitude was a successful cover-up of what he certainly knew, namely the fact that Italians' aggression against Ethiopia had exploited the ecological disasters of the Great Famine. Martini, a direct witness of the events, used the weapon of Italian "ignorance" as a defensive tool and a recipe for future action. In 1911, he frankly admitted that Ethiopians rebelled in 1896 because they had been "robbed of their land."[267] Suddenly Italians acknowledged that Eritrea could not become a settlement colony because there was no free land available. The mantra of liberal Italy in the early twentieth century became that "if only Italians had known better" local conditions, or indigenous laws about property, or Ethiopian society, they would not have been defeated at Adwa.

Of course, such admissions of "ignorance" were a convenient narrative protecting Italian racial superiority over Ethiopians, and continued to circulate for years. A typical example is this recollection by Alberto Pollera, one of Martini's best colonial administrators, years later: "We were guilty of ignorance (*Peccammo di ignoranza*) because we did not study enough customary land rights in Ethiopia… The confiscation of land included church estates without considering the political damage that we inflicted on ourselves with an action… We often ended up taking land that did not belong to the state and look like we were cheating. We raised among the natives the impression that we wanted to take all their land piece by piece."[268] Even if certainly a better explanation than "Ethiopians' deceitfulness" embraced by the military, Pollera's acknowledgement that the revolt of the indigenous population was "the logical consequence of our actions" and Italians' "ignorance of local social structures" became an acceptable cultural disguise of their intentions during the Great Ethiopian famine.[269]

Second, Martini was fully aware that scientific knowledge was crucial to produce a national consensus in support of Italian imperialism and sideline the polemics that had hampered

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[266] See chapter 1.

[267] Istituto Coloniale Italiano, *Atti del Secondo Congresso degli Italiani all'Estero* (Roma 1911) II, p. 1, 482-3, quoted in Richard Pankhurst, *State and Land in Ethiopian History* (Addis Ababa: Institute of Ethiopian Studies, 1966), 191.

[268] Alberto Pollera, "Le vicende della colonizzazione agricola in Eritrea," *Rivista delle Colonie Italiane* viii (8): 545-568, quoted in Barbara Sòrgoni, *Etnografia e Colonialismo: l'Eritrea E l'Etiopia Di Alberto Pollera: (1873-1939)* (Turin: Bollati Boringhieri, 2001), 34.

[269] Alberto Pollera, *Eritrea: il regime della proprietà terriera in Etiopia e nella colonia Eritrea* (Rome: Bertero, 1913), 55. Quoted in Sòrgoni, *Etnografia E Colonialismo,* 89-90. Sòrgoni mentions that the same role of "ignorance" was present in legal texts produced in this period as a spur to learn local costumes and avoid the mistakes that led to Adwa. She refers to Carlo Conti Rossini, *Principi di diritto consuetudinario dell'Eritrea* (Rome: Tipografia dell'Unione, 1916) and Dante Odorizzi, *Notizie sull'ordinamento della proprietà terriera in Etiopia e nella zona abissina della colonia Eritrea* (Rome: Tipografia dell'Unione Cooperativa Editrice, 1906).

the creation of any clear colonial policy before Adwa. Martini's skillful use of "ignorance" intended to hide the mistakes of previous colonial administrations and get rid of previous controversies at once: "It is as useless to research why we went to Africa as it is painful to remember how we went there. First, without any notion of the climate, so that we sent our officers and soldiers […] dressed as they used to in Milan or Turin. [Second] we landed in Massawa in February, when very violent—even if not lethal—fevers develop after the winter rainfalls in the lowlands. Let us not even mention geographic information [...]. Our lack of preparation made the challenges harder […] And the first impression [of the environment], which was so hard to cancel, was the following: the impression of a vain effort, namely an effort made without any precise goal, without profit or hope matching the expenses and dangers, in regions cursed by nature, marked by the stigma of sterility."[270] These words reveal that the promotion of a colonial scientific culture intended to build consensus, debunk the myth that Eritrea was a fruitless desert, and deactivate the troubles of the polemics of the past. Scientists were crucial to producing consensus. Thus, the creation of scientific societies and new institutions for the collection of colonial knowledge in Italy was mandated by the requests from the colonies. In other words, the nation was never created in isolation from its global and imperial context.[271]

Third, Martini's liberal techno-politics supported scientific studies not as a dispassionate undertaking for the pure pursuit of knowledge, but to promote colonial development by encouraging private businesses. In his mind, the state's job was to facilitate the interaction between politics, economics and science by sponsoring scientific research and technical infrastructures. Building a colonial epistemic community was an essential part of this endeavor. The organization of the first Italian meteorological network in Africa in 1905 was part of that infrastructure of knowledge that was created at the beginning of the twentieth century to transform Italian colonialism from a controversial and political enterprise to a form of economic development. In short, Martini intended to create a liberal techno-political regime that would be able to disguise colonial politics as colonial policies.

2.2 Italy's First Colonial Meteorological Network (1899-1905)

Martini's paternalistic claim that he was the father of modern Eritrea and his attitude as *prima donna* of Italian colonialism—monumentalized by the massive volumes of the *Report about the Colony of Eritrea* as well as the four volumes of his *Eritrean Journal* at the end of his governorship—cannot hide the army of technical experts and scientific collaborators that he mobilized or supported whenever their interests aligned with his vision of the future economic development of the colony. Despite Martini's attempts to celebrate his work and pretend that early twentieth-century Eritrea was a one-man show, a crucial aspect of his liberal techno-politics was the involvement of local personnel on the ground and a new generation of nationalist scientific experts in Italy, the first to be educated after the unification of the country.

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[270] Martini, *Nell'Affrica Italiana*, 3-4.

[271] See for example, Sebastian Conrad, *Globalisation and the Nation in Imperial Germany* (Cambridge and New York: Cambridge University Press, 2010).

In this section, I describe the birth of the meteorological service of Eritrea in order to show that the demand for a new beginning in the history of Italian scientific colonialism came from unknown personnel in the colonies rather than from the metropole. Martini's talent consisted in cultivating and organizing these efforts.

The main protagonist of Italian colonial meteorology in early twentieth-century Eritrea was not the famous governor, but the unknown captain of the Indigenous Battalion of *Ascari* (Italy's Eritrean soldiers) Alfonso Tancredi. His name recurs only a few times in Martini's huge diary about Eritrea, probably because of Tancredi's modest role in the mind of the Governor. Nevertheless, Tancredi was the "empire builder" that picked up the idea of a meteorological network in Eritrea and pushed for its actual implementation. He came originally from the corps of military engineers (*Genio Militare*) and was stationed at Adi Ugri [today called Mendefera], at the border between between Eritrea and Ethiopia. From the peak of Mendefera, Tancredi could see the cool plateau of the Ethiopian highlands across the frontier and the fertile Seraè region, where Franchetti had created some of his demographic settlements.

The seeds of the meteorological service of Eritrea were the instruments left behind by the failed project of demographic colonization of Leopoldo Franchetti in the early 1890s. Between 1894 and 1895 Franchetti had provided the agricultural station of *Gosostelasi* with some meteorological instruments, but after the failure of that experiment of settler colonialism in 1897 the area of the crops was handed over to the military. With the end of military rule in 1898, the instruments of the agricultural colony were collected and a new meteorological observatory was created at 2020 meters above sea level thanks to the engineer Guarducci of the Geographic Military institute. Only in 1899 the observatory was handed over to Tancredi from the Major Cao Signori with the task of reorganizing meteorological observations.[272]

Tancredi strongly believed in the potentialities of agricultural development of the high Eritrean plateau and reached out to the Director of the Central Meteorological Office in Rome Luigi Palazzo by his own initiative. On May 4, 1899, Tancredi introduced himself to Palazzo in a long letter titled "For the Meteorological Observatory [of *Adi Ugri*]." He set out to inform the Director of the "history of the observatory, its current needs, and the hopes for the future, in the interest of science and the climatology of Eritrea." He explained the way he had put together the meteorological observatory and listed the instruments saved from the failure of those previous attempts. He also borrowed some from other military officers, but wrote that "an observatory constituted in such a way is not stable, because instruments can be withdrawn from the officers that lent them. Some indispensable instruments are missing; others are not precise; the comparison between previous measures and contemporary observations at other observatories is missing. It would be superfluous to demonstrate the usefulness of such observatories, especially in a place like Adi Ugri, located at 2020 meters above sea level in the middle of the Seraé, the 'terra di lavoro' of the Eritrean Colony."[273] Tancredi compared the region around Mendefera to Italy's agricultural belt between Rome and Naples and drew for Palazzo a map of the current and previous position of the observatory (fig 2.1).

[272] C.R.A.-C.M.A, Fondo Palazzo, "Eritrea," Letter from Tancredi to Palazzo, Adi Ugri, May 4, 1899.
[273] *Ibid.*

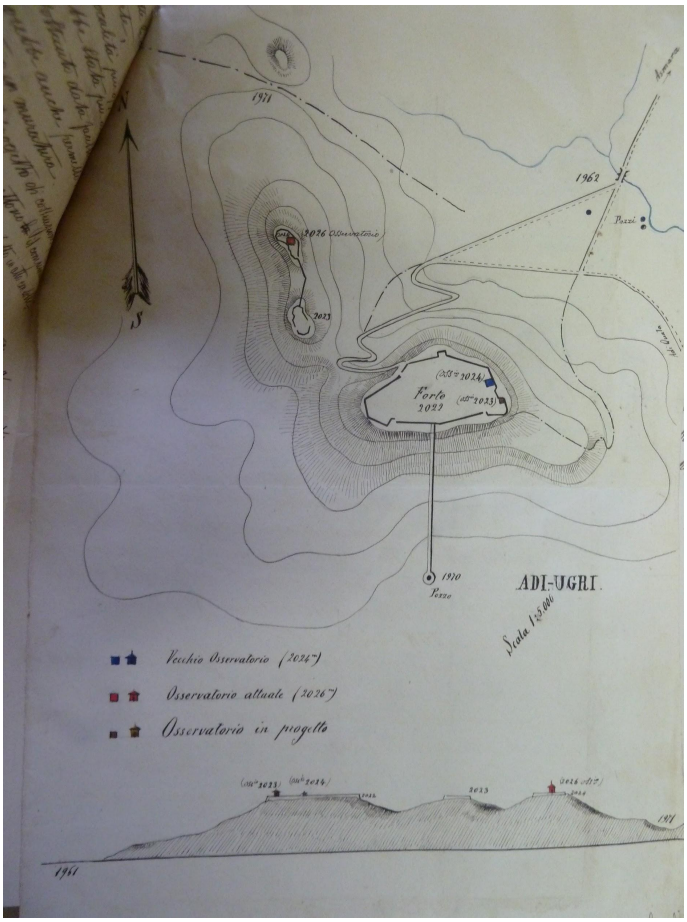

Fig 2.2: Map of the locations of the old, new, and future observatory of the Italian fort of Adi Ugri [Mendefera], with two views from above and below. The lower view shows the typical characteristics of Ethiopian mountains, the so called "ambe." The fort dominated the vast lower agricultural region of the Seraè [Debub region].[274]

Tancredi requested more instruments and suggested that "it would be necessary that colonial observatories exchange data at least in the rainy season, and that previously recorded data would be returned to Adi Ugri in order to study and compare them."[275]

Rainfall mattered tremendously in Eritrea. As historian James McCann explains, "Ethiopia's agricultural calendar is largely a product of a distinctive climatic regime and the patterns of variation within it... Ethiopia's climate is predominantly bimodal, with seasonality and variation in rainfall rather than temperature being the limiting factors."[276] The most determinant of environmental conditions in Ethiopia's highlands is elevation, which affects

[274] Drawing by Alfonso Tancredi, Archive C.R.A.- C.M.A, Fondo Palazzo, "Eritrea," f. "Adi Ugri."
[275] C.R.A.- C.M.A, Fondo Palazzo, "Eritrea," Letter from Tancredi to Palazzo, Adi Ugri, May 4, 1899.
[276] James McCann, *People of the Plow: an Agricultural History of Ethiopia, 1800-1990* (Madison: University of Wisconsin Press, 1995), 28.

temperature, rainfall, vegetation, and therefore agricultural and social life.[277] The lack of permanent reservoirs of water or glaciers on the mountains meant that the rainy season turned roads into rivers of mud. Communication and transportation during the two rainfall seasons was impossible. Ethiopia's social and economic life was regimented by its peculiar ecological and climatic regimes.

When he received Tancredi's letter, Luigi Palazzo (1861-1933) was waiting for the confirmation of his position as Director of the Meteorological Office after the retirement of Pietro Tacchini, director between 1879 and 1890. Palazzo belonged to a new generation of professional scientists born after the political unification of the Italian State and the standardization of the national educational curriculum with the Casati Law of 1859.[278] Unlike nineteenth-century regional naturalists, Italian scientists now shared a common national education.

As a result, their relationship with the State was completely different. Tacchini was frustrated with the lack of financial autonomy of the Meteorological Office, since the Ministry of Agriculture treated the bureau as a technical branch rather than a scientific institution. Tacchini could not stand the transformation of scientific research into a professionalized series of bureaucratic chores, a process described by Max Weber in "Science as Vocation."[279] Instead, Palazzo was a bureaucratic intellectual, meaning that his career started and developed entirely at the service of the State.[280] Palazzo's success consisted in the transformation of the Central Meteorological Office into an imperial institution of knowledge-collecting data in the Italian colonial empire before WWI as part of an internationalist and imperialist scientific paradigm at once.

Palazzo thanked Tancredi for his detailed report about the observatory in Adi Ugri, sent more instruments, and recommended the creation of an archive for the collection of weather records. He even suggested to backup weather data in order to have copies of the records in Eritrea and in Italy. Tancredi remarked that it was unclear whether to send the data to Massawa—the old military capital of the colony—or the new capital of the civilian government in Asmara. Martini had recently moved the capital from the hot and humid Massawa to the temperate highlands of Asmara.

This was the first time that the important archival question of how and where to collect weather data emerged the correspondence between Italian officials in Rome and in Eritrea. Before Adwa, meteorological observations were collected by a number of different actors and were scattered in a number of publications, or abandoned altogether. The creation of a colonial archive was connected with the establishment of Italian civilian rule, after the turbulent years of military administration.

Tancredi was an amateurial meteorologist - his requests for instructions to the Director of Meteorological Office reveal that he was not able to read, for example, the results of the

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[277] *Ibid*., pp. 26-8.
[278] Giorgio Canestri and Giuseppe Ricuperati, *La scuola italiana dalla legge Casati a oggi* (Turin: Loescher, 1977).
[279] Max Weber, *Max Weber's "Science as a Vocation"* (London and Boston: Unwin Hyman, 1988).
[280] See Tina Tomasi and Luciana Bellatalla, *L'università italiana nell'età liberale* (Naples: Liguori Editore, 1988); On the notion of "bureaucratic intellectual" see Mario Isnenghi, *Intellettuali militanti e intellettuali funzionari: appunti sulla cultura fascista* (Turin: Einaudi, 1979).

eliophanographer, an instrument designed for the measurement of the intensity of solar rays. His correspondence with Palazzo offers a rare glimpse of the textbooks available to a frontier military officer in Africa: he owned a manual by Robert Scott that had been translated into Italian in 1887 and a few instructions published by the Italian Meteorological Society.[281] In any event, Tancredi's interest in studying the weather probably originated from his direct exposure to African climate or from his access to forms of local knowledge, since he was the captain of a company of *Ascari*, Eritrean soldiers enlisted in the Italian army. At the end of his career in Africa, he published a small handbook with information about the Eritrean calendar, its climate, and some basic vocabulary translating geographical and climatological terms from Amhara and Tigrinya into Italian.[282]

Along with data, the circulation of instruments was Tancredi and Palazzo's major concern. Receiving and using meteorological instruments in the colonies was not easy. The majority of the letters between Palazzo and Tancredi dealt with the loss, destruction, and damage of scientific equipment from Rome to Massawa, and from there to the steep highlands of Mendefera. For example, the instruments requested in May 1899 arrived only in October of the same year. As a result, Palazzo preferred to send thermometers and barometers through intermediaries rather than in the mail.[283] Trust for the circulation of instruments was essential and connected actors that were involved in the study of the climate of Eritrea.

Building meteorological observatories through the exchange of instruments tightened Italian social networks of scientific experts and contributed to the making of a colonial scientific community. For example, Palazzo sponsored Tancredi's membership in the Italian Geographical Society. He also validated with his authority Tancredi's empirical studies when the Ministry of the Colonies inquired on whether to support their publication. The requests of meteorological instruments from Tancredi to Palazzo became more and more frequent starting in 1901. Tancredi asked Palazzo for geothermometers to measure the temperature of the soil when the colonial government decided to experiment with the cultivation of tobacco and cotton.[284] Yet there were also limits to how much money the Italian Central Meteorological Office could spend in the colonies.[285] When Tancredi became increasingly insistent with requests of instruments to study atmospheric electricity, since thunderstorms were a very dramatic feature of the local climate, the Director of the Central Meteorological Office suggested that the study of temperature and rainfalls would be enough for agricultural studies of the environment of Eritrea.

After his request for more instruments was turned down, Tancredi must have solicited a more active role from the Governor Martini, who was willing to help as part of his civilian program for the development of the colony along with the agronomist Gino Gioli. Unlike the first years of Italian colonialism, when individual contrasts had repeatedly wrecked Italian

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[281] Archive C.R.A.- C.M.A, Fondo Palazzo, "Eritrea," Letter from Tancredi to Palazzo, Adi Ugri, December 28, 1900.
[282] Alfonso Tancredi, *Notizie e Studi sulla Colonia Eritrea* (Rome: Ministero delle Colonie, 1913).
[283] C.R.A.- C.M.A, Fondo Palazzo, "Eritrea," Letter from Palazzo to Tancredi, January 14, 1902: "I have not found anyone trustworthy to send the barometer and I had to send it by railroad and boat. Please let me know in what conditions it arrived."
[284] C.R.A.- C.M.A, Palazzo, "Eritrea," Letter from Tancredi to Palazzo, March 7, 1901.
[285] C.R.A.- C.M.A, Palazzo, "Eritrea," Letter from Palazzo to Tancredi, May 11, 1901.

colonial projects, the making of a meteorological network became possible after Adwa because of the new alignment between politics and science.

The direct intervention of Governor Martini with the Colonial Office of the Ministry of Foreign Affairs institutionalized personal requests from an inferior colonial officer to a professional scientist in Rome and assured that Palazzo satisfied the conspicuous requests of meteorological instruments coming from Asmara. Martini offered to split the cost of the instruments for the meteorological network between the Central Meteorological Office and the Colonial Government.[286] Each observatory cost 736 lire of the time, for a total expense of 11,040 lire on the budget of the colony. The workshop of the Central Meteorological Office was in charge of the production of the instruments. Tancredi was behind the organization of the network, because they were sent to him in Adi Ugri in order to control them after their arrival to the colony.[287]

A significant sign of the growth of the network was also the surge in requests of printed forms to record weather data from Eritrea. At the beginning of 1903, Asmara asked for 1000 forms in addition to the 500 already sent from the Central Meteorological Office due to the increase of meteorological stations.[288] After such a long buildup of instruments and materials, on September 23, 1905 the Italian Governor of Eritrea Ferdinando Martini declared from the Bulletin of the colony the creation of a civilian meteorological service in the colony. The goal of the creation of a meteorological network in east Africa was "the yield of exact notions about climatic conditions and the need of agriculture." The meteorological service was placed under the control of the experimental agricultural office in Asmara. Here, the decree established also a meteorological archive for the collection of the data.

Martini invited all regional commissaries, civilian personnel employed in the postal and telegraph service, and military officers to contribute to meteorological observations. The third article of the decree affirmed that "meteorology will be a facultative subject in the exams to become colonial officers."[289] The first Italian colonial meteorological service in Eritrea was a civilian institution embodying Italy's liberal imperialism.

While Tancredi provided data from the field, Gino Bartolommei Gioli was the agronomist most involved in the making of the meteorological network. Gioli was the first agronomist to work in Eritrea for the experiments of the agricultural office in Asmara, until he was replaced in May 1902 by Isaia Baldrati. After his return to Italy he became the first director of the newly

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[286] The Central Meteorological Office would pay for the establishment of fifteen weather stations for the collection of data about rainfalls and temperature. The colonial state instead paid for the additional instruments that would turn the weather station into complete meteorological observatories. Thermo-udometric stations were equipped only with thermometers and pluviometers; meteorological observatories had much more complete instrumentation. C.R.A.-C.M.A, Palazzo, "Eritrea," Letter from Palazzo to the Ministry of Agriculture, July 11, 1901.

[287] C.R.A.- C.M.A, Palazzo, "Eritrea": Letter from Ministero degli Esteri, Ufficio Coloniale to Luigi Palazzo, July 8, 1902: "The Government of Eritrea confirms that meteorological instruments arrived to the colony in February and were shipped to Mr. Tancredi in Adi Ugri, who is in charge of their custody and their control."

[288] C.R.A.- C.M.A, Palazzo, "Eritrea": Letter from Ministero degli Esteri, Ufficio Coloniale, to Luigi Palazzo, January 27, 1903.

[289] Martini, Ferdinando, and Governo Eritrea. "Decreto Di Istituzione Servizio Meteorologico Eritrea." *Bollettino Ufficiale Della Colonia Eritrea*, no. 38 (settembre 1905).

created Colonial Agricultural Institute in Florence. The challenges of the African environment changed the practices of colonial administration and scientific imperialism back in Italy.

The creation of a meteorological network in Eritrea had the main goal of studying the climate to develop local agriculture. Gioli presented the first request of weather stations to the governor in order to study the acclimatization of cotton in February 1901.[290] Gioli's promotion of Eritrean agriculture continued when he left the colony for Florence. In 1902, in a public lecture at the prestigious florentine Accademia dei Georgofili—a scientific academy devoted to agricultural studies—Gioli remembered how "constant disagreement among competing directions of Eritrean politics and the disproportion between ambition and practical aspects, but especially the absolute lack of serious commercial goals and practical initiatives of colonization" caused the country to be disappointed by the colonization in Africa.[291]

Adwa, in Gioli's words, was "the fatal crisis of many mistakes," but after six months in Africa the climatic elements of the colony made him optimistic about the chances of agricultural development.[292] Rainfalls "produce deep differences between the coast and the highlands" and the comparison with southern Italian regions of Sardinia, Sicily, Calabria, Basilicata, and Apulia showed that agriculture could be carried out even in regions with poor hydrological resources.[293] The difference between previous accounts of the climate in Eritrea and Gioli's was his call to produce scientific *facts*. Only a new unified colonialist community could produce scientific facts about Eritrea - something that had not been possible before Adwa, when multiple regional communities of geographers and naturalists make meteorological data contentious.

Tancredi, Gioli and Baldrati were only a few of the scientific experts hired to work in the colony under the civilian governor Ferdinando Martini. He hired engineers, geologists and prospectors to investigate the rumors of the presence of gold mines in the soil.[294] He ordered the Military Geographical Institute to resume geodetic mapping in Eritrea, as the lack of accurate maps had proved disastrous at Adwa.[295] Additionally, he decided the establishment of an agricultural office in Asmara for experiments of acclimatization and a zoological institute for the cure and prevention of disastrous animal diseases like the cattle plague that had devastated the Horn of Africa during the Great Famine. The importance of involving Italian scientists and technical experts in the development of Eritrea went hand in hand with the organization of a colonial scientific community, namely a group of experts interested and involved in the development of the colony—a sort of huge operation of scientific marketing. Meteorology became crucial to harnessing Eritrea's climate.

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[290] Martini, Ferdinando. *Il Diario Eritreo*. 4 vols. Firenze: Vallechi, 1947, v. 2, p. 359, 19 febbraio 1901, from Agordat: "Il Gioli crede opportuno si stabiliscano osservatori meteorologici in parecchi punti della colonia. Propone: Massaua, Saati, Ghinda, Asmara, Adi Ugri, Main Haini, Senafè, Adicaiè, Saganeiti, Gura, Ad Teclezan, Cheren, Agordat, Adiqualà. Sta bene. Scriverò a Roma per chiedere i termometri e i pluviometri necessari."
[291] G. Bartolommei Gioli, *Le attitudini della colonia Eritrea all'Agricoltura*, Florence 1902, p. 4.
[292] Idem, p. 5.
[293] Idem, p. 8 and 16.
[294] Massimo Zaccaria, "L'oro dell'Eritrea, 1897-1914," *Africa: Rivista Trimestrale Di Studi E Documentazione dell'Istituto Italiano per l'Africa E l'Oriente* LX, no. 1 (2005): 65–110.
[295] Antonio Gandolfi, *et al*., eds., *Eritrea 1885-1898: Nascita Di Una Colonia Attraverso I Documenti E Le Fotografie di Antonio Gandolfi, Ledru Mauro, e Federigo Guarducci* (Bologna: Comune di Bologna, 2007).

2.3 The Making of a Scientific Colonial Community: The Colonial Conference of Asmara (1905)

Martini's greatest success as Public Relations manager of Eritrea was the organization of the First Colonial Congress of Asmara—a founding moment in the creation of an Italian scientific community directly involved in the study of the colonies. Historians Aquarone and Monina have pointed out the importance of this meeting in the endeavour of relaunching Italian imperialism after the defeat of Adwa. However, they have failed to understand the transformative nature of that event. By focusing on the representatives of political institutions, Monina has argued that "the political role of the conference was mainly the creation of an expansionist program that seemed to draft a potential "colonialist party."[296] I argue that the goal of the conference was the creation of an Italian epistemic community of scientists working with the State in the colonies.[297]

The major achievement of the Congress lies in the organization of the politics of knowledge, namely in the coordination of existing scientific and political interest groups. The First Colonial Conference in Asmara was about inaugurating new politics of scientific knowledge that would bridge the gaps between Italian colonial politics, economy, and science. Martini's report to parliament about the congress was titled "Coordination of Italian colonial action."[298]

Even the way planning activities took place before the meeting intended to overcome the regional differences among Italian geographers and colonialist elites that had foiled Italian colonialism before Adwa. The proposal of a conference to be held in Asmara was originally advanced in the fourth Italian geographical congress in Naples in 1904. The conference was designed to engage all Italian geographical societies through three regional committees, in addition to the local organizing group in Eritrea. In order to involve all three major geographical societies that had been competing against one another in the nineteenth century, the preparation of the congress was entrusted to committees based in Naples, Rome, and Milan.

Martini's liberal imperialism intended to forge a national community of colonial experts by exposing them to the environment of the colonies. By acknowledging the regional differences of Italian constituencies and encouraging their involvement in the colonial project, Martini inaugurated a new national imperialist epistemic community.

For the first time in Italian history, Martini managed to gather together in the colonies members of the political establishment, business associations, professional scientists, and the

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[296] Giancarlo Monina, *Il consenso coloniale: Le società geografiche e l'Istituto Coloniale Italiano: 1896-1914* (Rome: Carocci, 2002), 118.

[297] I agree with Giancarlo Monina that Aquarone failed to understand the importance of the Congress when he claimed that "the first Italian colonial congress failed to ensure the actual participation of authoritative representation of the cultural and political world, thus remaining within the tight limits of *fin de siècle* nostalgic africanism" (Quoted in *ibid*., p. 117). While my analysis is very indebted to Monina's analysis, I strongly disagree with the distinction between colonial "politics" and "science" based on his focus on the primacy of political history: "The majority of the reports [at the Conference] dealt with the economic and administrative features of the colony, but what I am mostly concerned with is the political aspect." *Ibid*., 118.

[298] *Ibid*.

press by inviting colonial officers, politicians, university professors, engineers, and journalists.[299] His interventions were an explicit call to end the controversies of the past and shape collaboratively reliable knowledge and information about the colony. Similarly, the Director of the paper *Gazzetta Coloniale* connected explicitly the failure of Adwa with the result of controversies about African conditions and the ignorance of the local environment: "A precise knowledge of the soil, of the resources, of the routes for penetration, of the topography of Eritrea; if all this knowledge had been spread in the widest audience we would have been spared the lies about the sterility of the soil and, dare I say, even the day of Adwa. Because knowledge of the places is for the strategist what the polar star is for the navigator without compass."[300] The goal of the conference was to coordinate research directions for Italian scientists, politicians, and businesses.

Education and scientific institutions devoted to colonial agriculture were necessary to blackbox the policies of Italian colonialism and chart a successful plan of colonization. Members of the conference did a lot of soul-searching of the deep causes of previous failures: "A quick look at the first years of Italian colonial history is enough to convince that all our colonial actions were sometimes hampered by the lack of determinate projects, by sudden changes of political and colonizing methods, by concessions to events and contingencies that could have brought to different logical results."[301] Scientific education and experience of African environments would produce new consensual knowledge and benefit new young Italian scientific experts.

Martini welcomed the visitors as "invoked verifiers" [*invocati verificatori*] of the progress that had been made since the establishment of the civilian government. He appealed to "you, the press, you can really help: we must educate the metropole. We must show that in colonial matters the popular proverb holds true: Rome wasn't built in a day: [...] We must teach that the valorization of a colony is a long enterprise, [...] it is a slow and expensive job. Eritrea is a child, not yet an adolescent." Martini's liberal imperialism was pervaded with elitist paternalism towards both people in the colony and the metropole. Eritrea was a child colony and Italy a young nation to be educated to the practices of a colonial mission.

The agronomist Gioli himself—the promoter of the establishment of weather stations in Eritrea—picked up this internal pedagogical problem in his speech at the conference. He complained about the lack of agricultural education of the illiterate masses of emigrating Southern peasants, but turned also against the ignorance of the Italian upper classes: "Did our upper and middle bourgeoisie and our educated classes bring a noticeable contribution of energy and knowledge to our colonial activity?"[302] Gioli's speech was a plea to strengthen Italian

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[299] For a list of participants, see Carlo Rossetti, ed., *Atti del Congresso Coloniale Italiano in Asmara (Settembre-Ottobre 1905)* (Rome: Tip. dell'Unione cooperativa editrice, 1906). The newspapers represented at the conference were *La Tribuna*, *Il Mattino*, *Il Secolo XIX*, *Il Messaggero*, *Il Secolo*, *Il Popolo Romano*, *Il Giornale d'Italia*, *Agenzia Stefani*, *Gazzetta Coloniale*, *Rivista Geografica* and *Rivista Marittima*.

[300] S. Falzone, Director of the *Gazzetta Coloniale*, "Reclutamento e coltura dell'ufficiale colonial," in Rossetti, *Atti del Congresso Coloniale Italiano in Asmara*, p. 218.

[301] "Vie commerciali di penetrazione dalla colonia Eritrea all'Impero Etiopico," in *Atti del Congresso Coloniale Italiano in Asmara*, 105.

[302] Gioli, "The Ordering of Agricultural and Commercial Studies in relationship with Colonial Politics," in *Atti del Congresso Coloniale Italiano in Asmara*, 10.

institutions of research and applied teaching about tropical agriculture in order to spread information among Italian farmers and political elites alike.

Gioli argued that "a more widespread teaching of meteorology and physical geography would be useful to produce knowledge about one of the most important factors of agricultural industries, namely the climate of regions that differ from ours."[303] He complained about the lack of institutions devoted specifically to colonial agriculture and the tragic backwardness of Italian botany compared to other European countries.[304] Italy had only five agricultural schools of higher education (Milan, Pisa, Bologna, Perugia, and Naples), only one of which was in the South—Italy's natural laboratory for the study of tropical agriculture.

The weakness of colonial cultural institutions was addressed by the journalist Salvatore Giannò as well. The major Francesco Coco called for the completion of a topographic and hydrographic map of Eritrea. The agronomist Baldrati presented reports about the possibilities of agricultural development in Eritrea based on Tancredi's climatological studies. Tancredi himself was in the audience as part of the local organizing committee and represented the Italian Geographical Society at the conference, along with the anthropologist Lamberto Loria. The reorganization of colonial knowledge that took place at the conference was crucial for the future coordination of Italian imperialist policies.

Space and environment mattered enormously in Martini's marketing operation. The location of the Congress in Asmara was crucial for the success of the event. The feedback loop between colony and metropole could be successful only if Italian scientists, journalists, and politicians could see the colony with their own eyes and be educated about the possibilities of development of the region on the spot. A series of trips were organized to expose participants to the environment of the colony. The Marquis Di San Giuliano, the president of the conference, had been in Eritrea with Martini in 1891 as a member of the Parliamentary Commission for the study of the Colony (see Chapter 1). In other words, the program of the conference made the experience of the African environment a crucial factor in forging a national community of experts and convince them to invest time, money, and energy in Eritrea.

At the end of the meeting, Martini renewed his plea for building trust by producing scientific *facts* about the colony. He issued a call for the collaborative production of a new scientific narrative about Eritrea: "This poor colony that was cursed in legendary tales invoques authoritative, unbiased and trustworthy witnesses; it invokes for itself words of trust [...]. The Colony does not expect harmony or benevolence of judgment from the participants of the conference [but] expects that you tell what you saw: tell *facts*, so that the *facts* that you validated will be the elements for thoughtful and serious judgment."[305]

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[303] *Ibid.*, 14.
[304] *Ibid.*, 16 and 18. To be fair, he mentioned the creation of the *Museo Coloniale* in Rome in 1904 under the direction of Pirotta, but critiqued the impossibilities of its development. Falzone was trying to create an institution of colonial knowledge in Naples. Gioli himself was working on the creation of the Italian colonial institute in Florence.
[305] Martini, *Il Diario Eritreo*, v. 4, 37-43.

2.4 Building an Imperial Infrastructure of Knowledge

What was the result of the Asmara Congress? There were three major outcomes of Martini's liberal politics of knowledge at the cultural, institutional, and political level. First, scientific expeditions were organized in the immediate aftermath of the conference. The geographer Olinto Marinelli (1876-1926) and the geologist Giotto Dainelli (1878-1968) were among the scientists present at the conference and undertook an expeditionary mission in Eritrea immediately after the event.[306] This was the first truly interdisciplinary expedition organized in Italy: rather than traveling as individual explorers, Dainelli and Marinelli explored the regions between Eritrea and Ethiopia with Lamberto Loria and Aldobrandino Mochi, who were in charge of the anthropological studies of the mission. Marinelli and Dainelli received instruments from the Central Meteorological Office, but also local data from Tancredi, in order to establish their distinctions between different climatic zones of Eritrea.[307] These studies proved foundational for later developments of Italian knowledge of east Africa. Giotto Dainelli and Olinto Marinelli wrote the section about meteorology for the new volume of scientific instructions to travelers in Italian, after the first publication of Arturo Issell's volume in 1881 (see Chapter 1), that was designed by members of the Asmara Conference.[308]

This volume of scientific instructions mirrored the openness—but also the weakness—of Italian liberal techno-politics. Their intended audience was an imaginary group of colonial functionaries, missionaries and doctors, farmers and businessmen, and "any ordinary person who wants to go or live in the colony."[309] Because they intended to educate ignorant colonial officers and travelers, they were written simply to encourage non-specialists to collect scientific information. Their geographical scope were Eritrea and Ethiopia, thus showing the ambition of producing a text that would work well also beyond the frontiers of Eritrea, into the Ethiopian empire. In other words, the structure, style, and audience of the pamphlet acknowledged that scientific experts and the colonial State could not do everything alone. Therefore, an Italian colonial society needed to be instructed and involved in the study of the colony.

Another cultural product of the First Colonial Conference was the promotion of professional careers for the scientists who intervened at the event. Gino-Bartolommei Gioli became director of the Italian Colonial Institute in Florence to coordinate scientific experts who had been part of this first wave of Italian colonial studies after the haphazard chaos of the late nineteenth century.[310] Baldrati continued to promote Eritrean agriculture at the experimental institute in Asmara until 1918 and had a new moment of celebrity after the invasion of Ethiopia

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[306] Giotto Dainelli e Olinto Marinelli, *Risultati Scientifici di un viaggio nella Colonia Eritrea* (Florence: Tipografia Galletti e Cocci, 1912). For the anthropological data, see Nello Puccioni and Pietro Battara, *Le osservazioni antropometriche eseguite dal prof. Aldobrandino Mochi in Eritrea: missione scientifica Eritrea, 1905* (Florence: Istituto di antropologia, etnologia e paleontologia della R. Università di Firenze, 1934).

[307] *Ibid.*, 315-91. See also Giotto Dainelli e Olinto Marinelli, "Le regioni climatiche della Colonia Eritrea," *Rivista Geografica Italiana* (1909) and Giotto Dainelli, *In Africa: lettere dall'Eritrea* (Bergamo: Istituto italiano d'arti grafiche, 1908-1910).

[308] Società di Studi Geografici e Coloniali e Società di Antropologia, Etnologia, e Psicologia Comparata, *Istruzioni per lo Studio della Colonia Eritrea* (Florence: Tipografia Galileiana, 1907).

[309] Ibid. 7-15.

[310] Società di Studi Geografici e Coloniali, *L'Eritrea Economica* (Novara-Rome: Istituto Geografico De Agostini, 1913).

in 1935. Dainelli and Marinelli became two of the most important geographers and exploratory scientists of liberal Italy. Dainelli also went back at the forefront of the study of the Horn of Africa at the time of the fascist invasion of Ethiopia in 1935.[311] Tancredi was pivotal in the organization of an expedition into Ethiopia in 1908 in order to study the climate and soil around Lake Tana, the source of the Blue Nile.[312] His environmental and climatological studies became official knowledge when they became part of Martini's *magnum opus*, his *Report to Parliament about the Colony Eritrea*, a massive body of work in several volumes collecting legal, statistical, anthropological, and environmental data about the colony (fig. 2.2).[313] In short, liberal techno-politics made colonialism part of a scientist's career and no longer a dangerous and political business like before Adwa. The politics and controversies of the age of exploration had become techno-politics of colonization projects.

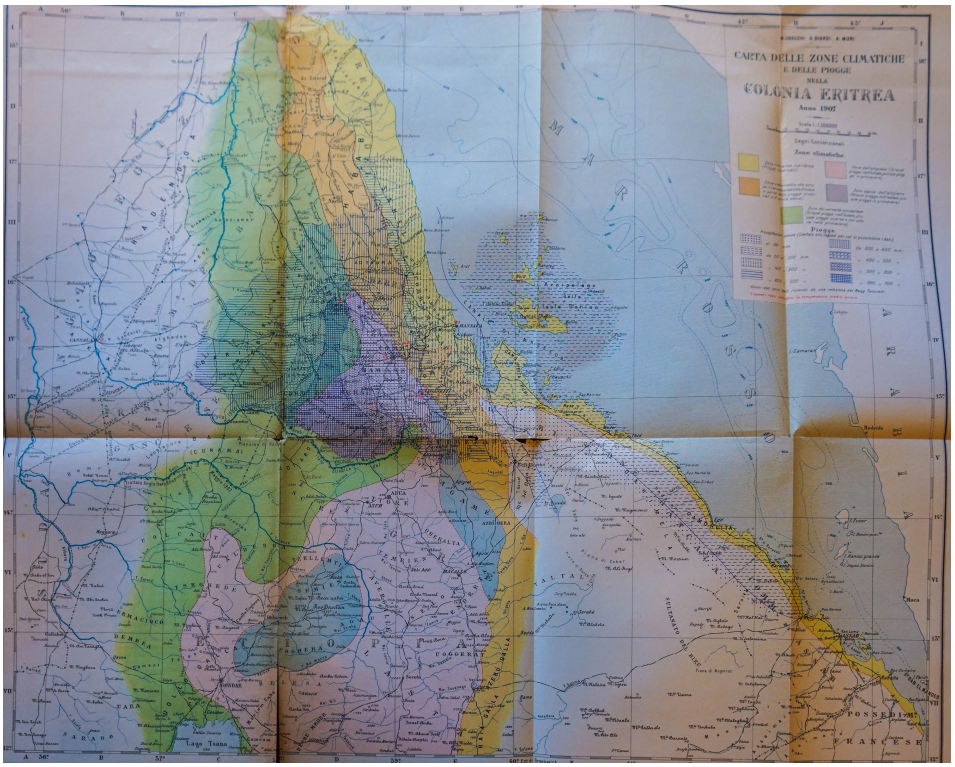

Fig. 2.3: Map of Climatic Zones in Eritrea and Northern Ethiopia. The maps are drawn based on Tancredi's meteorological studies.[314]

[311] After the fascist invasion of Ethiopia in 1935, Dainelli undertook an expedition to Lake Tana, the source of the Blue Nile. See Giotto Dainelli, *Geologia dell'Africa Orientale*, v. 3 (Rome: Reale Accademia d'Italia, 1943).
[312] Maurizio Rava, *Al Lago Tsana. Il Mar Profondo d'Etiopia* (Rome: Società Geografica Italiana, 1913). His helper was Abubacher Addala, nurse, zoologist, expert of meteorological observations, "an encyclopedist of the 1700s" (1).
[313] Ferdinando Martini, *Relazione sulla colonia Eritrea* (Rome: Tip. della Camera dei deputati, 1913).
[314] In *Ibid*., Appendix.

The most important institutional result of the Asmara Conference was the flourishing of an imperial infrastructure of cultural institutions devoted to the collection, organization and creation of colonial knowledge. Martini and Di San Giuliano, the President of the Conference of Asmara, worked together to establish the *Italian Colonial Institute* in Florence and coordinated it with the Italian Geographical Society.[315] At about the same time of the conference, the *Istituto Agronomico per l'Oltremare* (Agronomic Institute for Overseas) was created in Florence in 1904 with its journal *Colonial Agriculture*. In 1906, the Italian-African Institute (*Istituto Italo-Africano*) was founded in Rome for the promotion of colonial studies, the formation of a library, the collection of artifacts, data, specimens and materials, and the creation of an appropriate journal, the *Rivista Coloniale* ("Colonial Review").[316]

At the very same time, the botanist Pietro Romualdo Pirotta (1853-1936), professor of vegetal physiology at the University of Rome, coordinated with Governor Martini to create the first Italian National Colonial Museum. Pirotta had already created a colonial herbarium in 1892 at the Botanical Institute of the University of Rome in order to host the collections of several African explorers, but the new colonial museum had the explicit goal of using science for political pressure on the Italian government in the metropole.[317]

The museum was close to central government "in order to have in Rome, as in all the capitals of the countries that have colonies, a central institution not only about science but also for the promotion of agriculture, industry and trade of our colonies. Thus our colonies, like the Government and private people, could rely on the Herbarium and the Museum to have information about useful plants and agricultural products."[318] Martini also provided funding for Pirotta's study of Eritrea's flora that was published on the *Annuario del R. Istituto Botanico di Roma* between 1902 and 1908. Similarly, the Botanical Garden of Palermo created a colonial section in 1905.[319] In other words, the creation of a colonial infrastructure of knowledge in Italy did not precede, but followed colonial expansion and the practice of colonial rule. The need of producing knowledge about colonial environments reshaped Italy's institutional landscape of colonial knowledge.

Previous institutions did not stop functioning, but contributed to the new effervescence of scientific and cultural production. In particular, the Italian Geographical Society in Rome

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[315] Monina, *Il Consenso Coloniale*, 132-33. They had been together in Eritrea already in 1891 as members of the Parliamentary Commission for the Study of the Colony (see Chapter 1).

[316] Within the board of the journal, there were Enrico Catellani, professor of law at the University of Padua; Cesare Vivante, Professor of Commercial Law from the University of Rome; Pietro Romualdo Pirotta, Professor of Botany at the University of Rome; the statistician Augusto Bosco; and the cartographer Carlo Rossetti.

[317] Francesca Gandolfo., *Il Museo Coloniale di Roma (1904-1971). Fra le zebre nel paese dell'olio di ricino* (Rome: Gangemi Editore, 2014).

[318] Letter from Pirotta to Martini, February, 24 1903 for the creation of a colonial herbarium (MAE, ASMAI, Africa III, p. 41, f. 5, May 17, 1903). Pirotta insisted on the importance of placing the herbarium and colonial museum close to the Government and all Ministries involved in the colonization. See Francesca Gandolfo., *Il Museo Coloniale di* Roma, 79-80, 83.

[319] *Bollettino del R. Orto Botanico di Palermo*, March 31, 1905. The garden was directed by Agostino Todaro and later by Antonino Borzì. As a sign of its further growth, the section became an independent Colonial Botanical Garden in 1914 after the conquest of Libya. See *Bollettino di Studi e Informazioni del R. Giardino Coloniale di Palermo,* vol. I (1914), Law of July 11, 1913.

assumed an increasingly national role. The President of the Asmara Congress, Di San Giuliano, became also president of the Italian Geographical Society shortly after the 1905 conference. His program as president connected the future of Italian imperialism with new politics of knowledge. It was based on the belief that "scientific activities represent a valuable master key [*grimaldello*] for economic and political penetration. Scientific missions are already a form of territorial occupation, especially in regions that are contested with other powers. Science and its applications are not separated by strict boundaries. Science can choose as object of study those areas where the fatherland's interests are most important today and can mature tomorrow."[320] Thus, the main result of the Asmara Conference was the inauguration of new forms of politics of knowledge.

The buildup of scientific institutions devoted to the colonies depersonalized environmental information and made science the basis for new forms of imperial consensus. Not only could a new nationalist generation of professionalized scientists find new jobs - they could also produce cumulative knowledge. The organization of the scientific community and a new institutional landscape in Italy were the products of imperial expansion abroad.

Even if Ethiopia remained independent, the *Central Meteorological Office* continued to monitor weather data from Addis Ababa thanks to the doctor Lincoln De Castro, physician at the Italian embassy in Addis Ababa. Like Tancredi, De Castro arrived in East Africa at the time of the battle of Adwa and was a reliable source of information.[321] Yet despite De Castro's efforts, Italian liberal techno-politics struggled to compete with its British and French counterparts in Ethiopia.

2.5 International Competition

A crucial goal of the First Colonial Conference of Asmara was to use liberal techno-politics to expand Italian influence abroad, particularly in Ethiopia. This part of the program of Asmara was also crucial for the economic success of Martini's program because the development of the colony depended on its connections with inland resources. Without autonomous sources of water or an already strong market society, Eritrea could become profitable in the long term only as entry route toward the far greater hydrological and commercial resources of the interior in Western Ethiopia, in particular. Yet on this terrain of economic penetration that was key for the success of a liberal techno-political regime, Italy struggled to compete with its main rivals: France and England.

The battle of Adwa deterred other European powers from even using military force. Instead, they tried to take advantage of the Italian defeat by casting their economic influence in the region. France, in particular, struck the best bargain with the creation of a railroad between Djibouti and Ethiopia. Construction began already in October 1897 and a brand new city, Dire Dawa, sprouted up at the first stop of the railroad across the border between Ethiopia and French

[320] Monina, *Il Consenso Coloniale*, 134.
[321] Filippo Eredia and Lincoln De Castro, "Sulla Climatologia dell'Etiopia," *B.S.G.I.*, f. VIII, 1914: 845-884.

Somaliland.[322] Since construction costs across the challenging Ethiopian mountains soared, the British tried unsuccessfully to take over the capital of the French company with the International Ethiopian Railway Trust that purchased French stocks until the French government rescued the Compagnie Impériale des Chemins de Fer Éthiopiens in 1902.[323] The direct involvement of the French government alienated the project of the railroad from Menelik's court and the extension of the railroad from Dire Daua to Addis Ababa, since Ethiopians feared that the railroad would become a tool of French penetration.

Martini tried to respond to the French initiative by soliciting Rome to continue the Italian railroad from Massawa to the highlands. A small section of the railroad was built for military purposes between 1887 and 1888, but as historian Stefano Maggi comments, Martini's "struggle to create the railroad and bring it up to the plateau was the major enterprise of his activity as governor for ten years."[324] He strongly believed that connecting the Ethiopian mountains with the coast was an essential tool of economic penetration and political influence. Under his tenure the railroad developed a great deal, but it proceeded through a series of small steps, since he never managed to convince the government in Rome to invest great resources on it.

Asmara and Massawa were connected only in 1911 and the railroad did not continue to the border of Ethiopia. Even if the idea of a connection between Eritrea and Somalia through an Italian railroad was born in the projects of early twentieth century liberal imperialism, Italians' slow progress, lack of funding, and political inability to connect Eritrea with northern Ethiopia paled into insignificance at the time of the completion of the French railroad that reached Addis Ababa in 1917. A prodigy of Italian engineering for its itinerary across treacherous mountains, the Italian railroad's influence was limited to local traffic in Eritrea after the successful completion of the French railroad—despite its inefficiencies. Even in 1920, the line between Djibouti and Addis Ababa was much longer than the Italian railroad between Massawa-Asmara-Dem Sebai (783 km vs. 151 km).[325]

While the French experimented with the railroad as a techno-political tool to enter Ethiopia, the British recurred to the hydro-politics of the Nile as strategic leverage to control Egypt, the Sudan, the region of the equatorial lakes of Uganda, and Western Ethiopia. The defeat of the Mahdist revolution in 1898 opened "a new stage in the study of the Nile" and allowed British and Egyptian engineers to replace German, French, and Italian geographers in the study of the hydrography of the upper Nile.[326] Between 1899 and 1902 they built the first Aswan dam.[327] In 1896, the Uganda administration started observations of water levels at Lake Victoria

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[322] Stefano Maggi, *Colonialismo e comunicazioni: le strade ferrate nell'Africa italiana, 1887-1943* (Naples: Edizioni Scientifiche Italiane, 1996), 153-55.
[323] *Ibid.*, 155.
[324] *Ibid.*, 53.
[325] On the other hand, the French railroad was so dysfunctional that its trade amounted to a far smaller volume of goods (32,700 tons of materials vs. 51,000 tons). *Ibid.*, 162-63.
[326] Egypt and Henry George Lyons, eds., *The Physiography of the River Nile and Its Basin* (Cairo: National Printing Dept, 1906), 2. Previous explorers of the rivers were the German von Klöden, the Italian Lombardini and the French De Martonne, among others.
[327] Jennifer Derr, "Drafting a Map of Colonial Egypt. The 1902 Aswan Dam, Historical Imagination, and the Production of Agricultural Geography," in *Environmental Imaginaries of the Middle East and North Africa*, ed. Diana Davis and Edmund Burke III (Athens: Ohio University Press, 2011) 136–57.

and in February 1904 at Lake Albert. They also set up meteorological stations in Sudan. In 1901 Sir W. Garstin, British Under Secretary for Public Works in Egypt, published a report about Irrigation Projects in the Upper Nile, and a second more detailed one in 1904 with more hydrological data. He also authorized a mission by C. E. Dupuis to Lake Tana in Ethiopia in 1902-3. In 1904, the British divested Albert Ismalun, the Director of the Chemical Laboratory of the Khédivé with whom Italians had previously corresponded, and transferred Egypt's meteorological and geophysical scientific hub from his observatory in Abbassia (a neighborhood north of Cairo) to the Helwan Observatory, in a desert plateau 22 kilometers south of Cairo.[328] Their grip on Egypt and the Nile basin depended on their knowledge and management of the river.

By the early twentieth century, they realized that the major floods determining the seasonal regimen of the Nile came from the Blue Nile or Abbai river, whose origin in Lake Tana made it the subject of controversy and negotiation between British and Ethiopian authorities for decades.[329] The engineering of the river became essential to regulate the ecology of the river, begin the Gezira scheme for the plantation of cotton in Sudan, and control Egypt through the techno-politics described by Timothy Mitchell.[330]

The study of climate in Ethiopia was part of liberal techno-politics as a form of cultural and scientific influence abroad. Yet the British made better use of Italian meteorological data than the Italians themselves, meaning that they were able to use their observations to build their scientific and economic studies of the Nile while Italians were still struggling to organize an efficient network for the collection of data at the beginning of Martini's liberal techno-political regime.

British surveyors in Egypt were extremely interested in Italian meteorological studies in Africa, since their goal was to collect as much information as possible about the surroundings of the empire.[331] The Egyptian Survey Department was born in 1898 from the fusion of the Revenue Survey, the Hydrographical Survey, the Map Drawing Office of the Ministry of Public Works, and the Geological Survey. Its director was Henry George Lyons (1864-1944).[332] As early as

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[328] The observatory included meteorological equipment with self-registering apparatus, and the arrangement for issuing the noon time signal at Port-Said and Alexandria.

[329] See Chapter 4.

[330] See Timothy Mitchell, *Rule of Experts: Egypt, Techno-Politics, Modernity* (Berkeley: University of California Press, 2002). See also Terje Tvedt, *The River Nile in the Age of the British: Political Ecology and the Quest for Economic Power* (London and New York: I.B. Tauris, 2004); Gebre Tsadik Degefu, *The Nile: Historical, Legal and Developmental Perspectives* (Victoria: Trafford Publishing, 2003); Ḥagai Erlikh, *The Cross and the River: Ethiopia, Egypt, and the Nile* (Boulder: L. Rienner, 2002); Michael Barthorp, *War on the Nile: Britain, Egypt and the Sudan, 1882-1898* (Poole: Blandford Press, 1984). On the Gezira scheme in Sudan, see Tony Barnett, *The Gezira Scheme: An Illusion of Development* (London: F. Cass, 1977); Maurits W. Ertsen, *Improvising Planned Development on the Gezira Plain, Sudan, 1900-1980* (New York: Palgrave Macmillan, 2016).

[331] See Archive C.R.A.-C.M.A., Fondo Palazzo, "Egypt", letters from Palazzo to Lyons, July 13, 1904 and Lyons to Palazzo, April 26, 1905.

[332] Henry George Lyons, *The Cadastral Survey of Egypt* (Cairo: National Printing Department, 1908) 7. Lyons came from a military family. He was first stationed in Gibraltar in 1886 and later in Cairo in 1890 as part of a Company of Royal Engineers. In 1892 he became Assistant Quarter Master General on Sir. H.H. Kitchener's staff. He travelled to the Nubian desert in 1895 to inspect caravan routes and water supplies; in 1895-6 he inspected the temples on the river islet of Philae, above the first cataract of the Nile, near Aswan, before the construction of the dam. In July

1901, when Tancredi and Martini had not even constituted the meteorological service of Eritrea yet, Lyons inquired with the Italian Central Meteorological Office to obtain the data.

Fig. 2.4: Henry George Lyons (1864-1944), Director of the Egyptian Survey Department.

1896, he joined the Egyptian Ministry of Public Works while still holding active rank in the Royal Engineers in order to organize a Geological Survey of Egypt. His work attracted Lord Cromer's interest and in 1898 he was asked to accomplish the Cadastrial Survey of Egypt after the completion of the Geological Survey. However, in order to accept the job and retire from active military duty, Lyons asked Cromer to create a single Survey Department, encompassing the Geological Survey, the Revenue Survey, and the Drawing Office of the Department of Public Works. In addition to these surveys, Lyons developed an Observatory and a Meteorological Office. He certainly met the Italian Director Luigi Palazzo in Innsbrück at the International Congress of Directors of Meteorological Services (September 9, 1905). In 1906, he completed the book "The Physiography of the Nile and its Basin." He left Egypt in 1909 to lecture at the University of Glasgow and was replaced in Egypt by Ernest Dowson. He was Assistant Director of the Science Museum in South Kensington from 1912 to 1914 (the Director at the time was Sir Francis Ogilvie). In 1913, he was appointed a member of the Government's Meteorological Committee on the recommendation of the Royal Society and became president of the Royal Meteorological Society in 1915. In 1915, he was transferred from Chatham to London as representative of the War Office in the Meteorological Committee. As Major, he became the organizing Commandant of the Meteorological Service in London, with Major Gold in Command in France and Captain Wedderburn in the Eastern Mediterranean. In 1916, he took over the administrative direction of the Meteorological Office, reducing Napier Shaw to technical advice, and became effective director in 1918, with Shaw becoming scientific advisor and chairman of the Meteorological Committee. Shortly after, Lyons was gazetted Commandant of the R.E. Meteorological Services with the active rank of Lieutenant-Colonel until April 1919. He attended a conference in 1919 and served on the Committee transferring the Meteorological Office to the Air Ministry amalgamating with the Air Ministry's existing meteorological service. He remained a member of the Meteorological Committee and succeded Sir Arthur Schuster as vice-Chairman in 1932. After the war, Lyons was one of the British delegates nominated by the Royal Society to an International Conference on International Scientific Organization in 1918 in London and again in Paris after the armistice. In 1919, he attended the meeting of the newly formed International Research Council in Brussels and was elected Secretary-General of the International Union of Geodesy and Geophysics. He retired from active military service as Colonel in 1919 and returned to be the Keeper of the Science Museum, becoming the Director. He was Secretary of the International Union of Geodesy and Geophysics, active in the International Research Council, later renamed International Council of Scientific Unions, as General Secretary in 1931.

British data-diplomacy was a crucial aspect of imperial building and liberal techno-politics in the region, as Lyons was preparing at the time his "Physiography of the River Nile and its Basin," namely the major study of the hydrology of the river until then.[333] In a letter to the Italian Director Luigi Palazzo in November 1903, Lyons was very explicit about the reason why he needed the data: "meteorological stations are greatly important for the study of the Nile."[334] Thus, Lyons pressed Palazzo to have even more detailed observations "for the comparative study of the climate of Egypt and Sudan, and for the study of the regimen of the Blue Nile."[335] Because Italians collected the data but were not able to publish them yet, the British were able to get copies of all the forms produced by Italian meteorological stations in Eritrea and were willing to pay for them.[336] Copying the data was a huge amount of work. It took a total of 128 hours of work and four calculators to copy and process the forms, for a total bill of 96 lire for each clerk, since they were paid 0,75 lire/per hour.[337] In the spirit of early twentieth century international collaboration, Palazzo sent to Lyons also the study about the climate of Massawa and Assab produced by Italian doctors in the late nineteenth century. In short, British strategy allowed them to plan ahead and anticipate—or even exploit—Italian efforts in the regime of liberal techno-politics.

On one hand, the control of colonial data increased the international network of the Italian Central Meteorological Office. In the same way the exchange of instruments between Palazzo and Tancredi contributed to the making of a colonialist epistemic community between Italy and its colony, imperialism enhanced international communication, standardization and coordination among European scientific institutions. As we will see in the following chapter, by the early twentieth century this was an essential part of the international scientific paradigm of liberal meteorology.

On the other hand, the letters between Lyons and Palazzo expose the lack of preparation of Italian data collection practices. Before, inquiring with Palazzo in Rome, Lyons had previously contacted the harbormaster in Massawa to receive data about Eritrea, but he replied that the meteorological service in the colony did not have a good archive of the data, as they were split between Massawa and Asmara after the change of capital. He also had no way to find out anything about the data collected in Addis Ababa, across the Ethiopian border. Only Palazzo in Rome could answer Lyons' questions.[338] Embarrassingly, Palazzo even asked Craig to let him know if the Italian personnel in Massawa followed orders and sent him the data correctly.

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[333] H. G. Lyons, *The Physiography of the River Nile and its Basin* (Cairo: National Printing Department, 1906).
[334] C.R.A. - C.M.A., Fondo Palazzo, "Egypt," Letter from Lyons to Palazzo, November 9, 1903.
[335] C.R.A. - C.M.A., Fondo Palazzo, "Egypt," Letter from Lyons to Palazzo, March 22, 1904. Lyons asked Palazzo after receiving a disappointing answer from Massawa. He requested the monthly averages of barometric pressure and temperature, and the amount of monthly rainfalls from 1893 in Massawa and all other stations in Eritrea.
[336] C.R.A. - C.M.A., Fondo Palazzo, "Egypt," Letter from Lyons to Palazzo, April 14, 1904.
[337] C.R.A. - C.M.A., Fondo Palazzo, "Egypt," Letter from Palazzo to Lyons, June 4, 1904; the amount was paid in francs on June 22, 1904.
[338] C.R.A. - C.M.A., Fondo Palazzo, "Egypt," Letter from the Capitaneria di Porto in Massawa to Lyons, March 10, 1904.

National affiliation mattered less than imperial cooperation: Palazzo did not find bizarre to ask the British civil officer to inform him on the behavior of Italian data collectors in Eritrea.[339]

Trans-imperial cooperation was essential for the constitution of an international network of liberal meteorology. Palazzo was willing to send Lyons barometric data about Massawa even before they were published. Lyons sent Palazzo a copy of the study about magnetic measurements carried out in Egypt by the Survey Department and Bertram Keeling, after his request on September 23, 1908 for his own studies.[340] Even the language they used mirrored the lack a clear scientific hegemony. In some instances, Craig and Lyons wrote to Palazzo in Italian.[341] More often, Palazzo, Craig, and Lyons corresponded in French, using it as a *lingua franca*. The internationalism of early twentieth-century meteorology was built on the general sense that imperial competition could be harmonized as long as there was still space to colonize and control through the logic of a shared liberal techno-political regime.

In this spirit of trans-imperial cooperation, as much as increasing willingness between English and French to sideline colonial competition against the rise of German imperialism, the three European powers decided to recognize their reciprocal spheres of interests in Ethiopia despite Menelik's hostility.[342] The Tripartite Treaty signed in London in 1906—an idea originally invoked by Martini, among others—marked the triumph of European liberal techno-politics as covert imperialism in Ethiopia.

According to the agreement, the three imperial powers committed to respecting Ethiopia's territorial integrity, while at the same time violated blatantly its sovereignty by partitioning it in spheres of influence. French techno-politics of the railroad were granted the "permission" to continue the railroad to Addis Ababa. British hydropolitics and interests in the water of the Blue Nile basin and Lake Tana was recognized by all the parties involved. Italians could not compete with the French railroad and British hydraulic engineering. In 1906, they were recognized the very abstract control of the hinterland of Eritrea and Somalia, with the permission to build a railroad in the future connecting the two colonies west of Addis Ababa.[343] Considering the slow progress of the railroad advocated by Martini, this goal remained completely delusional, but it continued to represent the basis of European vows and agreements until the fascist invasion of Ethiopia in 1935 (see Chapter 4).

Martini himself was worried about the critical advantage of the British and the French in their economic capacity compared to Italy's poorer economy. In a letter to the agronomist Gioli, Martini wrote: "I am afraid, dear Gino, that after so much struggle [to promote the cultivation of cotton] Eritrea will become as a matter of fact a French or British colony. A French company has

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[339] C.R.A. - C.M.A., Fondo Palazzo, "Egypt," Letter from Palazzo to Craig, May 17, 1907.
[340] Bertram Keeling, *Magnetic Observations in Egypt 1895-1905* (Cairo: Ministry of Finance, Survey Department, 1907).
[341] For example, on May 8, 1907 the civilian officer J. D. Craig wrote to Palazzo a letter in Italian, asking to send him from Massawa the meteorological data for atmospheric pressure, the average temperature in the morning, and the total amount of rainfall on a monthly basis. This data was needed in order to complete the summary of temperature that he promised to send to Rome. C.R.A. - C.M.A., Fondo Palazzo, "Egypt," Letter from J.D. Craig to Palazzo, May 8, 1907.
[342] Maggi, *Colonialismo e comunicazioni*, 157-163.
[343] Del Boca, *Italiani in Africa Orientale*, v. I, 769-770.

already asked me for a concession [...] An Englishman is coming to talk to me and I anticipate the discussion will be about cotton."[344] Until they followed the rules of liberal techno-politics, Italians struggled behind their European counterparts.

As a result of the 1906 deal, the governor of Eritrea that followed Martini, Salvago Raggi, sent a mission in 1908 led by Giuseppe Ostini, in the lake Tana region. Ostini believed that building a railroad connecting Lake Tana with Eritrea was a priority, before British influence in the area would overcome Italian efforts. Construction studies developed in 1913 were halted by the beginning of the Great War, but Ferdinando Martini (the former Governor of Eritrea turned into Minister of the Colonies during the conflict) managed to get the Italian State Railroad Company to send an expert, the engineer Edoardo Pastore, to Western Ethiopia, disguised as if he was a member of a geographical mission.[345] As we will see in Chapter 4, the liberal techno-political efforts marked by Martini's approach remained the basis for Italian imperialism in the Horn of Africa until Mussolini's decision to reject the rules of liberal imperialism and invade Ethiopia in 1935.

2.6 Conclusions: The Limits of Italy's Liberal Imperialism

The 1906 Tripartite Treaty well represents the achievements and limits of Italian liberal imperialism and European liberal techno-politics in Ethiopia more broadly, conceived as it was as a set of economic parameters concerning railroads, water, and future economic development. On one hand, Martini managed to kick off a new phase of Italian colonialism in Eritrea, freeze French and Italian political expansion in the region diplomatically, and see Italy's influence recognized by their major competitors. Yet such "influence" was largely illusory and a dramatic setback compared to Italy's ambitions before Adwa, when the 1891 agreement with the British Empire placed the entire Horn of Africa in the Italian sphere. Italian liberal techno-politics was successful in relaunching Italian colonialism based on new premises, new methods, and an economic vision of imperialism after the catastrophe of Adwa. Yet it was too little, too late.

Martini's paternalistic claim that Eritrea was "a child colony" maintained that its economic development had actually started with his governorship after years of military administration and war. There was an aspect of truth in this claim, namely the fact that many Italian economic initiatives began after Adwa, as the prospect of conquering Ethiopia and settling the temperate highlands of the Horn vanished—at least until 1935. However, by 1897 British and French imperialism were so economically established and so much farther ahead in their colonial practices that Italians could only follow their footpaths—whether in railroad projects or hydrological studies—while they were competing on the terrain of liberal techno-politics. They were far too late to be completely successful in the Horn and did not have the same economic means to impose themselves in the region.

Yet Martini's megalomania points to a second fragility of Italian liberal imperialism, namely the reliance on individual characters, personality, and determination. If we did not have

[344] Letter from Martini to Gioli, Monsummano, September 2, 1902, in Ferdinando Martini, *Lettere, 1860-1928* (Milan: A. Mondadori, 1934), 383.
[345] Maggi, *Colonialismo e comunicazioni*,163-167, in particular 165.

the correspondence between the unknown Tancredi and Palazzo, Italian liberal imperialism and the making of the first meteorological service would seem the result of Martini and Gioli's initiative. Of course, this was the image that Martini wanted to project in order to monumentalize his own efforts, work, and long-term legacy.

Despite the creation of an epistemic community working with the state and an infrastructure of cultural institutions devoted to colonial development, Italian liberalism still worked through networks of personal contacts rather than an institutionalized bureaucracy. This practice could still be successful in Martini's cultural politics, but failed economically without a stable, predictable, and profitable economic structure in place.

Martini sent his agronomists Gioli and Baldrati to contact individual merchants and to present Eritrea's products at international exhibits.[346] He promoted mining and cotton-producing companies. But even the creation of weather stations had always been contingent on individuals like Tancredi and their availability. In 1902, during his visit to a cotton plantation, Martini complained that Tancredi had not followed up properly on his promises to organize the meteorological service and the instruments were pretty much abandoned.[347]

As a result, the end of Martini's governorship in 1907 marked also the crisis of the Eritrean meteorological service. Agricultural and meteorological research in the colony lacked political and financial support. Despite the efforts by Palazzo and the Director of the Office of Colonization, Isaia Baldrati, the collection of data was sloppy because of lack of personnel. Baldrati inquired with the Central Meteorological Office to learn whether the use of automatically recording data would eliminate the instability and lack of discipline of individual personnel. After all, the circulation of instruments had created the network. Maybe they could also keep it alive. Unfortunately for Baldrati, meteorological instruments alone did not have enough agency to keep the meteorological service in place and Palazzo clarified that even automatically recording instruments needed constant maintenance and instructed personnel.

Palazzo recommended the creation of a job for a stable meteorologist in the colony, but lack of funding prevented the implementation of the proposal. He complained that after years of Italian occupation in Eritrea, notions of the climate were still extremely general. He had seen the organization of the meteorological service in German East Africa and in British dominions. He lamented that "even the Japanese" in colonial Korea did better than the Italians. Like many other scientific experts, Palazzo was disappointed by the lack of consistency and determination of the Italian Government. In other words, the inefficiency of the meteorological network exposed the limits of Italian liberal techno-politics.

Like the scientific instructions produced at the congress of Asmara, liberal imperialism took for granted the existence of good colonizers, willing to understand and study their colony. For some individual cases the instructions proved useful, such as for the anthropological studies,

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[346] Massimo Zaccaria, "L'Eritrea in Mostra. Ferdinando Martini e le Esposizioni Coloniali, 1903-1906," *Africa: Rivista Trimestrale Di Studi E Documentazione dell'Istituto Italiano per l'Africa E l'Oriente* LVII, no. 4 (2002): 512-45.

[347] "Captain Tancredi did not complete anything. He was good at making promises, but bad at keeping them. The meteorological instruments that were shipped from Italy have been abandoned." Ferdinando Martini, Letter to Gino Bartolommei Gioli, April 20, 1902, in *Lettere, 1860-1928. Con 26 Tavole E 7 Autografi Fuor Di Testo* (Milan: A. Mondadori, 1934), 378.

published by the colonial officers Alberto Pollera and Ruffillo Perini, or the doctor Lincoln Di Castro.[348] Yet the fact that their publications stand out for their exceptional quality tells us more about the education of their authors and their sensitivity to the natural and social environment where they lived, rather than about the success of liberal techno-politics as a system. Only an institutionalized and regimented structure—like the one we will see in Libya in the next chapter—managed to instruct and discipline Italian colonists and produce an efficient meteorological service.

Despite the limits of their economic resources, the liberal techno-politics promoted by Martini were fruitful at the cultural level. The studies produced in this period—such as those about the climate of Ethiopia by Di Castro and Eredia—resisted the passing of time, since they were still considered useful during the invasion of Ethiopia in 1935 and were never actually replaced after that.[349] In fact, this was the most prolific period for Italy in the production of scientific research about the colonies, as Italians endeavored to achieve a level of scientific accuracy that would shelter them from the controversies of the past and place them at the same level as their European counterparts.

Italian scientific imperialism in East Africa came to a halt once Italian attentions focused on Libya, and later on the effort of the Great War. Despite the institutionalization of Italian imperial knowledge, capable individuals and personnel were necessary to keep that infrastructure of knowledge alive. The physical and cultural infrastructure produced in this period—whether the railroad or the set of studies produced at the beginning of the century—proved insufficient in 1935 because they were designed for a different, cheap, and slow colonial project that differed dramatically from the needs of a massive invasion under fascism.

Fundamentally, the organization of science and politics between Adwa and Fascism tried to cope with the lack of funding that plagued liberal Italy by coordinating scientific research across disciplines and regional groups, as we have seen for the first colonial conference in Asmara. The major cultural success of the conference was the preparation of a national-imperial scientific community interested in Italy's expansion abroad.

Martini had been successful in rallying the scientific community—in fact, in creating one—around his program of coordination between science and politics. Yet he did not believe in technocracy. For example, he rejected multiple times the requests from the agronomist Baldrati to be appointed provincial governor in Eritrea. He believed that science was fundamental for colonial governance, but he wanted scientists and technical experts to be collaborative employees, not to rule themselves. The liberal government had to promote their alignment to the needs of a new imperial state.

The form of scientific coordination of science and empire in the colonies spurred the making of a national scientific community with the growth of scientific associations and the perception that the country needed more national cohesion and consensus to compete on the

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[348] *Ibid.*, 8. See Magg. Ruffillo Perini, *Di Qua dal Marèb* (Florence, Tipografia Cooperativa, 1905). A Pollera, *I Baria e I Cunama* (Rome: Reale Società Geografica, 1913), quoted in Barbara Sorgoni, *Italian Anthropology and the Africans*, 62-80, and in Patrizia Palumbo, ed., *A Place in the Sun* (Berkeley: University of California Press, 2003). See also Lincoln de Castro, *Nella Terra Dei Negus. Pagine Raccolte in Abissinia* (Milan: Fratelli Treves, 1915).

[349] Filippo Eredia and Lincoln De Castro, *Sulla climatologia dell'Etiopia* (Rome: Tip. Unione Fd, 1914).

international stage. Geographical, geological and botanical societies were born at the beginning of Italian colonialism. In 1897, the Italian National Society of Physics was created by Pietro Blaserna, with the collaboration of Vito Volterra and Angelo Battelli (1862-1916).[350] In 1907 the Società Italiana per il Progresso delle Scienze ("Italian Society for the Advancement of Science") provided the first forum for nation-wide intellectual exchanges across disciplines. In 1907, the Italian Philosophical Society was founded by the mathematician Federigo Enriques, who directed the journal *Rivista di Scienza* (later called "Scientia") with Eugenio Rignano. In short, colonialism and international competition spurred the making of nation-wide forms of scientific associationism. As Sebastian Conrad has shown in the German case, the nation was built amid global, international, and colonial connections.[351]

The success of this reorganization is evident if we compare the attitude of scientific experts in the middle of the nineteenth century and in Libya. The 1905 Asmara conference approved the request to the Italian State to promote the study of the Ottoman provinces of Tripolitania and Cyrenaica, before the invasion of the country. While it took almost three decades to bring Italian naturalists to Eritrea in some coordinated fashion, in 1911 an interdisciplinary committee of scientists went to Tripoli too soon, while fighting was still under way and they could not explore the region outside the city beyond Italian control. In the 1890s, colonialism was a controversial topic among Italian scientific experts. In 1911, Italian scientists flocked to support Italian expansion in Africa.

Paradoxically, the Italian scientific community and colonialist groups set the expectations of the country too high. Their socio-technical imaginary did not correspond to the reality of agricultural prospects in Italy's Fourth Shore. Libya was called "the huge sand box," even if ironically there are huge amounts of water and oil under the desert, as we know today. After all, the temporary alignment between politics, business, and science planned by Martini was an exception in the history of Italian science and a sign of the fragility of Italy's civilian liberal imperialism. A new techno-political regime emerged through the environmental limits and the failures of liberalism in Africa.

[350] Russo, *Ingegni Minuti*, 297. Angelo Battelli (1862-1916) was professor at the University of Pisa since 1893, founder of the Italian Society of Physics, and director of the journal *Il nuovo cimento* since 1894. He worked in experimental physics and termoelectricity.

[351] Sebastian Conrad, *Globalisation and the Nation in Imperial Germany* (Cambridge and New York: Cambridge University Press, 2010). In the Italian case, this point has been affirmed more clearly in the history of emigration, but not yet in the history of Italian colonialism or the history of science. See Mark Choate, *Emigrant Nation: The Making of Italy Abroad* (Cambridge: Harvard University Press, 2008).

CHAPTER 3

The Crisis of Liberal Meteorology: The Conquest of Libya, the Great War, and the Collapse of the Paradigm of International Meteorology (1911-1931)

"[The war] is a deluge, it is a convulsion of Nature…
bringing unheard of changes in the social and industrial fabric.
It is a cyclone that is tearing up by the roots the ornamental plants of modern society."
David Lloyd George
London 1915[352]

"The war was like a kinema film that is run too fast:
one missed what one is accustomed to see
and saw things that pass unnoticed in ordinary life."
Sir Napier Shaw
Director of the Meteorological Office
London 1926[353]

3.1 Introduction

In this chapter, I argue that Libya was the laboratory for the transformation of Italian colonial sciences from a liberal to a fascist techno-political regime. Moreover, I show that this transformation took place in the broader international context of the collapse of the scientific paradigm of science and empire that had driven European explorations and colonization since the early modern period.

As we have seen in Chapter 1, the defeat at Adwa in 1896 blocked Italian imperialism in East Africa and forced scientific experts to emulate their more experienced European counterparts with the organization of a liberal techno-political regime. This new structure of imperialist consensus allowed Italians to resume their colonial expansion with the attack to Ottoman Libya in 1911, only to discover an environment that was arid and challenging to colonize. While the first conquest of Libya (1911-1912) set the stage for the use of meteorology in colonial warfare, the destruction of the international scientific paradigm of liberal meteorology in the Great War wiped out any possible international resistance to the militarization of meteorology and set the foundation for the rise of a more authoritarian techno-political regime from the ashes of the failures of liberalism.

Kuhn's famous concept of paradigm is the best suited to capture the broader global transformations revolutionizing the field of meteorology and the geophysical sciences in the

[352] Quoted in J. Adam Tooze, *The Deluge: The Great War and the Remaking of Global Order 1916-1931* (London: Allen Lane, 2014).
[353] Napier Shaw, *Manual of Meteorology*, v. 1 (Cambridge: Cambridge University Press, 1926), v.

period before and after World War I. As Kuhn clarified, a "paradigm" has two different scopes, namely "the entire constellation of beliefs, values, techniques, [...] shared by the members of a given community" and "the concrete puzzle-solutions which, employed as models or example, can replace explicit rules as a basis for the solution of the remaining puzzles of normal science."[354]

In the first notion of paradigm, the development of Western sciences in connection with European explorations produced an approach that assumed the world to be an open space of discovery, a world that Europeans saw as increasingly interconnected by their activities since the early modern period. This worldview triumphed with what historians call "Humboldtian science", a form of scientific practice pioneered by Humboldt that worshipped the values of instrumental accuracy, standardization, and international exchange among European savants.[355]

This international community had overcome both the divisions of the Napoleonic wars and the rise of nationalism in the middle of the nineteenth century. The birth of new states in Germany and Italy drove scientists to increase and organize international collaboration. In short, within this paradigm as general worldview the spaces of science and empire expanded together, as scientific internationalism and European imperialism needed one another to relocate nationalist conflict outside of Europe and science marked the boundaries between civilized Europeans and uncivilized "natural" peoples.

If we consider the notion of paradigm as a set of problem-solving techniques, there is no doubt that European meteorologists before the Great War were fully aware of operating according to a set of practical rules and methodological concerns that the British meteorologist Napier Shaw called "general meteorological program" that "became so conspicuous after the introduction of the weather map."[356] As weather phenomena obviously ignored national boundaries, meteorology became the international science by definition, especially when European meteorologists started cooperating on a regular basis to produce weather maps. I will describe the scientific aspects of this paradigm in further detail in the next section. However, I should warn the reader that I adopt Kuhn's paradigm only to describe the functioning of international meteorology as normal science before the war. The Great War "revolutionized" the field of meteorology in a very different sense from the way Kuhn intended the concept of "scientific revolution."

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[354] Thomas S. Kuhn, *The Structure of Scientific Revolutions*, 3rd ed. (Chicago: University of Chicago Press, 1996), 175.

[355] See Andrea Wulf, *The Invention of Nature: Alexander von Humboldt's New World* (New York: Alfred A. Knopf, 2015); Gregory T. Cushman, "Humboldtian Science, Creole Meteorology, and the Discovery of Human-Caused Climate Change in South America," *Osiris* 26, no. 1 (2011): 16–44.

[356] Shaw, *Manual of Meteorology*, v. I, 145. Shaw described this European division of labor in meteorology as a general program after its destruction in the Great War. Unlike any other twentieth century meteorology textbook that followed the revolution of modern meteorology after the Great War, Shaw's *Manual of Meteorology* still described the history of the discipline and its "international program" as an essential, not an accessorial part of it. Shaw's textbook could be considered the last "natural history of meteorology." In his analysis of scientific textbooks and manuals, Kuhn points out how scientific disciplines "forget" their history after a revolution, as they try to recompose the linear narrative of science as a cumulative process. Shaw's famous and often quoted *Manual of Meteorology* is an important exception, as the manual was written precisely as the older paradigm of liberal international meteorology was disappearing.

Kuhn was interested in how new scientific paradigms come into existence, gain consensus, and become successful. I deal here with how scientific paradigms get destroyed, lose consensus, and disappear to mutate into something new. The war paved the way to the birth of modern meteorology as weather forecasting, especially thanks to the invention of "Polar Front Theory" by Vilhelm Bjerknes and his Norwegian Bergen School of meteorology. Yet even if the method of the Bergen school required to "see" the weather and weather maps differently, there was no "Gestalt Shift" to the theories of the Norwegian school after the war, no matter how much effort Bjerknes put into promoting them. Many meteorologists intuited immediately their importance, but they did not immediately subscribe to the new vision of modern meteorology as weather forecasting promoted by Bjerknes and there was no possible linear narrative of cumulative scientific development in the birth of modern meteorology. The Great War derailed the scientific paradigm of liberal international meteorology in the same way it wiped out the "age of empires" without replacing it with a new international consensus, scientific paradigm, and clear geopolitical hegemony.

After the war, nationalist and fascist techno-politics emerged from the ashes of the old order first as discontent for its limits, then as a protest against its failures, and finally as an independent techno-political regime. In order to clarify this process, sections 2 and 4 offer the first contribution toward an international, environmental, and global history of modern meteorology. It is my fundamental contention here that the Great War destroyed the paradigm of liberal meteorology because it broke apart the international community of European meteorologists by forcing them to work in isolation from one another and produce weather forecasts on the specific local environments of the frontlines.

The Great War is known as the chemists' war, in the same way World War II is considered the physicists'.[357] Yet the Great War was also the meteorologists' war, as they found themselves deeply involved in assistance to military operations. The invention of poison gas by the chemist Fritz Haber and its use by the German army depended on knowledge of the wind and weather, as well as opening a new, environmental battlefield.[358] Moreover, the birth of military aviation transformed a discipline that before the war interested the entire civil society. Aerial warfare ensured the state's involvement in the organization and control of meteorology beyond the conflict. Thus, sections 2 and 4 make clear the crucial importance of the geographies of scientific knowledge before and after the war, as well as the fact that "internationalism in science [...] must be considered a social achievement, not the inevitable consequence of some inherent scientific essence. It has had to be worked at."[359]

Internationalism was replaced by "international cooperation" after the war in the vain effort to restore institutionally and from above what had been a spontaneous cultural process of globalization in the nineteenth and early twentieth century.[360] In *Governing the World*, Mark

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[357] See Michael Freemantle, *The Chemists' War: 1914-1918* (Cambridge: Royal Society of Chemistry, 2015); L. F. Haber, *The Poisonous Cloud: Chemical Warfare in the First World War* (Oxford: Oxford University Press, 1986).
[358] See Peter Sloterdijk, *Terror from the Air* (Cambridge: MIT Press, 2009).
[359] David N. Livingstone, *Putting Science in Its Place: Geographies of Scientific Knowledge* (Chicago: University of Chicago Press, 2003), 89.
[360] Akira Iriye explains that cultural internationalism is "an intellectual proposition. The cultural internationalists agreed that the key to peace lay in cross-national understanding, which in turn had to be built solidly upon active

Mazower has recently pointed out that scientific internationalism was crucial for the notion of an organized world, but its abrupt ending in 1914 leads him to dismiss it without explaining the reasons and results of this mutation.[361] In this chapter I explain why a very internationally oriented scientific community turned into nationally fragmented scientific groups and what were the consequences of the Great War in the development of the climate sciences.

Why does Italy offer a unique point of view to describe these phenomena that have been overlooked by national historiographies of science? First, Italy's switch from the Triple Alliance with the Central Powers to the Triple Entente in exchange for vague promises of new colonial possessions in the Treaty of London in 1915 makes the country a hybrid case study that sheds light on the events on both sides of the conflict. As the history of the Italian Director of the Central Meteorological Office Luigi Palazzo will show (see section 2), the Italian scientific community was as entangled with Germany as with France and England at the turn of the century. In the case of meteorology, it was even strongly dependent on German-led internationalism.

The change of geopolitical alliance abruptly interrupted the history of the climate sciences in Italy as a collaborative effort with Germany. As a matter of fact, Italians shared the experience of the conflict with their British and French allies. Yet the economic, social and political turmoil at the end of the war, as well as the disappointment with the denial of new colonies (epitomized in the famous slogan of the "mutilated victory"), made Italy suffer the consequences of the conflict as if it had been among defeated countries like Germany and Austria. These events set Italy on a different path from its liberal-democratic allies, a trajectory that culminated in the rise of fascism. In short, the Italian experience reveals the consequences of the conflict from the perspectives of both winners and losers.

Within Italy, Palazzo's imperialist and pro-German internationalism lost against the rise of nationalist-imperialist scientists of the Comitato Talassografico and the future National Research Council (CNR). From being a collaborative scientific internationalist project, imperialism became a matter of geopolitical survival. After the war, colonial empires continued to offer a space of research that needed to be maximized and felt increasingly narrow even in the British empire. Fascism would well express the need of imperial expansion as a zero-sum game against—rather than along with—other European colonial powers. Its support for the birth of Italian aviation and the deployment of airplanes in colonial warfare resulted in the transformation of meteorology itself.

Second, the Italian case shows the transformation from a liberal to a fascist techno-political regime because the country was almost constantly at war between 1911 and 1931, from the invasion of Libya to the Great War and the reconquest of Libya that terminated in 1931.

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cooperation of cultural elites." International cooperation was an institutionalized effort and came to dominate instead the discourse of the interwar period, especially with the birth of the League of Nations' Committee on Intellectual Cooperation, as it was based on the "greater self-consciousness about cultural cooperation as an instrument for peace." See Akira Iriye, *Cultural Internationalism and World Order* (Baltimore: Johns Hopkins University Press, 1997), 60-2.

[361] Mark Mazower, *Governing the World: The History of an Idea* (New York: The Penguin Press, 2012) 94-115.

Thus, the birth of military aviation in Italy is tightly connected with the history of Italian colonial expansion.

My argument in this chapter is that Libya was the laboratory of the transformation of Italian techno-politics. I adopt the concept of "laboratory" from Helen Tilley, meaning that I see complete continuity between colonial and metropolitan sciences.[362] In section 5, the example of the colonial meteorologist Amilcare Fantoli, the Director of the Meteorological Service in Libya, shows the making of a vernacular science emerging in the seamless exchange between metropole and colonial environments. The ingredients for the militarization of meteorology in 1911, the challenge of a hostile natural environment, and the perception of lack of space of expansion after the Great War turned Libya into the ideal laboratory for the transition from liberal to fascist techno-politics, which began already in 1919 with the failure of liberal techno-political approaches to the colonization.

3.2 The Paradigm of Liberal International Meteorology: Aerology, Terrestrial Magnetism, and European Empires before WWI

In this section, I describe the paradigm of international meteorology before the Great War. This paradigm was the end product of the growth of Western science along with European imperialism since the early modern period. Internationalism and imperialism were the two main infrastructures that had made scientific research possible on a global scale in this period. The generation of meteorologists and geophysicists active in the early twentieth century saw their efforts as the frontline and completion of a scientific imperialism that began in the early modern period. Their goal was to tighten their global network of observations and cover regions of the world, such as oceans, the upper atmosphere, deserts, and new territories that were just being opened by European colonial empires.

The Great War produced a clear break and condemned this world to an abrupt end. I would like to highlight three significant changes in the history of meteorology before and after the Great War that explain my adoption of the category of "paradigm" as problem-solving techniques in this period.

First, the very meaning and definition of the world "meteorology" went through a significant shift in its transition across scientific paradigms before and after the war. As Gregory Good pointed out, "meteorology" and "geophysics" were a much broader field of scientific inquiry whose disciplinary boundaries did not correspond to the contemporary earth and atmospheric sciences.[363] Several lines of scientific research that have later disappeared coexisted. Nowadays we identify "meteorology" primarily as the science of "weather forecasting," but before the war, weather forecasting was a small part of the broader field of meteorology and definitely not its most "scientific" and accurate part.

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[362] Helen Tilley, *Africa as a Living Laboratory: Empire, Development, and the Problem of Scientific Knowledge, 1870-1950* (Chicago: University of Chicago Press, 2011).

[363] Gregory Good, "From Terrestrial Magnetism to Geomagnetism: Disciplinary Transformation in the Twentieth Century," In *The Earth Inside and Out: Some Major Contributions to Geology in the Twentieth Century*, ed. D. R Oldroyd, (London: Geological Society (London), 2002), 229–39. Id., "Magnetic World: The Historiography of an Inherently Complex Science, Geomagnetism, in the 20th Century," *Earth Sciences History* 26, no. 2 (2007): 281–99.

This pre-war broader "meteorology" belonged to a scientific paradigm based on observational methods, rather than theoretical beliefs. In terms of the history of scientific ideas, meteorology was an open ecumenical field with multiple beliefs. What unified disparate theories about the weather and the atmosphere was the method of streamlining the practices of scientific observation across the globe and coordinating their accuracy through international meetings. Without a regimen of truth, scientists followed an empirical research program based on the practical composition of synoptic weather maps that provided very general "forecasts." Instead, the Great War made weather forecasting the paramount goal of meteorologists, national governments and military establishments, as we will see in section 4.

Second, practices of data collection were crucial for the scientific paradigm of liberal international meteorology, as international consensus and trust were based on the dogmas of quantification, standardization and codification of observations.[364] International meteorological committees discussed the rules on how to collect more data, how to standardize them, and how to promote their circulation. They were focused on the international coordination of observational and instrumental practices. Gregory Good has called the practice of shared instrumentation and shared activities" the "unity of geomagnetism" in the early twentieth century.

In this paradigm, the expansion of European imperialism and Western science went hand in hand. Before the war scientists were obsessed by the lack of data about distant and unexplored provinces to be annexed to the empire of science, whenever and wherever the geopolitics of imperialism allowed new observations. The same scientific experts were often involved in both imperial and aeronautical scientific enterprises for the collection of data. The exploration of the upper atmosphere and the birth of aeronautics were cast in the same language of colonial and imperial exploration. Imperial competition found an accommodation and reciprocal acknowledgement in the division of labor for the collection of data in different parts of the world. Instead, the Great War produced more observations than meteorologists could ever process. Computing and rearranging the data became a huge challenge, on a completely new scale. The era of early twentieth-century internationalist scientific positivism finished with the end of the age of empires, as the space for a division of labor among European scientists in an expanding colonial horizon came to an end.

Finally, the social infrastructure of liberal meteorology was an international community whose very identity was the result of late nineteenth-century globalization.[365] The increasing frequency of their international meetings at the turn of the century made this group a sort of face-to-face society. The Director of the British Meteorological Office, Sir Napier Shaw, distinguished three generations of meteorologists. First, there were the pioneers (17th century-mid 19th century), living meteorologists (20th century), and between them stood "the meteorologists who gave expression to the idea of meteorology as an international science."[366]

Shaw refused to provide biographies of them, "because the subject cannot be regarded as a collection of separate contributions [...]. They can be represented best by photographs of

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[364] Id., "The Assembly of Geophysics: Scientific Disciplines as Framework of Consensus," *Studies in the History and Philosophy of Modern Physics* 31 (2000): 259–92.

[365] On the paradigm of international meteorology from the French perspective, see Alfred Fierro, *Histoire de la meteorology* (Paris: Denoël, 1991), 126-143.

[366] Shaw, *Manual of Meteorology*, vol. I, p. xi.

international assemblies which were a characteristic feature of the period and the mode of representation is the more appropriate because the development of photography is practically contemporaneous with that of the weather-map."[367] He remembered two conferences in particular: the Meteorological Conference in Rome in 1879 and the Meteorological Conference in Paris in 1896 that initiated the International Commission for the Study of the Upper Air. In short, these scientists are largely unknown today to the broader public because their efforts were never considered as those of individual geniuses, but as a part of a social and collective endeavor that Shaw called "the general programme" of international meteorology—the closest definition offered at the time of its collapse right after the Great War to describe what I called the paradigm of international meteorology.[368]

The scientific paradigm of liberal international meteorology was based on the cumulative efforts of two generations of scientists. The first was born in the middle of the nineteenth century as all major nationalist revolutions turned to conclusion. Some of its prominent representatives were the Austrian Director of Meteorology Julius von Hahn (1839-1921), the Italian Pietro Tacchini (1838-1905), the already mentioned Wladimir Köppen (1846-1940), the French Director of the Bureau Centrale Météorologique Alfred Angot (1848-1924) and the pioneer of aerology Léon Teisserenc de Bort (1955-1913), the British Director Napier Shaw (1854-1945), the German Richard Assmann (1845-1918). Their major effort was to organize international research in meteorology in collaboration with the state, despite the birth of new, younger and competing countries such as Germany and Italy.

The second and younger group, born in the 1860s, received its scientific training after the rise of Germany as superpower in the world of science and at the height of European imperialism, such as the Italian Director of the Meteorological Office Luigi Palazzo (1861-1933), the Norwegian meteorologist Vilhelm Bjerknes (1862-1951) and geophysicist Kristian Birkeland (1867-1917), Louis Agricola Bauer (1865-1932) in Washington D.C., the director of the Prussian magnetic observatory at Potsdam Adolf Schmidt (1860-1944), the meteorologists and aerologists Arthur Benson (1859-1942), and Hugo Hergesell (1859-1938) in Strasbourg. As Gregory Good has pointed out, this new generation differed from mid-nineteenth century researchers because they had post-graduate training and PhDs in physics, often in Germany.[369] The most important cement of this community was their similar, German-speaking education.

Internationalism was a crucial part of the fabric of this community. Some of them navigated across different cultures altogether, such as Wladimir Köppen, a Russian meteorologist working for the German navy at the Deutsche Seewarte; Rudolf Gustav Lempfert, a British meteorologist born in Manchester of German immigrants; Arthur Benson, German

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[367] *Ibid.*

[368] Shaw has highlighted "the general programme" that had inspired the European division of labor after the introduction of the weather map. "First, the improvement of equipment and extension of the range of observations; secondly, the use of equipment to obtain an organised series of observations; thirdly the coordination of observations to represent the structure and circulation of the atmosphere leading on to inductive laws for the application of weather knowledge, and fourthly the development of a physical and dynamical theory of the circulation either as a whole or in detail." *Ibid.*, p. 145. Such partition in four divisions structured the rest of Shaw's analysis of meteorology after the introduction of the weather map, see *Ibid.*, 147.

[369] Good, "Magnetic World," 285.

aerologist born in Polish Galicia; and the geophysicist Louis Agricola Bauer, the German-American Director of the Carnegie Department of Terrestrial Magnetism. Before the war, speaking of "national styles" in meteorology made no sense, whereas during and after the war meteorologists divided across national lines in favor of and against the "Norwegian" school of meteorology or the "French" method of weather forecasting. In the early twentieth century, meteorologists and geophysicists organized themselves in international committees depending on their interests, not their nationality.

The international commissions of "aerology" and terrestrial magnetism were the two most active and lively at the turn of the century.[370] Among all European countries, Germany benefited the most by the scientific internationalism of these fields in the late nineteenth and early twentieth century. Germany was the leader in scientific research in physics, meteorology, terrestrial magnetism, and the study of the upper atmosphere —"aerology," as it was called at the time. Geography helped German and Austrian meteorologists because they were positioned in the middle of Europe and could benefit from observations collected by their European colleagues in advance, unlike their British and French counterparts exposed to uncharted oceanic currents coming from the Atlantic. German scientific hegemony worked in Europe by coordinating international scientific meetings and effectively exploiting the efforts of smaller, peripheral countries around them.

"Aerology" was named and pioneered by German scientists. Before the war, the International Aerological Commission was the main organization through which Germany coordinated research of the upper atmosphere in Europe through its central observatory at the University of Strasbourg. Hugo Hergesell was the main leader of the enterprise as director of the Bureau for the Exploration of the Upper Atmosphere, first located at the Meteorological Institute in Strasbourg and later at the Observatory of Lindenberg. He was pivotal in organizing international efforts for the study of the upper atmosphere, such as with the first meeting of the International Commission for Scientific Aeronautics that took place in Berlin in 1902 and scheduled simultaneous launches of balloons in all adhering countries on the first Thursday of every month.[371] The meetings of the International Aerological Commission intersected with those of the International Meteorological Committee, traditionally coordinated by the British Meteorological Office, thus giving Germany the opportunity to flank England and isolate France in driving international scientific research.

German scientific hegemony consisted in enlisting smaller countries in international scientific enterprises. At the following meeting of the Aerological Commission in Saint Petersburg in 1904, Hergesell asked to divide among members of the committee the expenses for

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[370] The International Aerological Commission (also called for the Exploration of the Upper Air or Scientific Aeronautics) was appointed in 1896 and held its 1st meeting in Strasbourg (1898), its 2nd meeting in Paris (1900), its 3rd meeting in Berlin in 1902, its 4th meeting in Saint Petersburg in 1904, its 5th meeting in Milan in 1906, and its 6th meeting in Monaco in 1909, its 7th meeting in Vienna in 1912. The International Commission of Terrestrial Magnetism and Atmospheric Electricity (appointed in 1891) held meetings in Munich (1891), Paris (1896), Bristol (1898), Paris (1900), Innsbruck (1905), Berlin (1910). The International Meteorological Committee held meetings in Paris on Sept 15th, 1900, in Southport in 1903, in Paris 1907, in Berlin in 1910, and in Rome 1913.

[371] Italy was represented by Palazzo, the Tenente Colonello Mariano Borgatti (Brigata Specialisti, Terzo Reggimento Genio) and Maurizio Moris (Maggiore Brigata Specialisti, Terzo Reggimento Genio, Sezione Fotografica).

the publication of the data gathered in international observations, as their publication was funded by the German government between 1900 and 1903. In the name of standardization and order, Hergesell managed to convince reluctant countries that preferred to published the data independently and multiply the number of simultaneous observations to three consecutive days each month. The results of the launches were published on his journal in Strasbourg, *Veröffentlichungen der Internationalen Kommission für Wissenschaftliche Luftschiffahrt* and every contributing country received them.[372]

Country	**Contribution to the International Commission of Aerology in 1914 (in francs)**
Germany	8034
England	1261
United States	1232
Italy	1200
Russia	1200
Spain	1200
Austria	1042
Hungary	1042
India	1001
Sweden	1000
Romania	877
France	800
Canada	777
Belgium	500
Denmark	500

[372] Servizio Meteorologico dell'Aeronautica Militare, *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, vol. 1, (Rome: 1975) 38.

Finland	500
Netherlands & Colonies	500
Switzerland	500
Bulgaria	494

Fig. 3.1: List of countries contributing to the International Aerological Commission.[373]

The simple list of contributing countries is misleading because it gives the impression of a balance of power between German and English speaking scientists, with Germany, England and the United States at the forefront. By rearranging the order of contributors in a list of empires, the landscape of power in international cooperation becomes much more evident. In this new order, Germany still stands out as the major contributor to international scientific cooperation in aerology, as it funded Hergesell directly. The British Empire and Austria-Hungary follow immediately below, despite the much wider territory under English control. The United States, Italy, and Russia were all in the same second tier of importance and ability to contribute. A counterproof of German-speaking hegemony in scientific internationalism before the Great War is France's marginal position in both tables: France is only the twelfth contributor in the first one and remains the tenth in the second chart, far below the United States, Italy, Russia, Spain, Sweden, and even Romania. In other words, German and Austrian meteorologists led pre-War World I internationalism in aerology for the most part, followed by their British, American and Italian colleagues, whereas the French were relatively isolated as their activities were heavily controlled by the government.

Empire	**Francs**
Germany	8034
British Empire	6078
Austria-Hungary	2084
United States	1232
Italy	1200

[373] From International commission for the investigation of the upper air, ed., *Report of the Proceedings of the Seventh Meeting of the International Commission for the Investigation of the Upper Air, Held in Bergen 25th-29th July 1921* (Bergen: J. Grieg, 1921), Appendix.

Russia	1200
Spain	1200
Sweden	1000
Romania	877
France	800
Belgium	500
Denmark	500
Finland	500
Netherlands & Colonies	500
Switzerland	500
Bulgaria	494

Fig. 3.2: I arranged the same list as empires.

Germans were the strongest supporters of European internationalism. Germany had an extremely diversified federal organization of meteorology. Each state had its own meteorological network, while the navy had the Deutsche Seewarte in Hamburg for maritime meteorology, so that Germans could send a great number of meteorologists to participate in international conferences and set the tone of international conventions. While their numbers allowed them to maintain a certain hegemony, internationalism allowed to spread expenses across different countries and collect more data across Europe. German meteorologists maintained a federal structure internally—with meteorological networks organized at the level of different *Länder*, in particular for Bavaria, Baden, Wüttemberg, and Alsace-Lorraine, and the maritime network of the navy, namely the Deutsche Seewarte in Hamburg. This federal structure allowed them to avoid internal local competition, while they acted united together in the international sphere.

Instead, the British meteorological service was much busier with requests about shipping services, and the Italian and French Meteorological Offices juggled multiple tasks. In this respect, Germany was exceptional for its ability to allocate economic resources to specialized scientific institutions and Italy more typical of national meteorological bureaus forced to address disparate tasks with limited resources.

The Italian Central Meteorological Office was divided in five sections: instrumental physics for the production and sampling of instruments; the weather forecasting section; the department of "geodynamics" (namely seismology); and the climatological section. The office

was modeled as a hybrid of the Austrian and the French Central Meteorological Offices, but it combined the activities that were pursued in other countries by completely different institutions. For example, it executed the tasks carried out in the United States by two as the Weather Bureau and the Department of Terrestrial Magnetism of the Carnegie Institution for Science.

The forgotten Director of the Italian meteorological service, Luigi Palazzo (1861-1933), embodied the scientific paradigm of liberal international meteorology that I have described so far, as his activities focused on the three most promising directions of the "broader meteorology" of the time: international collaboration in terrestrial magnetism, colonial expansion, and aerology. Italian meteorology—like that of many other smaller and peripheral countries, such as Norway, which would later gain huge importance in the history of meteorology—functioned thanks to its international collaboration with the Carnegie Institution for Science in the research about terrestrial magnetism, with Germany for the study of aerology and the study of the upper atmosphere, and with the Italian state for the expansion of observations in Italy's colonial empire.

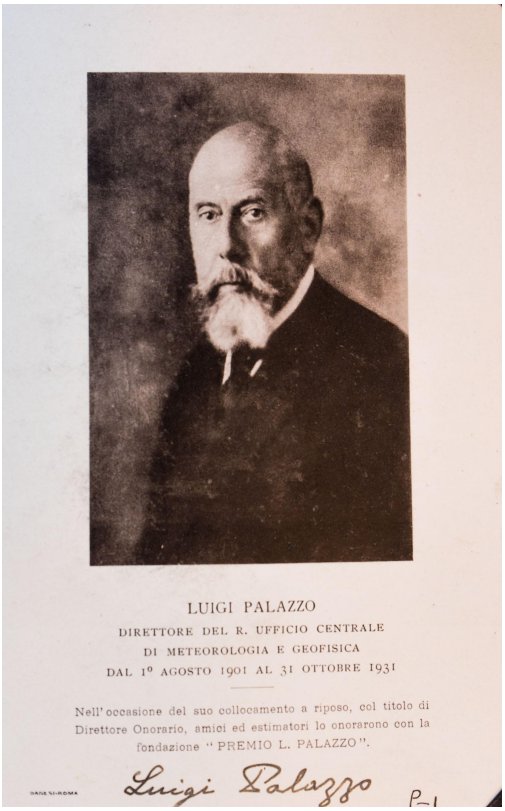

Fig. 3.3: Luigi Palazzo in a photograph commemorating his retirement in 1931.[374]

[374] Courtesy of the Archive of the Department of Terrestrial Magnetism at the Carnegie Institution for Science, Washington D.C.

Palazzo was a "meteorologist" in the paradigm of liberal international meteorology, but in modern terms he would be a geophysicist focusing on geomagnetism rather than a meteorologist working on weather forecasting in the modern sense.[375] Like many scientists of his generation, he received a post-doctoral education in Germany and studied for two years in Würzburg, Berlin, and the Prussian Meteorological Institute. His first work, between 1881 and 1892, consisted in the production of magnetic charts in the Italian South, in particular with Ciro Chistoni, a task he completed in 1904.[376] When Chistoni moved to the university of Modena in November 1887, Palazzo replaced him as Physical Assistant at the Central Meteorological Office. When the Director, Pietro Tacchini, retired in 1889, Palazzo acted as interim director until his official appointment in 1901. Even if appointing a geophysicist specialized in terrestrial magnetism as director of a meteorological office could seem odd today, there were three reasons why this was a reasonable choice in the scientific paradigm of liberal meteorology described above.

First, in this scientific paradigm the relationship between atmospheric phenomena and variations in terrestrial magnetism was the subject of debates among scientists, but the implicit assumption of this line of inquiry—later abandoned and so different from the way mathematical weather forecasting developed after the Great War—was the collective and global effort to measure the effects of solar activity on the earth.[377]

Because both the disciplines of meteorology and terrestrial magnetism descended from astronomy, it was widely admitted that solar spots, wind and eclipses influenced the Earth's magnetic field, as we all as the fact that rainfalls were due to sun-produced evaporation and different climates were the result of the different inclinations of the sun's rays. Changes in atmospheric electricity were observed in connection with thunderstorms. However, scientists struggled to turn these general geographical observations into a quantifiable—and therefore predictable—mechanism. Thus, meteorological and magnetic data were observable together as they were two end products of solar activities on the atmosphere.

I am not arguing that all meteorologists were also magnetic observers in the paradigm of liberal international meteorology, but that the paradigm of liberal international meteorology included a broader set of geophysical theories than just weather forecasting because scientific consensus was based on the methodological need of more observations around the globe and its instrumental coordination rather than on theoretical principles. This explains why European meteorological offices at the turn of the century dealt with seismology, geomagnetism, and climatology in addition to weather forecasting, and why Palazzo—a geophysicist and magnetic observer—could be director of the Central Meteorological Office in Italy.

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[375] Palazzo was born on January 18, 1861 in Turin, where he studied at the Liceo Cavour and at the local University with the physicist Giuseppe Basso. As a doctoral student, he moved to the Central Meteorological Office in Rome, where he was particularly interested in the theoretical and experimental study of magnetic instruments used in terrestrial-magnetic measurements.

[376] At the Geographical Congress of Naples of 1904, where he presented charts of the three magnetic elements: declination, inclination, and horizontal intensity.

[377] See, for example, Richard Owen, "Relazioni fra la meteorologia ed il magnetismo terrestre," *Bollettino Mensuale pubblicato per cura dell'Osservatorio Centrale del Reale Collegio di Moncalieri*, Torino s. II, v. VIII (1888): 142.

Second, meteorology and terrestrial magnetism were based on the same practices of data collection that required discipline, precision, and repetition of observations, as Palazzo himself explained.[378] Despite belonging to different theoretical bodies of scientific literature of these two fields, the same scientific institutions and instrumental infrastructure could collect meteorological and magnetic data in the eminently practical scientific paradigm of the time. Most European scientists believed that the major challenge to the development of meteorology as an exact science laid in its observational, rather than theoretical inaccuracy.

No wonder then that Palazzo's main contribution to meteorology was the invention of a specific pluviometer, namely an instrumental aspect of meteorology, whereas most of his observational work dealt with terrestrial magnetism.[379] At the same time, his first mission as director was to travel to Austria, Germany, France and England to compare the instruments of the Italian Meteorological Office with those of the other main European scientific institutions, those making data compatible in the future. In his mind, these two pieces of scientific research that seem distinct today were part of the same scientific paradigm of the time.

Third, terrestrial magnetism had the upper hand over synoptic meteorology in the 1890s, despite the fact that the origin of "modern meteorology"—and especially weather forecasting—came from the latter after World War I. Meteorology's inability to produce reliable forecasts was for decades a reason of frustration for many meteorologists of positivist upbringing that valued "accuracy" as the cornerstone of nineteenth-century scientific research. In the middle of the century, the rise of telegraphy deluded scientists that the rules for predicting the weather were only around the corner. However, by the 1880s and 1890s synoptic weather telegraphy had not produced any significant theoretical advancement to explain the mechanisms of the atmosphere. Many meteorologists had accepted the fact that science could only forecast the weather with some degree of probability, not certainty, and borrowed statistical methods for their calculations.

Palazzo was the main Italian representative of this international research effort in meteorology that focused on geomagnetism and terrestrial magnetism that was abandoned after World War I. While Palazzo never explained his opinion about weather forecasting techniques, his practices over the years reveal that he considered the analysis of atmospheric electricity and geomagnetism as possible key to the problem of weather forecasting. At the meeting of the International Meteorological Committee and the Commission of Terrestrial Magnetism and Aerial Electricity in 1910, Palazzo proposed to "promote research about the polarization of the atmosphere in order to ultimately find out useful criteria for weather forecasting."[380] He also pointed out that the location of neutral magnetic points of the atmosphere was very much

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[378] Luigi Palazzo, *Meteorologia e Geodinamica* (Rome: Salviucci, 1911).

[379] Id., "Confronti Degli Strumenti Magnetici dell'Ufficio Centrale Meteorologico e Geodinamico di Roma Con Quelli Degli Osservatori Di Potsdam E Di Pola," *Annali Del R. Ufficio Centrale Meteorologico E Geodinamico*, II, no. XXIII (1901): 1–15. This note was originally supposed to appear in a volume celebrating the birthday of the German scientist Wilhelm Von Bezold. See also Id., *Rendiconti della R. Accademia dei Lincei*, v. VIII, 1 sem., sed. April 23 and May 7, 1899.

[380] Id., "Sur l'opportunité de promouvoir les recherches sur la polarisation atmosphérique et spécialement les déterminations des points neutres, dans le but d'obtenir des critériums éventuels utiles pour la prévision du temps," in International Meteorological Committee, *Bericht über die Versammlungen des Internationalen Meteorologischen Komitees un dessen Kommission für Erdmagnetismus und Luftelektrizität* (Berlin: Behrend&Co, 1910).

influenced by meteorological conditions and examining such measurements was important "even to see if… it would be possible to gain some useful criteria to forecast the weather of the following day." Because atmospheric influences went beyond national borders, it was necessary to measure magnetic data in the atmosphere in different locations, thanks to international cooperation.

Palazzo informally coordinated his activities with Louis Agricola Bauer, the Director of the Department of Terrestrial Magnetism at the Carnegie Institution for Science in Washington D.C. The best collection of Palazzo's publications is preserved at the library of the Department of Terrestrial Magnetism of the Carnegie Institution for Science.[381] As Gregory Good has shown, Bauer and the Carnegie embodied the internationalist German-speaking spirit of early twentieth century research in terrestrial magnetism.[382] Bauer used a special experimental vessel, the Carnegie, whose flag represented a globe.

Palazzo's and Bauer's research was not just similar, but part of the same scientific project, namely the first world magnetic survey covering regions of the world uncharted by Western governments. Indeed, examining their scientific practices and the repetition of observations in Tripoli and Eritrea carried out by the Italian Meteorological Office and by magnetic observers of the Carnegie suggests that Palazzo and Bauer saw their work as a collaborative and cumulative project. For example, Palazzo managed to obtain the support of the International Commission for Terrestrial Magnetism and Atmospheric Electricity during its sixth meeting in Berlin to request the creation of a magnetic observatory in Southern Italy or in Tripoli, even before the Italian invasion of Libya.[383]

Thanks to Bauer's efforts, the field of terrestrial magnetism and atmospheric electricity was emerging as a very promising part of geophysics, frankly more promising than meteorology itself. At the time of its foundation, the Carnegie Institution preferred to build a well-funded Department of Terrestrial Magnetism rather than a purely meteorological institution, despite the recommendations of several scientists at the time. The Carnegie offered individual grants for "cultural investments" that were probably considered riskier, such as the one used by Vilhelm Bjerknes to begin his meteorological research in Norway. Bjerknes was an "exceptional man" whose research in meteorology was promising and interesting but isolated, whereas Palazzo and

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[381] It is difficult to establish their level of cooperation because Bauer's papers were lost after his suicide and the collapse of the scientific paradigm of liberal international meteorology. On the history of the Carnegie Institution in general, see James Trefil and Margaret Hindle Hazen, *Good Seeing: A Century of Science at the Carnegie Institution of Washington, 1902-2002* (Washington, D.C: Joseph Henry Press, 2002); Allan Sandage *et al.*, eds. *Centennial History of the Carnegie Institution of Washington* (Cambridge and New York: Cambridge University Press, 2004).

[382] On Bauer, see Gregory Good, "Vision of a Global Physics: The Carnegie Institution and the First World Magnetic Survey." In G. Good (ed.), *The Earth, the Heavens and the Carnegie Institution of Washington*, (Washington D.C.: American Geophysical Union, 1994), 29–36.

[383] For Palazzo's contributions to the 9th Meeting of the International Meteorological Committee in Berlin (September 26-29 1910), see Luigi Palazzo, "The Present State of the Question Regarding a National Magnetic Observatory in Italy" in International Meteorological Committee (ed.) *Report of the International Meteorological Committee* (London: Her Majesty's Stationery Office, 1910) and Id., "On some Magnetic Observations in Eastern Equatorial Africa," *Ibidem*, appendix VII, 123-24.

Bauer belonged to the mainstream world of magnetic observers in the international paradigm of liberal meteorology.[384]

In short, the concern about weather forecasting as one of the essential missions of meteorology was always central in the history of the discipline, but mathematical approaches to weather forecasting that would triumph after World War I (such as those pioneered by the Norwegian Vilhelm Bjerknes) were marginal in the broader paradigm of "meteorology" of the turn of the century.[385]

The geography of these scientific practices of data collection was the exciting part of the repetitive job of accumulating of observations without knowing how and when they would eventually complete the puzzle of the influence of the sun on the atmosphere. The location of measurements in the upper atmosphere and colonial outposts made the boring practice of data collection far more exciting than any kind of physical laboratory work and the frustrating calculation necessary for the production of inaccurate weather maps.

The first steps in the history of flight excited meteorologists across Europe with plans for the measurement of atmospheric data at higher altitudes. Moreover, it strengthened European solidarity, as Stefan Zweig recollected in *The World of Yesterday*: "When Blériot made the first cross-channel flight in an aeroplane, we rejoiced in Vienna as if he were a hero of our nation; pride in the triumphs of our technology and science, which succeeded one another by the hour, had led for the first time to a European sense of community, the development of a European identity. How pointless, we said to ourselves, frontiers were if it was child's play for any aircraft to cross them, how provincial and artificial were customs barriers and border guards, how contrary to the spirit of our times that clearly wished for closer links and international fraternity! This upward surge of feeling was no less remarkable than the upward rise of aircraft; I feel sorry for all who did not live through these last years of European confidence while they were still young themselves."[386]

Luigi Palazzo was no exception. He was among the founders and pioneers of the Italian Society of Aeronautics. He was at the center of the birth of the Italian Aeronautical Society on January 19, 1904 as Secretary General whose first meetings took place at the Central Meteorological Office.[387] He carried out several launches of balloons not only as a scientific

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[384] "The Department of Terrestrial Magnetism at Carnegie soon got its well-funded laboratory and its world-wide magnetic expeditions, but meteorology did not." James Rodger Fleming, *Inventing Atmospheric Science: Berknes, Rossby, Wexler, and the Foundations of Modern Meteorology* (Cambridge: MIT Press, 2016), 23.

[385] The Bjerknes family always complained about its marginality before the discovery of Polar Front Theory. See Robert Marc Friedman, *Appropriating the Weather: Vilhelm Bjerknes and the Construction of a Modern Meteorology* (Ithaca: Cornell University Press, 1989).

[386] Stefan Zweig, *The World of Yesterday* (London: Pushkin Press, 2009 [1942]), 218-9.

[387] The Society was the result of several meetings for the creation of the association that took place starting on October 20, 1903. The Bulletin of the Society was published in Via del Caravita 3, right next to the Central Meteorological Office. Conferences and events about the birth of of the Society were held in the hall of the Collegio Romano, the same building of the Meteorological Office. See "Cronistoria della S.A.I. fino al 1 luglio 1904," *Bollettino della Società Aeronautica Italiana* (From here: *B.S.A.I.*) (July 1904): 2. See also *Verbali del Consiglio Direttivo* (1904): 98. Among the members of the committee directing the society, Palazzo worked with several aristocrats interested in science: the Count Roberto Biscaretti di Rufia (1845-1940), one of the founders of the Italian car company FIAT in Turin; the diplomatic Luigi Hardouin Di Gallese (1862-1920), the engineer and student

observer, but also as a pilot. The goals of the society were to contribute to all sciences necessary for the birth of aeronautics, plan trips with balloons, and organize scientific experiments, conferences, and exhibits for the development of aeronautics, meteorology, and aerial photography. Additionally, the society intended to spread scientific and technical knowledge among the public (both specialists and non-specialists) about aeronautics, meteorology, and the physics of the atmosphere.

The caricature of the first flight sponsored by the Society in a balloon in 1904 in Rome shows the essentially inclusive features of aviation as an expression of *belle époque* civil society (Fig. 3.4). Before being taken over by the government and the military during the Great War that made flying (and even meteorology itself) a gendered experience for men, the "basket" of the early history of upper atmospheric explorations included scientists (Palazzo's caricature is represented by the men with the goatee pointing at the sky), women (as long as they were wealthy enough to be members of the Society and sponsor its enterprises), rich civilians, and the military (the man turned on his back with a military belt that is waving his hat to an invisible audience). Participation in the first flights was open to all members of the association, including women, as long as they contributed to the expenses for the maintenance of the balloon of the society, called Fides ("Faith"), with a contribution of 250 lire.[388] In short, aeronautics was a sport at the intersection of science and technology, a typical expression of the marriage between *belle époque* faith in scientific progress, industrial development, and civil society.

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of the physicist Pietro Blaserna Guglielmo Mengarini (1856-1927). The Society had a technical commission, led first by the Lieutenant Colonel M. Borgatti and later by Maurizio Moris, starting in September 1904, and as some pilots that included both military officers and civilians, such as Palazzo himself and his colleague Alfredo Pochettino, physicist at the Central Meteorological Office (1876-1953). Even if Palazzo's direct involvement in the publication of the bulletin decreased over time, the Central Meteorological Office was constantly represented by the physicist and meteorologist Emilio Oddone, vice-director of the Meteorological Office and member of the editorial staff of the aeronautical bulletin, and Filippo Eredia, a meteorologist that published a long series of analysis of types of wind in Italy throughout the history of the bulletin, starting in 1906.

[388] As a result, several aristocratic women were part of the association: Princess Potenziani, the Duchess of Genzano, and Donna Maria Gori Mazzoleni joined in August 1904. "Interessi Sociali," in *B.S.A.I.* no. 8 (August 1904): 36.

Figg. 3.4-3.5: It was not uncommon for women to be part of the first experiments in aeronautics. In the paradigm of liberal meteorology, the entire civil society was excited about the new development of aircrafts. On July 7, 1904 Palazzo was assistant pilot of the balloon Fides when the balloon fell in the water, in a very rocambolesque action. The balloon crashed in the Adriatic in 1908.[389]

Palazzo's aeronautical activities combined internationalism with scientific research in the space of inquiry opened by the birth of aeronautics. The first initiative was the already mentioned International Conference of Scientific Aeronautics held in Berlin in May 1902. With the support

[389] From *B.S.A.I.* no. 9 (September 1904): 75.

of military engineers (the Brigata Specialisti Genio Militare), he started immediately this international collaboration for the exploration of the upper atmosphere in Rome with German balloons on November 6, 1902 along with the Tenente Cianetti and Silvio Polenghi.[390] Palazzo actively promoted the birth of the Italian Society of Aeronautics as part of internationalist collaboration with European scientists.

Meteorological and aeronautical associations collaborated not just in Italy, but across Europe in their internationalizing effort.[391] The Bulletin of the Italian Aeronautical Society reported information about aeronautical competitions, experiments across Europe with new models of balloons and airplanes (in particular in France and Germany), and international exhibits.[392] Palazzo's interest in being part of—and, to a certain extent, the leader of—the Aeronautical Society was connected with his effort to participate in the international study the upper atmosphere. Starting on May 25, 1904, he asked the Aeronautical Society to devote ten or twelve aeronautical trips yearly (one on the first Thursday of every month) to meteorological studies.[393] Meanwhile, he strengthened his collaboration with Germany to promote his scientific initiatives.

Scientific collaboration between Palazzo, Hergesell, and the international community of European meteorologists reached a new level of integration after the Fourth International Conference of Scientific Aeronautics in Saint Petersburg in 1904.[394] The first collaborative experience for the study of the upper atmosphere was held in Pavia with the presence and support of Hugo Hergesell, Director of the Strasbourg Observatory and President of the International Commission of Scientific Aeronautics, who even brought balloons from the

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[390] Servizio Meteorologico dell'Aeronautica Militare, *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, vol. 1, (Rome: 1973-1975), 41.

[391] In Belgium, for example, the Belgian Society of Astronomy and Meteorology and the Belgian Aéro-Club organized the eleventh Congress of the Atmosphere during the exhibit of Liège in 1906. See *B.S.A.I.* no. 5-6 (May-June 1904): 96-8.

[392] The Bulletin's internationalist orientation made it focus on international developments, rather than just national achievements. It summarized information from the other main European aeronautical journals from France, Germany, and Austria-Hungary: "L'Aérophile", "L'Aéronaute," "Illustrierte Aëronautische Mitteilungen", "Wiener Luftschiffer-Zeitung." International scientific and industrial exhibits were crucial to display the technical-industrial potential of new engines, models, and instruments, such as the Aeronautical Exhibition in Saint-Louis in 1904.

[393] *B.S.A.I.* no. 5-6 (May-June 1904): 99-102. Luigi Palazzo, "Primi esperimenti di palloni sonde in Italia," *B.S.A.I.* no. 8 (August 1904): 1.

[394] The number of participants at international meetings mirrors the scientific importance of each nation in this field. The most numerous group of foreign scientists came from Germany, with nine representatives, followed by Austrians, English and French (three each). Italy had two, namely Palazzo and the chemist Helbig as representative of the Aeronautical Society. The United States, Spain, Sweden, and Romania sent one each. The German group was the most numerous: Hugo Hergesell, Director of the Meteorological Service of Alsace-Lorraine and President of the Commission; Berson, Tegel Observatory; De Quervain (Strasbourg), Stade (Berlin), Artillery Major Moedebeck (Graudenz); Köppen (Hamburg); Director Erk and Baron von Bassus (Munich); Bamler (Barmen). The Austrian group was composed of three captains: Kosminski, Hintestoisser and Engel, as well as three French representatives: M. Teisserenc de Bort (Director of Aeronautical Observatories of Trappes and Itteville), M. Bordè, President of the French Society of Aerial Navigation; Conte De La Vaux, vice-president of the Aéro-Club. Luigi Palazzo, "Il Congresso Internazionale di Aerostazione Scientifica" *B.S.A.I.* no. 1 (January 1905): 18-22. The German meteorologists Arthur Berson (1859-1942) asked to fly on the balloon "mit seinem alten Luftgenossen," (with my old flight-companion), namely Palazzo.

Continental Caoutchouc Company (Hannover) and the recording instrument from Bosch in Strasbourg.[395] Even the selection of Pavia to start their launches was dictated by its proximity to other international observatories across the Alps and their launches in Zurich, Strasbourg, and Friedrichshafen.[396]

The 1904 Conference decided to meet again in Italy in 1906 at the International Exhibit of Art and Industry held in Milan and called "Del Sempione" to celebrate the opening of the tunnel connecting Italy to Northern Europe through Switzerland. The exhibit meant to celebrate industry and science as crucial actors to make Italy closer to Europe, and Palazzo was appointed representative of the Aeronautical Society for the creation of the aeronautical exhibit.[397] The most important decision of the conference was to adopt the word "aerology" as opposed to "scientific aeronautics" to define the scientific study of the upper atmosphere by aeronautical techniques, an idea suggested by Vladimir Köppen, the Russian-German director of the Deutsche Seewarte in Hamburg.[398] The Conference included a visit to the Geophysical Observatory of Pavia sponsored by the Central Meteorological Office and of course a visit to the aeronautical section of the International Exposition of Milan.[399]

[395] Other participants to the first launch from Pavia were Patrick Alexander, a rich British man from Bath, university professor Carlo Somigliana (Pavia), and Palazzo himself along with his assistant Camillo Alessandri.

[396] In addition to the proximity to other observatories, Pavia was pretty far from the Mediterranean and the Alps, so the risk of losing the balloons at sea was inferior. Instruments were recovered thanks to a parachute or a second smaller balloon, after the explosion of the main balloon in the upper atmosphere. Instruments with the recorded data were placed in a protective cage with an envelope reading "please open and read", promising some money to whoever would telegraph the Central Meteorological Office after finding the balloon. Therefore, a literate peasantry like the one cultivating the Po valley was fundamental in finding and collecting the balloon with its recording instruments. In short, liberal meteorology required collaboration with Italy's lower classes.

[397] Along with Palazzo, the higher representatives were Ten. Ricaldoni, Ten. Crocco, Dott. Helbig. See Filippo De Filippi, "Riunione Generale della Sezione di Roma (1 febbraio 1906)," *B.S.A.I.* no. 1-2 (January-February 1906): 46.

[398] Emilio Oddone, "La Quinta Conferenza Internazionale d'aerostazione Scientifica a Milano," *B.S.A.I.*, no. 10-11-12 (October-November-December 1906), 281-82.

[399] R. Ufficio Centrale di Meteorologia e Geodinamica in Roma, *Conquième Conférence de la Conmission Internationale pour l'Aérostation Scientifique à Milan, du 30 Septembre au 7 Octobre 1906, Procès Verbaux des Séances et Mémoires* (Strasbourg: Imprimerie M. Di Mont Schauberg, 1907).

Fig. 3.6: The Conference of Scientific Aeronautics at the International Exhibit of Art and Industry "Del Sempione" held in Milan in 1906. The organizer of the meeting, the director of the Italian Central Meteorological Office Luigi Palazzo, sits in the middle front line.[400]

International scientific cooperation, industrial fairs, and aeronautical exhibits were part of the culture of the *belle époque* as well as the scientific paradigm of liberal international meteorology. The 1906 meeting in Milan marked the triumph of the collaboration between Palazzo and Hergesell, as well as an impressive display of German scientific and technological prowess. Of the 25,000 square meters of space for the exhibit, Germany claimed 1700, while France and England only 450 and 100 square meters respectively. The Lindenberg Observatory transferred to Milan an entire section of the observatory in order to carry out daily upper air measurements, and the meteorological observatories of Strasbourg, Munich, Hamburg, and Posen were represented along with the aeronautical societies of Berlin, Strasbourg, Marmen, Munich, Absburg and the Deutscher Luftschiffer Verband, the first aeronautical federation. The exhibit of meteorology was just next to the pavilion of metrology [*sic*] and aeronautics, thus celebrating standardization, the birth of flight, and the study of the weather at once.[401] Palazzo successfully organized the meeting in Milan of the International Conference of Scientific Aeronautics—led by Hergesell—and the International Conference of Aeronautics (controlled by the French Permanent Commission of International Aeronautics).[402] In other words, the exhibit

[400] From *B.S.A.I.*, no. 10-11-12 (October-November-December 1906): 288.
[401] Enrico Clausetti, "La sezione aeronautica all'Esposizione di Milano 1906" *B.S.A.I.*, no. 7-8-9 (July-August-September 1906): 206. "La sezione aeronautica all'Esposizione di Milano," *B.S.A.I.*, no. 5-6 (May-June 1906): 126.
[402] German hegemony was evident even at the creation of the first meeting of International Federation of Aeronautics, held in Paris on October 12 1905. The French Aéro-Club organized the event where each European society was represented in proportion of the volume of gas used for aeronautical experiments between July 31, 1904 and August 1, 1905. Again, Germany secured nine votes and six representatives against three from Belgium, and one respectively from England, Spain, Italy, Switzerland, and the United States. "Cronaca Aeronautica: La

gave Palazzo and the Italian Aeronautical Society the opportunity to mediate between French and German scientists. Until the outbreak of the Great War, most activities of the Geophysical Laboratory of Pavia and the Central Meteorological Office in Rome consisted in collaboration with the Germans.[403]

Since the middle of the nineteenth century, International exhibits were sites for the production of scientific knowledge, as well as the key opportunity to display new prototypes of balloons and aircrafts. For example, at the previous International Exposition in Liège in 1905, the Belgian Astronomical Society promised a prize of 5,000 francs to the meteorologist who could devise a technique of short-term weather forecasting. The forecast of barometric pressure, movement of center of low pressure, and the arrival of cyclones should have been based on synoptic maps issued by European meteorological services. However, even the method that won the competition proved to be successful only locally in Belgium and did not gather much success until World War I, when it became the basis for the French method of weather forecasting.[404]

In short, European scientists were looking for an answer to weather forecasting in several directions, but before the Great War theories and methods for weather forecasting did not gather enough consensus. Of course, European armies (especially in France and Germany) looked with interest to the development of aerology, but they did not dominate the field quite yet. The paradigm of liberal international meteorology placed consensus in voluntary standardization

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Federazione Aeronautica Internazionale," *B.S.A.I.*, no. 10 (October 1905): 169. For the German Deutscher Luftschiffer Verband there were Busley, Hergesell, Von Hewald, Moedebeck, Niemeyer, and Parseval. Germany had the oldest aeronautical society, founded in the 1880s, while France had the most numerically present.

[403] Most of the activites in Pavia were in direct connection with Hergesell's studies in Strasbourg and were carried out by the geophysicist Pericle Gamba. The data were published with very long delay, a sign of the later crisis of the Central Meteorological Office after the Great War: see Pericle Gamba, "Risultato del Lanci di Palloni-Sonda e Palloni Piloti effettuati nel R. Osservatorio Aerologico di Pavia nell'anno 1913. Le unità di misura della pressione barometrica (bar) e dell'altezza (metro dinamico)," *Memorie del R. Ufficio Centrale di Meteorologia*, s. III, v. I (1925): 5-194. The adoption of the bar and the dynamic meter were proposed in 1909 by Koppen at the VI meeting of the International Aerological Commission (Monaco - Principato) in 1909 and requested again by Bjerknes in 1912 at the meeting in Vienna. See Pericle Gamba "La VI Conferenza Internazionale di Aerologia a Monaco," *B.S.A.I.*, no. 9 (September 1915). Id., "Le caratteristiche dell'atmosfera libera sulla Valle Padana, risultati dei sondaggi compiuti nel R. Osservatorio Geofisico di Pavia nel quindicennio 1906-1920."

[404] Among the twenty participants, the winner was Gabriele Guilbert from Caen, while Durand-Gréville from Paris came second. While Durand-Gréville proposed a theory of grains based on the observation of wind movements, Guilbert proposed a technique that focused on trends in barometric pressure. However, while these methods seem to work well in Belgium and parts of the northern European continent, they were not universal laws and did not work at all south of the Alps, where wind regimes were far more complicated and different. The Italian director of the weather forecasting section, Monti, tested the Guilbert method in Italy unsuccessfully. Research in Italy focused instead on the effort to correlate astronomical phenomena, such as solar spots, and atmospheric movements, in particular at the astrophysical observatory of Catania. See "Concorsi di osservazioni di temporali e di previsione diurna del tempo," *B.S.A.I*, no. 7-8-9 (July-August-September 1906): 256-8. See also Antonio Mascari e Alfonso Cavasino, "Relazioni fra il grado di definizione delle immagini del Sole, e le ondulazioni del suo orlo e le correnti atmosferiche a varie altezze in base a 23 anni di osservazioni fatte in Palermo e in Catania," *Bollettino della Accademia Gioenia* 82 (1904):13-6); Id., "Studio delle relazioni fra l'agitazione delle immagini solari ed i movimenti atmosferici da 23 anni d'osservazioni fatte nei RR. Osservatori di Catania e Palermo," *Memorie della Società degli Spettroscopisti Italiani* 33 (1904): 189-204; Emilio Oddone, "Sul Servizio Meteorologico e la previsione del Tempo," *La Meteorologia Pratica* (July-December 1920), 137-39.

practices, the internationalization of observations, and their global expansion by following colonial conquests.

The meteorological division of labor allowed European scientists to mark their territories and claim rights to new areas that were opening to European expansion and science alike. Again, Luigi Palazzo was a willing and convinced participant in Italian scientific colonialism, as a seamless part of his contributions to international cooperation and the exploration of the atmosphere as part of the global effort of early twentieth-century meteorologists.

In general, the enthusiasts of aeronautical explorations were also supporters of colonial explorations in the same spirit of international competition and cooperation that the opening of new spaces of inquiry allowed at once. For example, Palazzo worked as acting president of the Italian Aeronautical Society with the naturalist Filippo De Filippi, a famous explorer of the Himalayas, and by late 1904, the Society had gained the support of the King and the member of the Royal family Luigi Amedeo di Savoia, Duke of Abruzzi, himself a famous explorer in the Arctic who became later a pioneer of Italian colonization in Somaliland (see Chapter 4). The connection between flight and exploration was particularly strong when it came to the international exploration of the North Pole. An International Association for the Study of Polar Regions was created in 1906 after the International Congress for Economic Expansion (Mons, September 1905), whose first congress took place in Brussels in September 1906. The Italian Aeronautical Society joined through the Central Meteorological Office.[405] The entanglement of scientific, aeronautical and imperial interests was stronger than ever at the beginning of the twentieth century across the world.

Yet Palazzo's *personal* involvement is quite extraordinary, since he was the first—and to my knowledge the only—director of a European meteorological office to carry out colonial missions in person for the government, rather than delegating others like his predecessor Tacchini. In the name of international research and in collaboration with Luis Bauer of the Department of Terrestrial Magnetism of the Carnegie Institution for science, he travelled in 1905 to Tripoli to collect magnetic data even before Libya was invaded by Italian troops.[406] Between 1908 and 1909 he travelled to the Indian Ocean in order to produce magnetic maps of Italian Somaliland and carry out upper air observations as part of the plan established by the International Aerological Commission for simultaneous international launches of balloons across the globe.[407] Operating within the context of the scientific paradigm described above, it is clear that Palazzo's mission and his observational practices combined the study of terrestrial

[405] "Congresso Internazionale per lo studio delle regioni polari," *B.S.A.I.* (1906): 256.
[406] Luigi Palazzo, "Magnetic Elements determined at Tripoli, Barbary," in *Terrestrial Magnetism and Atmospheric Electricity*, v. XI, (1906), 93-6. They were later repeated by W. F. Wallis, sent by the Carnegie Institute.
[407] Id., "Alcune Misure Magnetiche Eseguite nell'Est Africa Inglese e nella Somalia Italiana," in *Annali dell'Ufficio Centrale di Meteorologia e Geodinamica*, Part I, v. XXXII (Rome: Tipografia Nazionale Bertero, 1912). He also informed the scientific community about these activities in Id., "Sur quelques mesures magnétiques dans l'Afrique équatoriale orientale," *Bericht über die Versammlungen des internationalen meteorologischen Komitees und dessen Kommission für Erdmagnetismus und Luftelektrizität* (1910): 93-4.

magnetism, international upper air atmospheric observations, and scientific colonialism for the Italian government.[408]

Fig. 3.7-3.8: Aerological Observations on the Indian Ocean, probably carried out by Luigi Palazzo in Italian Somaliland. A balloon was used to measure upper air data. The second image represents wonderfully the entanglement between European science and colonialism as an expression of civilizational distance from colonized subjects. European scientists felt that *they had to* collect data in regions of the world were local societies were not scientifically advanced.[409]

Considering the history of entanglement between science, the birth of aeronautics, and colonial expansion that constituted the scientific paradigm of liberal international meteorology, it is not surprising that Palazzo was more than willing to contribute to the study and colonization of Libya, which the Italian state decided to invade in 1911. Yet, this war paved the way for the future marginalization and demise of the Central Meteorological Office itself, by transforming Italian meteorology from a liberal and international enterprise into a militarized and nationalist colonial project.

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[408] In a small pamphlet published by the Ministry of the Colonies, Palazzo pointed out that the map offered several practical uses for travelers whose orientation depended on compasses, such as ships sailing along the coast of the Indian Ocean and military expeditions traveling in the interior. The flat landscape of Somalia offered few reference points, so the map could complement military instructions on the use of the astronomic and magnetic observations to find directions. Id., "Somalia Italiana. La carta magnetica del Benadir. Nota del Prof. Luigi Palazzo, Roma 1912. Omaggio al X Congresso Geografico Internazionale" *Monografie e Rapporti Coloniali* no. 17, (1912): 12. Palazzo returned to the Indian Ocean in December 1909 and travelled to Mombasa with the East African German Company. Palazzo also travelled to Eritrea in the summer 1913 to establish a seismological station and study the earthquake that had shaken the region. See *La Stazione sismica di Asmara* (Modena: Società Tipografica Modenese, 1913), excerpt from *Bollettino della Società Sismologica Italiana*, v. XVII (1913). For the magnetic stations, see "Misure Magnetiche in Eritrea," *Annali del R. Ufficio Centrale di Meteorologia e Geodinamica*, v. XXXV, Part I, (Rome: Tipografia ditta Cecchini, 1914).

[409] Courtesy of the archive C.R.A.-C.M.A of the Central Meteorological Office and Maria Carmen Beltrano.

3.3 Libya 1911-1914: The Rise and Fall of Liberal Techno-Politics

Tripoli, November 1, 1911. After the improvement of meteorological conditions, the Italian pilot Giulio Gavotti, a military engineer, completed the first aerial bombing in world history by dropping four bombs on two Ottoman encampments on the outskirts of the capital of Tripolitania, in Ain Zara and Tajoura. Later, on February 23, 1912 Italian airplanes accomplished the first photographic reconnaissance mission.[410] The invasion of Libya intended to fulfill the long-overdue colonial aspirations of Italy in Tripolitania, after more than a decade of preparation after the military defeat at Adwa that had frozen Italian expansionist ambitions. With the first display and use in warfare of airplanes, draken balloons, and meteorological observations in preparation of aerial mission, the conquest of Libya was designed by the Italian state to prove that the politics of liberal imperialism discussed in Chapter 2 had made Italy a modern colonial power.

The war in Libya was the first laboratory where the ingredients for the transformation of Italian meteorology in the twentieth century came together. From a civilian scientific enterprise devoted to agricultural development under liberal imperialism, meteorology became a militarized enterprise through the experience of colonial wars and conquest. Indeed, despite the official conclusion of the war against the Ottoman Empire in 1912, the actual conflict for the full control of Libya continued until 1931, involving Italy in colonial warfare before and beyond the Great War.[411] Throughout this time, Italian colonial meteorology became a fundamental infrastructure of knowledge for Italian empire-building in North Africa. Italian scientists, like Palazzo, had fully made the transformation into an "epistemic community" of experts working with and for the state.

Yet this collaboration came at a high cost. The transformation from a liberal meteorology—devoted to agricultural development, civilian colonization, and aerological studies in the name of the internationalist scientific paradigm described in the previous section—into a militarized service was the result of the environmental failure of liberal techno-politics. Despite a much more coordinated effort between Italian scientific experts and the Italian state, the environment of Libya was too arid to turn the "Fourth Shore" into an Italian settlement colony.[412] After about a decade of institution-building and preparation of a colonial consensus, Italian scientific experts set their expectations too high only to discover that Libya was "a big sand box" where a settlement colony was impossible through liberal techno-politics. The brutal reconquest of fertile eastern Cyrenaica in the 1920s and 1930s ushered in a new—fascist—techno-political regime that made demographic colonization a priority of Italian colonialism. The history of

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[410] Ferdinando Pedriali, *L'Aeronautica Italiana nelle guerre coloniali. Libia 1911-1936* (Rome: Ufficio Storico Aeronautica Militare, 2008), 14. Andrea Cumami and Gianluca Balestra, "L'aeronautica italiana nelle campagne coloniali libiche," in *Le guerra coloniali del Fascismo* ed. Angelo Del Boca (Rome and Bari: Laterza, 1991), 197-213.

[411] Nicola Labanca, *La Guerra Italiana per la Libia, 1911-1931* (Bologna: Il Mulino, 2012).

[412] See Claudio Segrè, *Fourth Shore: The Italian Colonization of Libya* (Chicago: University of Chicago Press, 1974).

colonial meteorology sheds light on the impact of colonialism in the transformation of Italian climate sciences from liberalism to fascism.

Modern "Libya" was an invention of Italian colonialism, a name meant to evoke the ancient Roman name of the coast between Tunisia and Egypt and unify three Ottoman *vilayet* of the Ottoman Empire: Tripolitania, Cyrenaica, and Fezzan. These regions differed so much from one another that they could be considered three different countries. Fezzan was the most internal desert region, with oasis and trade routes connecting the Mediterranean with central Africa.

In the west, Tripolitania shares the environment and culture of the Maghreb with Algeria and Tunisia. Tripoli dominated its agricultural hinterland region where settled agriculture was possible thanks to coastal rainfalls around the city and the mountains of the Gebel Nefusa, an extension of the Atlas Mountains. Yet trans-Saharan trade and piracy mattered more than agriculture in its economy, at least until French occupation of the Sahel and Niger regions dried up trade routes across the western Sahara between the Mediterranean and Central Africa. Tripoli was historically known as "the gateway of the Sahara," but when Italians conquered the city in 1911 its commercial importance was in decline.[413]

Ottoman authorities developed several strategies to respond to European colonial expansion. Since its second conquest in 1835, Tripoli had become the centre of Ottoman empire-building in Africa. Ottoman administrators tested in Tripoli Tanzimat reform to promote state-building through taxation, agricultural improvement, and military service.[414] Based on their previous experience with British and French intrusions in their empire, the Ottomans also actively discouraged foreign travelers and scientific expeditions, making Libya the most unknown region of North Africa. In short, Tripoli was a city of the Maghreb, with a society, economy, environment, and institutions similar to other forms of Mediterranean and Ottoman statecraft, but most of the rest of Libya was unknown to Europeans.

In the east, Cyrenaica is like an isolated island of Mediterranean climate, situated 700 km from the Nile delta and 650 km from Tripoli. Its name comes from the ancient city of Cyrene, where Greek colonists settled in antiquity as the area lies much closer to Crete (300 km) and the Greek mainland (400 km) than to any other hospitable region in Africa. The stunning geography of the *Gebel Akhtar*, or Green Mountain in Arabic, gives Cyrenaica unique features in North Africa that shaped its natural environment, history, economy and society. The wealth of Cyrenaica originated from its rainfalls in the mountainous countryside, not in coastal cities.

The Gebel is characterized by a series of three high terraces that rise suddenly from the coast and descend more gently toward the Sahara. The three-step plateau enjoys increasing amount of rainfall at higher elevation and soil fertility depends on altitude. Rainfall drain to the Mediterranean in steep ravines toward the coast, but the water flows south in seasonal streams,

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[413] See Lisa Anderson, *The State and Social Transformation in Tunisia and Libya, 1830-1980* (Princeton: Princeton University Press, 1986); Ali Abdullatif Ahmida, *The Making of Modern Libya: State Formation, Colonization, and Resistance, 1830-1932* (Albany: State University of New York Press, 1994).

[414] See Nora Lafi, *Une Ville Du Maghreb Entre Ancien Régime et Réformes Ottomanes: Genèse Des Institutions Municipales À Tripolide Barbarie, 1795-1911* (Paris and Tunis: L'Harmattan, Institut de recherche sur le Maghreb contemporain, 2002); Lisa Anderson, "Nineteenth-Century Reform in Ottoman Libya," *International Journal of Middle East Studies* 16, no. 3 (1984): 325–48; Mostafa Minawi, *The Ottoman Scramble for Africa: Empire and Diplomacy in the Sahara and the Hijaz* (Stanford: Stanford University Press, 2016).

allowing temporary agriculture and creating seasonal pastures in the semi-arid southern slopes of the peninsula. Because of its special features, Cyrenaica allowed some settled agriculture on its highest terraces, but provided a crucial environment for forms of transhumance and nomadism between the more fertile plateaus and the lowlands where only grazing was possible.[415]

Such peculiar environment shaped the political ecology of the region that reversed power relations between city and countryside that existed instead in Tripolitania. Evans-Pritchard was the first to emphasize the peculiarity of the relationship between city and countryside in Cyrenaica as opposed to Tripolitania and other forms of traditional statehood in the Middle East and North Africa: "Town and country kept apart, with the towns dependent on the country and not the country on the towns, [...] there was in Cyrenaica no client peasantry bound by debt, need for protection, and trade monopoly to the towns. The Bedouin did not settle on the land where they would be an easy prey to the usurer, overseer, and tax collector."[416]

Benghazi, the Ottoman capital of the province, was more a coastal entrepôt than the actual seat of power or economic prosperity, since it was situated in the arid coastal plain called as-Sahil. According to Evans-Pritchard, "the absence of a substantial peasantry in Cyrenaica is one of the characteristics which most distinguishes it from the Arab societies of Palestine, Syria, Iraq, Egypt, and the Maghrib. The peasant can be dominated. He is fixed to the earth and can be made to surrender it and till it for others. The Cyrenaica Bedouin is fixed to no place and cannot be forced to sell his birthright by bad seasons and intimidation. This has meant that there have not been in Cyrenaica any social enclaves attached to the towns through which the towns and administrative centers could lord it over the Bedouin. Outside the towns all is Bedouin and the Turkish administration, and afterwards the Italian administration found that they could not get a grip on the Bedouin of Cyrenaica as they could on the peasantry of Tripolitania."[417]

Ottoman power was constantly negotiated between Istanbul and the *Senussi*, a Sufi religious order that found particular support among Bedouin nomadic and seminomadic population in the region. Historians disagree on whether the *Senussi* order was an independent "theocratic empire" or a proxy ruler of the Ottoman empire in its strategy of expansion in central Africa, an important historical question at the foundation of the legitimacy of the monarchy of Libya in the post-war period. Yet all geographers, anthropologists, and historians agree that the environment of the Gebel Akhtar was fundamental for the ecological life of the Bedouins and the political economy of the *Senussi* order. Rainfall variation is particularly important for the distribution of natural resources, vegetation, livestock, and population.[418] Drawing on the

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[415] Douglas L. Johnson, *Jabal Al-Akẖḍar, Cyrenaica: An Historical Geography of Settlement and Livelihood*, University of Chicago, Dept. of Geography, Research Paper, no. 148 (Chicago: University of Chicago, Dept. of Geography, 1973); Roy H. Behnke, *The Herders of Cyrenaica: Ecology, Economy, and Kinship among the Bedouin of Eastern Libya*, Illinois Studies in Anthropology, no. 12 (Urbana: University of Illinois Press, 1980).

[416] E. E. Evans-Pritchard, *The Sanusi of Cyrenaica* (Oxford: Clarendon Press, 1954), 45.

[417] *Ibid.*, 46.

[418] "All activities are intimately dependent upon the climatic regime and relatively minor departures from 'normal' conditions can have severe consequences for the farmers and nomads of the area. Three aspects of the climatic regime, its seasonality, its relationship to the landforms, and its extreme variability, are of crucial importance in understanding the potentialities of the eastern jabal and the uses to which it is put by its inhabitants." "While it is true that some climatic zones receive appreciable rainfall, and thus possess considerable agricultural potentia, precipitation remains unreliable. Rainfall in one year is seldom similar to that of another. Drought, with all its

resources of Cyrenaica's plateau, the order projected its religious and political power across the Eastern Sahara to Sudan and Lake Chad. Through its network of *zawiyas*, it offered forms of social assistance, education, and commercial support in a very volatile region, unifying different tribes across a hostile environment.

The first to make the connection between Cyrenaica's environment and the *Senussi* order was the British civil servant Evans-Pritchard, who was stationed in Libya during World War II while fighting against the Italian army. Evans-Pritchard described the *Senussi* order as a semi-nomadic state grounded on the environmental mobility dictated by the regime of rainfalls affecting the Gebel Akhtar. "The rainfall very exactly determines the vegetation belt and thereby limits human distribution and imposes a certain way of life."[419] Using the meteorological data collected for decades by Italians (without quoting them), he showed that the distribution of winter rains (the only source of water allowing settled agriculture and seasonal grazing) shaped agricultural practices, vegetation and types of livestock that could sustain Bedouin tribes in their seasonal migrations.[420] "The Bedouin of the forest area are essentially a goat people… and it is mostly through the medium of the goat that the vast natural wealth of the forests of Cyrenaica is transformed into human wealth… Just as the forest would be useless to the Bedouin without the goat so the much vaster stretches of steppe would be useless to the Bedouin without the sheep and camel which turn its grasses and scrub into food. Thus, Cyrenaica is fundamentally a pastoral country, primarily country of sheep farming, and its people, as they say themselves, have the hearts of shepherds and not of peasants. While agriculture and pastoralism are both practised, the bias of nature and tradition is toward animal husbandry, by which the rich vegetation of the country is turned into milk, butter, meat, wool, hides, and draught and

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implications for crop failure and herd decimation, is an ever-present threat in Cyrenaica." "Not only does rainfall vary from year to year in quantity and monthly timing, but also it differs widely from place to place in the same year. Sites only a few chilometers apart might experience the opposite extremes of drought and surplus. It is this type of variability between neighboring territories that favors the development of marriage and other ties between the groups occupying different areas in order to overcome the short-term unpredictability of the micro-climate by activating reciprocal patterns of assistance in times of need... In the precarious semi-arid environments even a minor alteration can create serious difficulties, for the margin of security within which individuals must operate is much less." Johnson, *Jabal Al-Akḫḍar, Cyrenaica*, 10, 14, and 15.

[419] "Sheep, goats, and camels do not have to be watered from the time the first rains make grass till the end of April or early May: even horses do not drink until well into April. This fact is important, because it means that the prolific pastures can be grazed by all without dispute, since the wells, which belong to tribal sections or families, are not drawn on. While rain is still falling regularly human requirements are met from pools. To the south of the Tariq 'Aziza, generally speaking, there is no ownership in land—there are no hudud, boundaries, as the Arabs say—and anyone may cultivate or graze where he pleases, but there is strict ownership in wells; whereas to the north of the Tariq 'Aziza there is less narrowly restricted ownership in water, which is here spring water in abundance, but there are very well defined rights in arable. The water of the southern wells is essential for the Bedouin who own the country and who live in it all the year round, and their rights are respected by those who graze there." Evans-Pritchard, *The Sanusi of Cyrenaica*, 31, 36.

[420] "There are many advantages in this annual move to the south. Rain falls and the grasses spring up in advance on the plateau, and grazing is more abundant and of better quality. On the other hand, the grasses of the plateau and its southern slopes are still green when the desert grasses, except in specially favoured depressions, are withered. By their annual oscillation the Bedouin thus give their animals the best grazing at all seasons of the year." Evans-Pritchard, *The Sanusi of Cyrenaica*, 35.

transport."[421] The British anthropologist embedded with the army in Libya argued that rainfall and nature gave "an overwhelming bias toward pastoralism" in the region, maybe attributing to nature his own perspective that contradicted the logic of Italian agricultural projects for a settlement colony in Libya under fascism.[422] Pritchard highlighted that contradiction in his portrayal of the "Bedouin way of life" as "well adapted to its environment" given the inconstancy of the rainfall and the distribution of water supplies, implicitly condemning—and ignoring from his account—Italian agricultural settlements.

In short, Italian colonialism in Libya is the story of the clash between an agricultural and a pastoralist techno-political imaginary of the same landscape. In an apparent contradiction, Italians called Libya *lo scatolone di sabbia* ("the big sand box") through the lenses of a liberal techno-political approach, and yet the same country became the one colony where the project of a demographic colonization for Italian peasants actually took place through the mechanisms of a fascist techno-political regime. Evans-Pritchard synthesized the ambivalence of different techno-political imaginaries of the same region when he observed that "Cyrenaica is a rich country for the bedouin, a poor country for Europeans."[423] The militarization of colonial meteorology shows how liberal techno-political colonization plans for a settlement colony were shattered by the aridity of Tripolitania and the peculiar political ecology of Cyrenaica, ushering in a new techno-political regime.

The early history of meteorology in Libya recapitulates the trajectory of Italian scientific imperialism from a liberal to a fascist techno-political regime. Italian attempts to study the environment of North Africa in the nineteenth century were less controversial than those in the Horn of Africa described in Chapter 1, because after the humiliating French occupation of Tunisia in 1881 and the British invasion of Egypt in 1882 many Italians recognized that expansion in the Mediterranean was necessary.

Unsurprisingly, the first attempts of Italian "peaceful penetration" through scientific instruments and weather data in North Africa took place after the 1881 invasion of Tunisia. In Benghazi, a meteorological observatory had been set up as early as 1882 by the Milanese Geographical Society (Società d'Esplorazione Commerciale) with the support of the Central Meteorological Office.[424] The astronomer Giovanni Schiaparelli, a member of the society, asked the Central Meteorological Office to provide the captain of the navy Giuseppe Bottiglia with forms for the registration of the data.[425] Bottiglia even provoked a protest from Istanbul filed with the Italian embassy for carrying out topographic surveys outside Benghazi.[426] When the society's attempts at economic penetration failed, the meteorological station remained the only legacy of its activity in Cyrenaica. The director of the Central Meteorological Office protested the decision

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[421] *Ibid.*, 34.
[422] *Ibid.*, 33.
[423] *Ibid.*, 38.
[424] A. Milanini Kemény, *La Societá d'esplorazione commerciale in Africa e la politica coloniale (1879-1914)* (Florence: La Nuova Italia, 1973), in particular 105-112.
[425] Archive C.R.A.-C.M.A., (letter without date). Schiaparelli, an astronomer from Piedmont, was from 1862 director of the Observatory of Brera and a member of the Società di esplorazioni scientifiche, which later merged in the Società d'esplorazione commerciale. See Milanini Kemény, 40 n. 36.
[426] *Ibid.*, 111.

to suspend observations for financial reasons, so they continued until 1886 by Giovanni Rossoni, the interpreter of the Italian consulate in the city and son of the Consul, for 600 lire every year.[427] Measurements resumed with several interruptions until 1891, and from then were continued by the French consulate until May 1908.[428] At the same time, Istanbul was well aware of Italian diplomatic efforts to gather international support for colonial expansion in Libya and protested with frustration against the occupation of Massawa in 1885, technically part of the Egyptian—and therefore Ottoman—sphere of influence in the Red Sea.[429]

Similarly, in Tripolitania the Central Meteorological Office made an agreement with the Ministry of Foreign Affairs for the creation of a meteorological station on the roof of the Italian technical school in Tripoli in 1892, under the supervision of Giuseppe Ayra.[430] Schools and commercial activities of the Bank of Rome had been a means of "pacific penetration" in Libya since the 1880s, when the Prime Minister Crispi turned Italian schools abroad into "state schools" and education was overwhelmingly offered in Italian to project Italy's influence abroad.[431] In 1910, on the eve of the war with the Ottomans, the Ministry of Foreign Affairs and the Ministry of Agriculture directly intervened to propose the creation of a new observatory on the roof of the Italian elementary school in Benghazi, following the example of the school in Tripoli, again with the assistance of the Central Meteorological Office for instructions and instruments.[432] In short, Italy's meteorological imperialism in Tripolitania and Cyrenaica started before military occupation.

Luigi Palazzo's Central Meteorological Office was a pivotal actor in the strategy of promoting the cause of Italian liberal imperialism before 1911. Since the first Colonial Congress of Asmara described in chapter 2, Italian liberal elites had agreed on the need of using science to build consensus to refund Italian imperialism on the basis of a new techno-political regime. Using scientific parties for political purposes was part of this strategy. The Minister of Education Nunzio Nasi, a supporter of Italian expansion abroad, often assigned tasks of espionage to scientific missions that received permission to visit the region, such as the expedition of the geologist Paolo Vinassa di Regny, Ascanio Michele Sforza and Ignazio Sanfilippo.[433] Luigi Palazzo, the young new director of the Central Meteorological Office, was one of the most prominent scientists who spontaneously joined the techno-politics of Italian liberal imperialism.

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[427] C.R.A.-C.M.A., letter dated February 15, 1883; reply from the Società d'esplorazione on February 17, 1883. *Ibid.*, 129.

[428] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," Letter by Palazzo to the Ministry of the Navy, March 14, 1912.

[429] Mostafa Minawi, *The Ottoman Scramble for Africa*, 66. The Ottomans were equally outraged by the negotiations between British and Italians about the region of Kassala, in Sudan, that became public in 1894, and the partition of British and Italian Somaliland, from which they were excluded (75-6).

[430] Servizio Meteorologico dell'Aeronautica Militare, *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, vol. 1, (Rome: 1973-1975), 62; Giuseppe Ayra*, Tripoli e il suo clima* (Turin: Frassati, 1895). The data were gathered again by Federico Minutilli, *La Tripolitania* (Turin: Fratelli Bocca, 1912). Gino Laganà, "Tripoli ed i suoi dintorni," *Bollettino Società Africana d'Italia* XXIV (ff. 3-4-5 1905): 51-69; 87-95; 123-137. A reference to the influence of the Ministry of Foreign Affairs is in a letter by Palazzo to the Ministry of the Navy dated March 19, 1912, C.R.A.-C.M.A., Fondo Palazzo, "Tripoli."

[431] Del Boca, *Gli Italiani in Libia*, v. 1, 47.

[432] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," letters dated April, 11 1910 and April 20, 1910.

[433] Del Boca, *Gli Italiani in Libia*, v. 1, 37.

As I have mentioned in the description of the scientific paradigm in which Palazzo operated, he traveled to Tripoli in 1905 to collect magnetic data in coordination with the Department of Terrestrial Magnetism of the Carnegie Institution in Washington D.C.[434] He even advocated the creation of an Italian geophysical observatory in Tripoli at the International Congress of Meteorological Directors in Salzburg in 1905, in order to gain international acknowledgment of the Italian scientific sphere of influence in Ottoman Libya. As a member of the Italian Geographical Society, he believed in the importance of colonialism to raise Italy's political status and its international scientific standing at once. Thus, 1911 was only the breaking point of a crescendo of pressure, but Italian information was limited to the coast.

Italians' ignorance of inland Tripolitania was the paradoxical result of the hurry characterizing the response of Italian scientists to the war in Libya. In general, the invasion of Libya met a much more excited reaction from the press, Italian scientists, and nationalist intellectuals than the occupation of Massawa in 1885 had. The contrast with the invasion of Eritrea in the 1880s reveals the importance of about a decade of preparation in institution-building and the creation of a colonial epistemic community working with the state (see chapter 2). In Eritrea, it took years to send a parliamentary commission collecting information about the environment of East Africa. In 1911, the Minister of Agriculture (and later Prime Minister) Francesco Saverio Nitti sent to Tripoli a committee of scientific experts that reached the city in February 1912, when Italian troops only controlled the outskirts of the city.[435]As a result, their observations were limited to the area around the city. In short, the fact that Italian colonial expansion was finally resuming set the expectations for the creation of an agricultural settlement colony so high that the actual sight of the coast of Tripolitania originated the stereotype that Libya was a "big box of sand."

Italian colonial knowledge remained limited to the coast even in following years. A broader committee of scientists operated in Libya between March and June 1913.[436] All the experts in the committee were from the South or worked in Southern Italian academic institutions: the botanists Enrico Pantanelli (from Apulia), Alessandro Trotter (Naples), Fridiano Cavara (Naples), and especially Emanuele De Cillis (Naples), who became Director of the experimental Institute of Sidi el-Mesri, near Tripoli; the zoologist Francesco Tucci (Palermo); and the meteorologist Filippo Eredia, who had worked at the Sicilian observatory of Catania and had recently joined the Central Meteorological Office in the weather forecasting section. Italian scientific experts did not find the fertile land needed to create a settlement colony according to the rules of a liberal techno-political regime and the volume about Cyrenaica (where fighting continued much longer) was never published. The environmental challenges of Tripolitania and

[434] Luigi Palazzo, "Magnetic Elements determined at Tripoli, Barbary," in *Terrestrial Magnetism and Atmospheric Electricity*, v. XI, (1906), 93-6.

[435] In order to evaluate the chances of agricultural development of the region, Nitti personally commanded that Palazzo supply the leader of the mission, the engineer Secondo Franchi, with the necessary equipment, paid for the Ministry of Agriculture. 12 thermometers were delivered on February 17. Letter from Nitti to Palazzo dated February 9, 1912. C.R.A.-C.M.A, Fondo Palazzo, "Tripoli."

[436] See Del Boca, *Gli Italiani in Libia*, v. 1, 254 and 256; Ministero delle Colonie, *Commissione per lo studio agrologico della Tripolitania, La Tripolitania Settentrionale* (Roma: Tipografia Nazionale Bertero, 1913).

the lack of control over Cyrenaica exposed the failures and limits of Italy's liberal techno-political regime.

The war in Libya spurred the military to get increasingly involved in the study of the weather for military forecasts. The deployment of three dirigibles and about fifty airplanes in total for the first time in history during the war against the Ottoman Empire ushered in the era of military aviation. In the earliest phase of the occupation, the high cadres of the military did not integrate meteorological information in their plans, despite the environmental challenges that they faced. As troops' landings took place during the winter, the docking of materials was extremely difficult due to severe weather conditions of the sea. Several storms destroyed the hangar where Italian airplanes were stored. Even the assembly of the aircraft proceeded with delay.

When they realized that the local population did not greet them as liberators but sided with the Turks, Italians distrusted them and used airplanes for reconnaissance missions. Thus, they also collected the first aerological observations in Tripoli and Benghazi. Realizing the importance of weather forecasts for the use of airplanes and draken balloons, the military was further spurred to create the Royal Aerological Service, centered on the military base of Vigna di Valle (on the lake of Bracciano, north of Rome) where the army was establishing the first Italian aeronautical base for the construction and test of aircraft.[437] Vigna di Valle is still considered the place of birth of Italian military aeronautics and is the location of the Italian museum of military aeronautics.

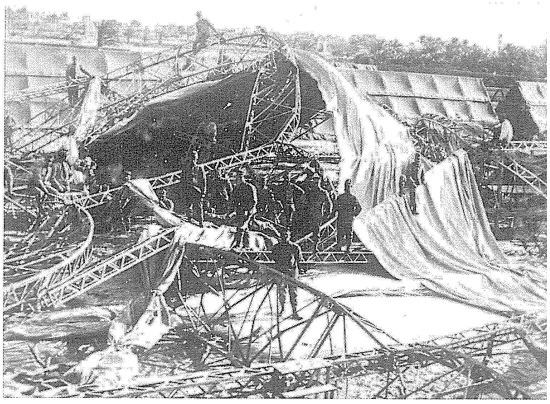

Fig. 3.9-3.10: The first conquest of Libya (1911-1912) saw the first use of airplanes and draken balloons in colonial warfare. Yet Italians were also facing new challenges of colonial weather and environments for the first time. In the second image, the destruction of the hangar of the draken during a storm.[438]

[437] Attilio Ferrari, "La Regia Stazione Aerologica Principale Di Vigna di Valle (Bracciano)," *Memorie R. Comitato Talassografico Italiano* 29 (1913): 1–15.

[438] From Ferdinando Pedriali, *L'aeronautica italiana nelle guerre coloniali: Libia 1911-1936: dallo sbarco a Tripoli al governatorato Balbo* (Rome: Aeronautica militare, Ufficio storico, 2008) 44, 57.

Despite relying at first on the expertise of civilian scientists of the Central Meteorological Office and the Comitato Talassografico (a committee for all maritime studies of the Mediterranean, including maritime meteorology, created in July 1910), the military took full control of the Aerological Service for the study of upper air meteorology in 1913 - after the war in Libya had proven the importance of weather forecasts in military operations, and before the Great War.[439] Already in 1910 the Comitato Talassografico—a scientific committee largely sponsored by the army and navy with a far more nationalist agenda than the internationalist Central Meteorological Office—had been assigned by the Government the study of the Upper Atmosphere and the station of Vigna di Valle.[440] These were major blows to the civilian Aeronautical Society and Palazzo's efforts to foster international collaboration with Hergesell in Germany. The first phase of the war in Libya (1911-1913) was the first nail in the coffin of Italian liberal meteorology.

Meanwhile, actors on the ground continued to rely on Palazzo and the Central Meteorological Office as the main authority to gain instruments and instructions for the study of the newly conquered coast of Tripolitania. Observations from the Italian school in Tripoli (the Istituto Tecnico Commerciale), which had been interrupted during the conflict for the occupation of the city, were restarted by the Italian army on January 5, 1912.[441] Arcangelo Ilvento, hygienist from the University of Palermo and director of the Service of Maritime Health, wrote to Palazzo listing all functioning instruments and asking more climatological information.[442] Palazzo asked Ilvento to record data three times a day (at 9 am, 3 pm and 9 pm) and transmit them to Rome every ten days.[443] Clearly, such activity had nothing to do with the weather forecast, which would have required the immediate broadcasting of the data by telegraph to Rome, but rather with climatological study of the region. At this stage, meteorology remained a civilian business. Or rather, the military would have taken part in it as a request from below, from individual officials on the spot, as in Eritrea in the early twentieth century (see Chapter 2).

The need to face a new and irregular climate—whose sudden storms could flood the desert and even bring snow on the Gebel Nefusa—drove the creation of the first Italian meteorological network in Tripolitania, beyond Palazzo's expectations in Rome. Still in March 1912 Palazzo thought that eventually there would be only four meteorological observatories in Libya: Tripoli (in the Istituto Tecnico Commerciale), Benghazi and Tobruk (both controlled by

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[439] The law assigning to Vigna di Valle the role of main aerological station was a royal decree signed on February 25, 1912, in the middle of the Libyan war. See Giovanni Piero Magrini, "Gli Scopi e L'attività Del R. Comitato Talassografico Italiano," *Memorie R. Comitato Talassografico Italiano* XXI (1916), 91-5.

[440] Attilio Ferrari, "La Regia Stazione Aerologica Principale Di Vigna di Valle (Bracciano)." Ferrari was assigned by Maggiore Moris in 1909 of the Brigata Specialisti of military engineers to study the creation of an aerological observatory. He travelled to France and Germany before submitting a proposal for the creation of Vigna di Valle.

[441] Attilio Ferrari, the military founder of Vigna di Valle, had been interested in the reactivation of the observatory, but he had been transferred with other pilots from Tripoli to the nearby town of Homs. C.R.A.-C.M.A., Fondo Palazzo, "Tripoli" Letter from Tripoli, January 26, 1912. "Cronaca Tripolitana," *Corriere della Sera*, January 6, 1912.

[442] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," Letter dated January 7, 1912.

[443] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," Letter dated January 19, 2012.

the navy), and Derna, whose equipment had been supplied by Palazzo directly to the military.[444] Instead, meteorological stations mushroomed in Tripolitania wherever there were military settlements and, by April 1912 followed Italian military conquest to Tajoura, Zawiya, Zuwarah, 'Aziziya, Gharyan, Tarhuna, El-Gusbát, Nalut, Yefren and even Ghadames, a distant oasis in the desert that Italian leaders wanted to control so as to mark the desert border with French Tunisia and Algeria.[445]

Fig. 3.11: The meteorologist Filippo Eredia (to the right of the pluviometer and meteorological station, in civilian clothes) in Tarhuna, Tripolitania, in 1913. The first meteorological network of Libya had agricultural purposes like in Eritrea, even if it was largely entrusted to military officers on the ground.[446]

Requests for meteorological instruments came from below rather than from decisions taken by the high command in Rome, mostly from military officers on the spot who were interested in meteorology and wanted to contribute to the enterprise, or simply found it useful to explore regions that were opening to the Italian advance. Colonels Vagliasindi and Romanelli started spontaneously the observations in Zuara and Homs. A lieutenant named Rossi wrote: "Believing that meteorological information is necessary for our accurate knowledge of this area, please send necessary instruments to the Giosc [Al-Jawsh]".[447] Perhaps because he was irritated by the tone of the request, Palazzo invited the officer to ask the government of Tripoli, as they already had some supplies.[448] The captain of Jefren, a locality in the mountains behind Tripoli,

[444] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," Letter by Palazzo to the Navy, March 19, 1912.
[445] Filippo Eredia, "Appunti di climatologia," in Ministero delle Colonie, *Commissione per lo studio agrologico della Tripolitania, La Tripolitania Settentrionale*, (Roma: Tipografia Nazionale Bertero, 1913).
[446] From the Filippo Eredia archive, courtesy of Mirella Petitto-Eredia.
[447] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," letter from Jefren, December 17, 1913.
[448] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," letter from Palazzo to Jefren, January 7, 1914.

asked for an anemometer, because "the wind is the dominant character of the climate here on the Gebel."[449]

The government and the military were clearly aware and supportive of these initiatives. The local governor, Garioni, visited the observatory of Tripoli in June 1913.[450] Martinuzzi, the Director of the Istituto Tecnico Commerciale in the old city of Tripoli who had been in touch with Palazzo for many years before the Italian invasion, was free to organize meteorological stations under Italian rule. He travelled for Palazzo in order to identify the best site for a magnetic observatory and to distribute thermometers, even if "it took ten hours in a truck," he remarked. "It seems that bringing those thermometers to Azizia has spurred military authorities to care about meteorological studies, because as soon as they occupied the [Mount] Garian, the authorities themselves established immediately an observatory. They wanted to do the same thing in Sirte."[451] The expansion of meteorological stations and Italian rule followed hand in hand, so that Martinuzzi was not able to take care of it alone only a few months later: "Because of the numerous [requests of] news from this observatory, this has truly become an office of public interest that I, alone, cannot satisfy."[452]

Thus, Palazzo sent to Libya as part of the committee of scientific experts devoted to the study of the region his most capable assistant, the Sicilian meteorologist and weather forecaster Filippo Eredia—who would later become a crucial figure for the transition of meteorology from an agricultural to a military science. Eredia became the collector of colonial meteorological data at the Central Meteorological Office. He provided the first fundamental study of the climate in Tripolitania by comparing the data from 1892 with his own observations of temperature, humidity, rainfalls and winds.[453] The most striking feature of Eredia's reports is that they compared data from Libya with southern Italian cities rather than Tunisia or Egypt, and stressed the environmental similarity between the Italian South and the "Fourth Shore."[454] The Sicilian botanist Antonino Borzì, director of the Colonial Botanical Garden of Palermo, drew a similar climatic comparison between Sicilian and Libyan data.[455]

While maintaining the comparison with the South, the anti-colonialist geographer Arcangelo Ghisleri contested Eredia's conclusions. According to Ghisleri, temperatures were not sufficient to determine the climate of an individual region, which was affected by broader

[449] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," letter from Jefren, November 18, 1913.
[450] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," letter from Martinuzzi to Palazzo, July 3, 1913.
[451] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," letter from Martinuzzi to Palazzo, February 18, 1913.
[452] C.R.A.-C.M.A., Fondo Palazzo, "Tripoli," letter from Martinuzzi to Palazzo, July 3, 1913.
[453] Filippo Eredia, "Climatologia Di Tripoli e di Bengasi" series Monografie e Rapporti Coloniali. Ministero degli Affari Esteri Direzione centrale degli Affari Coloniali (Roma: Tipografia Nazionale di G. Bertero) 1912.
[454] "The average annual temperature in Tripoli is 19.7 degrees, higher by only two degrees than those of Siracusa, for two and half higher than Catania and Palermo, and three higher than Lecce". Filippo Eredia, *Il clima*, in Ministero delle Colonie, *Commissione per lo studio agrologico della Tripolitania, La Tripolitania Settentrionale* (Roma: Tipografia Nazionale Bertero, 1913), 43.
[455] Antonino Borzì, "Tripolitania e Cirenaica. Condizioni Di Clima e di Suolo Della Libia in Rapporto a Quelle Del Mezzogiorno d'Italia e Specialmente Della Sicilia," series Monografie E Rapporti Coloniali (Roma: Tipografia Nazionale di G. Bertero) 1912.

orographic and maritime influences.[456] Eredia also collected information from the local population about the recurrence of exceptional meteorological phenomena such as snow on the mountains behind Tripoli, and a hot wind called *Ghibli*, which was particularly ruinous for agriculture. Still in the spirit of a liberal techno-political regime, Eredia suggested the organization of weather forecasts produced by "lovers of science" to predict the arrival of the wind and protect agricultural settlements on the coast. Yet the final work of the committee was very cautious and made clear that demographic colonization was not an immediately achievable goal. Further studies were still necessary.

Beginning in September 1914, the main center of the meteorological network of Tripolitania became the agricultural experimental institute of Sidi el-Mesri, directed by the agronomist Emanuele De Cillis. Sidi el-Mesri was a research institute founded on March 2, 1914 in a previous Ottoman school of agronomy situated 6 kilometers further out from Tripoli. The location of the observatory in the countryside outside Tripoli makes clear that the purpose of meteorological observations during this first phase of the occupation (1913-1914) was the study of natural environment for the agricultural development of the country in the future. Privileging scientific accuracy over easy access to communication by telegraph or boat was a principle of the liberal techno-political regime.

In 1913, the Director of the Central Meteorological Office Luigi Palazzo took part in the tenth International Congress of Geography (March 26-April 13, 1913) and the tenth meeting of the International Meteorological Committee (April 7-12, 1913) in Rome.[457] These two events offered the opportunity to the liberal Italian State and its epistemic community to show that Italy had finally joined the international club of imperial powers with the recent conquest of Libya in 1911.[458] Receiving Hugo Hergesell and the Norwegian meteorologist who revolutionized the field of meteorology in the interwar period, Vilhelm Bjerknes, in the long corridors that used to host the headquarters of the Jesuits' scientific hub of the Collegio Romano, Palazzo could show that he had built his own modern empire made of weather data, instruments, and information.

At the peak of his authority and power in 1913 as a full member of the internationalist and imperialist paradigm of liberal meteorology, Palazzo collected data coming from weather stations abroad, in Italy, and in its colonies. There were eight observatories in Eritrea, with several other weather stations. The office received weather data from Addis Ababa in Ethiopia, even if the country was still independent after the battle of Adwa. Six observatories recorded data in Somalia, one in Cairo, and six brand-new ones in Libya. All Italian and colonial observatories needed to ask for instruments here, and here they had to send back their data.

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[456] Arcangelo Ghisleri, *Tripolitania e Cirenaica*, (Milan: Società Editoriale Italiana and Istituto Italiano d'arti Grafiche 1912), 79-83.

[457] Reale Società Geografica, *Atti del X Congresso Internazionale di Geografia Roma 1913* (Rome: Società Geografica Italiana, 1915). International Meteorological Committee, *Report of the Tenth Meeting, Rome 1913*, M.O. n. 216, London, 1914.

[458] At the same congress, the military geographer Attilio Mori described "The Contribution of the Italian Military Geographical Institute to the Progress of Geography and its colonies," in Reale Società Geografica, *Atti del X Congresso Internazionale di Geografia,* 393-406; Ettore Ricci presented a paper Cyrenaica "Nota sopra l'Eocene nella Cirenaica," *Ibidem* 856-74. Alessandro Mazzoni presented a paper about the Italian of the river "Uebi Scebeli" in Somalia, *Ibidem* 1235-44.

Palazzo corresponded with colleagues in Washington D.C., Berlin, Vienna, Cairo, Tripoli, Asmara, Addis Ababa, and Mogadishu. For the International Exposition of Naval Hygiene and Italian Colonial Exhibit that took place in May 1914, Palazzo's Meteorological Office proudly prepared a small pamphlet with a bibliography of the Studies Published on Meteorological and Geophysical Matters in Italian Colonies.[459] Scientific internationalism, international cooperation, and imperial expansion went hand in hand in Palazzo's scientific paradigm.

Yet the peak of "success" for Palazzo's paradigm of international liberal meteorology in 1913 concealed its imminent downfall. The challenge of studying colonial environments drove the transformation of such a techno-political regime back in Italy. The Director of Sidi el-Mesri Emanuele De Cillis, Palazzo's main correspondent from Tripoli in those years, became after the Great War a crucial figure in the fascist "battle for the wheat" and employed in southern Italy some of the techniques developed in Libya. He became chancellor of the Department of Agriculture of the University of Naples, Senator, member of the Colonial Council and President of a section of the CNR, the research institute created by the fascist regime.

His collaborator for the registration of meteorological data, Nallo Mazzocchi Alemanni, became a crucial figure in plans of internal colonization in Italy in the 1920s and 1930s, when Mussolini started his massive plan of "land reclamation." De Cillis and his son in law, Giuseppe Leone, dealt with Sidi el-Mesri like a family business for the whole Italian colonial experience. Filippo Eredia, the meteorologist sent to organize the first weather network in Tripolitania, became the most important meteorologist of the interwar period. In other words, the scientific personnel that would later become essential to build a fascist techno-political regime shared the frustrating experience of the challenge of the colonization of Libya on the ground.

Meteorology remained the fundamental premise for any plan of conquest and future development in Africa. Yet the discovery of a largely arid environment around Tripoli following the Italian conquest exposed the fragility of a liberal techno-political regime. The war itself created a precedent for the entanglement between the military and environmental scientists that would later transform meteorology into a militarized science for weather forecasting. This entanglement became increasingly powerful with the Great War (1915-1918) and the re-conquest of Libya (1921-1931). The former eroded Palazzo's paradigm internationally. The latter completed its demise at home. As a result, Palazzo's internationalist scientific paradigm of colonial expansion in harmony with other colonial powers collapsed in the Great War and his science became obsolete.

3.4 The Destruction of an International Community: The Great War and the Rise of Local Weather Forecasting

In this section, I argue that World War I derailed the paradigm of liberal meteorology and localized the international community of European meteorologists. Before the war, European meteorologists worked around a similar program of exploration of the upper atmosphere and expansion of data across the globe by embedding themselves with Western colonial expansion,

[459] R. Ufficio Centrale di Meteorologia e Geodinamica, *Studi Pubblicati su Questioni Riguardanti la Meteorologia e la Geofisica nelle Colonie Italiane* (Rome: Tipografia Nazionale Bertero, 1914).

as we have seen with the Italian Director Luigi Palazzo. Internationalism was hugely important, as we have seen by analyzing the history of the International Commission for the Study of the Upper Air. Yet in the same way the Great War destroyed the era of the "age of empire" without producing a new clear global hegemony, it also destroyed the scientific paradigm of international meteorology without immediately replacing it with a new one.

The Great War was the first global war, but was also a very geographically localized conflict. Enrolled in national armies, meteorologists' forecasting efforts were directed to different regions of the frontline for four years in isolation from one another. With the exception of the Russian front, Western trenches and frontlines moved very little, if at all. Therefore, European meteorologists were responsible for forecasts that worked empirically for the areas of combat operations. Their reference community became the armies and soldiers fighting in the heat, rain and snow all-year-round, rather than the invisible international network of their European colleagues. In other words, the First World War was a global and a local phenomenon at once. As a result of the isolation and competition that destroyed their international community during the war, by the end of the conflict European meteorologists had produced national methods of weather forecasting whose application was local rather than universal in scope. The international solidarity and paradigm of liberal meteorology was shattered.

The meaning of "meteorology" itself shifted dramatically, as weather forecasting became by far the most useful branch of the discipline for military operations and the use of poison gas. Nineteenth-century and early twentieth-century meteorology were turned toward the past and the collection of data to understand the laws of the atmosphere. The war turned "meteorology" into a discipline whose major goal was to offer short- and long-term forecasts. Before the war, European scientists struggled to get their national institutions to support scientific research and invest in the collection of data. During the war, national armies were collecting more data than any meteorological office could ever process.

As a result, speed replaced accuracy as the most important value of these forecasts. The nineteenth-century scientific value of accuracy based on the virtue of rigorous observational practices dissolved, because forecasting speed took over as the priority of European meteorologists. As the director of the British Meteorological Office Napier Shaw wrote: "The war was like a kinema film that is running too fast: one missed what one is accustomed to see and saw things that passed unnoticed in ordinary life."[460]

The Norwegian "Polar front theory" - the fundamental model for the development of cyclones designed by Vilhelm Bjerknes that is at the foundation of modern meteorology - came out largely thanks to the circumstances of the war effort. Polar front theory explained *why* cyclones moved the way they did in three dimensions, rather than simply try to predict statistically how and where they would move in the future, as meteorologists had been doing since the middle of the nineteenth century. With the transfer of the Bergen School methods to the United States through England during World War II, "polar front theory" triumphed as THE method for weather forecasting, whose vocabulary of "air masses" and "polar fronts" borrowed from the Great War is still with us today.

[460] Shaw, *Manual of Meteorology*, v.

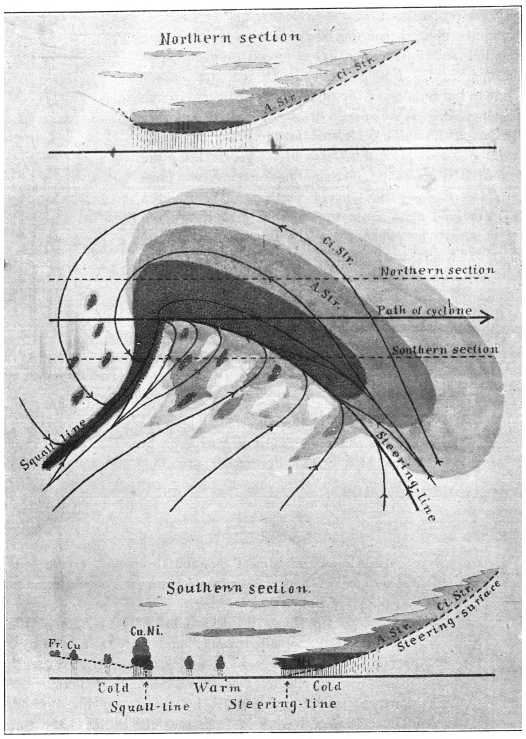

Fig. 5. Clondiness and Precipitation in moving cyclones.

Fig. 3.12-3.13: The Norwegian meteorologist Vilhelm Bjerknes, inventor of Polar Front Theory. His model of the cyclones - on the right - required meteorologists to "see" the weather in three dimensions.[461]

Yet, the difficult reception of the Norwegian theory right after the Great War disproves linear narratives of progressive scientific discovery driven by the war. As international consensus in the geophysical and atmospheric sciences based on observational practices had been destroyed, in the post war period meteorologists started fighting about how to understand the data, rather than how to collect them. Even if "Polar Front Theory" was revolutionary in the long term in the field of meteorology, there was no "Gestalt Shift" in Europe accepting it right away. The war had destroyed a scientific paradigm and its community without replacing it with a new one, because the international community of meteorologists was fractured in national camps by four years of local forecasts for very specific war-front environments. The war had a destructive rather than constructive role in the history of meteorology, despite the seeming expansion of the number of observations and the birth of the theory later recognized as the foundation of modern meteorology.

Following the geopolitical domino effect of the declarations of war, a blackout of the free exchange of weather data across meteorological institutions interrupted the paradigm of liberal

[461] Fig. 3.12 courtesy of the archive of the Department of Terrestrial Magnetism at the Carnegie Institution for Science, Washington D.C. Fig. 13 from Jacob Bjerknes, "On the Structure of Moving Cyclones" in *Geofysiske Publikationer*, Kristiania 1918, 4. Jacob was Vilhelm's son.

international meteorology, and a meteorological silence fell on Europe. I will briefly examine the transformation of meteorology from North to South, namely from Norway to England, France and Italy.

In this context of complete isolation, the Norwegian Vilhelm Bjerknes articulated Polar Front Theory from his Geophysical Institute at Bergen, on Norway's Western coast. As Norway was crippled by food shortages and its fishermen could not receive any weather forecast data from England or Germany, Bjerknes managed to convince the Norwegian government to invest in a thick network of weather stations that allowed him to understand the development of cyclones as thermo-dynamic movements of air, due to the clash between cold and warm air masses originating "polar fronts." Strongly influenced by oceanography and hydrodynamics, Bjerknes conceived of the atmosphere as an "ocean of air" and believed in meteorology's ability to predict storms with mathematical certainty rather than statistical probability in the future. As Jim Fleming has pointed out, "in the absence of the world war, what we know today as the Bergen school of meteorology might have never developed, or it might have been called the Leipzig school [...]."[462]

In England, British preparation for the conflict was extremely deficient. Napier Shaw, the Director of the British Meteorological Office, remembered years later that the Office was forced to improvise forecasts in order to meet the requests of the navy and the army, especially considering German superiority in the field of aerology.[463] The United Kingdom had no specific academic positions for the teaching of meteorology and the Meteorological Office was the only place to train meteorologists and pilots. The British network based on voluntary observations for data collection paled compared to continental organizations. The meteorological section of the army—called Meteorological Field Service—was created in 1915 and assigned to Major H.G. Lyons. Several members of the forecast division suffered mental breakdowns during the war due to the amount of work and stress.[464]

Meanwhile Lewis Fry Richardson, a Quaker mathematician and former superintendent of the Eskdalemuir Observatory, invented numerical weather prediction while serving in the Red Cross during the war in France. However, his pacifist beliefs compelled him to resign from the British Meteorological Office when it was transferred to the Air Ministry and effectively militarized in 1920. He published his wartime studies in 1922, too late to make a significant impact on the practices of the Meteorological Office. Therefore, the British Meteorological Office continued to rely on the classification of barometric "weather types" designed by Abercrombie in the nineteenth century and did not adopt the methods of the Bergen school until the 1930s.[465]

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[462] Fleming, *Inventing Atmospheric Science*, 39.

[463] "Special compilations of data had therefore to be improvised when the demands of the Navy and the Army were made known," whereas in Germany "some of the compilations which we have found necessary had already formed the subjects of university exercises." Quoted in J. M. Walker, *History of the Meteorological Office* (Cambridge: Cambridge University Press, 2012), 204.

[464] About British wartime meteorology, see *Ibid.*, 191-202.

[465] About Lewis Fry Richardson's famous story, see Paul N. Edwards, *A Vast Machine: Computer Models, Climate Data, and the Politics of Global Warming* (Cambridge: MIT Press, 2010), 92-6. Peter Lynch, *The Emergence of Numerical Weather Prediction: Richardson's Dream* (Cambridge: Cambridge University Press, 2006); Oliver M.

In France, the Second Battle of Ypres in spring 1915 and the first German use of chemical weapons against the French army triggered the militarization of meteorological services. A special chemical and meteorological service for "companies Z" had its main station in Satory and an aeronautical meteorological service followed in September 1915. The three meteorological services of the special chemical companies, artillery and aviation were finally combined in the Military Meteorological Service in 1916.[466]

French meteorologists Philippe Wehrlé (1890-1965) and Philippe Schereschewsky (1892-1980) resurrected the weather forecasting method created by Guilbert for the 1905 international exhibition of Liège that worked well in Belgium, but had failed to gain international consensus before the war. Building on that local technique, they practiced weather forecasting thanks to the analysis of "systems of clouds" and their morphological correlation with barometric pressure.[467] By the end of the war, the French Military Meteorological Service dwarfed the nineteenth-century civilian Bureau Central Météorologique, with two thousand employees against thirty. French meteorology was essentially militarized with the creation of the Office National Météorologique directed by General Émile Delcambre (1871-1965) in 1920.[468]

The war mobilized Italian meteorologists as well as their international colleagues before them. Italy abandoned the Triple Alliance with Germany and Austria-Hungary and joined England and France on May 24 1915. On May 31, the Ministry of Agriculture interrupted the exchange of meteorological information with foreign institutions. On July 5, 1915 Luigi Palazzo hosted in the library of the Central Meteorological Office—the same library previously used for international conferences—the first meeting with representatives of the Ministries of War, Navy, and military Aerology. The meeting focused on directing the circulation of meteorological data and forecasts to military forces and the adoption of a secure code in order to prevent the enemy from getting information.[469] In Rome, the personnel of the weather forecasting section increased to fifteen people, including its director Filippo Eredia and ten military officers, with the task of issuing two daily forecasts at 12 pm and 4 pm, based on the observations carried out at 8 am and 12 pm.

The Central Meteorological Office produced general forecasts for the Meteorological Section of the Chief of Staff, the main station of the Aerological Service in Padua, and a number of military observatories depending on the requests from the army and navy. International collaboration was restricted to exchanges of weather bulletins with the British Command in Salonika, Malta, and Alexandria. However, Palazzo managed to prevent the move of the forecasting service of the Central Meteorological Office from Rome to Padua, near the

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Ashford, *Prophet—or Professor? The Life and Work of Lewis Fry Richardson* (Bristol and Boston: Adam Hilger, 1985).

[466] Alfred Fierro, *Histoire de la météorologie* (Paris: Denoël, 1991), 228-230.

[467] Philippe Schereschewsky and Philippe Wehrlé, *Les systèmes nuageux* (Paris: l'Office National Météorologique, 1923). This method was widely critiqued after the war for the fictive concept of a "system of clouds." On Schereschewsky, see Fierro, *Histoire de la météorologie*, 229; about Wehrlé, p. 244.

[468] Fierro, *Histoire de la météorologie*, 241-57.

[469] Servizio Meteorologico dell'Aeronautica Militare, *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, vol. 1, (Rome: 1973-1975), 66.

frontlines, where the army was setting up the command of the army and the military aerological service.

The Aerological Service of the army instead moved to Padua and focused its activity on local observations near the frontline. It developed local observations in connection with the use of poison gas during combat. Meteorology became a crucial military science on June 29, 1916, when the Austrian army used poison gas for the first time against 8,000 Italian soldiers near mount San Michele.[470] The threat of gas encouraged the unprepared Italian authorities to develop their own chemical weapons and defensive masks as well as a meteorological section within the Supreme Command because poison gas was effective only in certain meteorological conditions, namely when the wind was blowing the "poisonous cloud" against the enemy and when it was not strong enough to reduce the concentration of chemicals in the atmosphere.[471]

The "Special Company X" was composed of four military, chemical, medical and meteorological officers and was in charge of chemical and meteorological matters.[472] It was also in charge of training medical officers for anti-gas defense.[473] This military group was soon placed under direct control of the Supreme Command. [474] By 1917, the roles of such combined chemical-meteorological companies had significantly expanded, and chemical-meteorological officers became "indispensable" even for smaller military units.[475] Soldiers on watch in the trenches had been given anemometers to measure direction and force of the wind, so that they could transmit the information when requested.[476] Moreover, chemical officials were taught meteorology precisely at the Central Meteorological Office by Palazzo and Eredia "in order to learn how to take the best advantage of atmospheric conditions, especially the wind, for the use of poison gas."[477]

Among the instructions distributed to soldiers to defend themselves from chemical attacks, the Command of the Third Army wrote: "Point 8: Do not fear attacks by poisonous clouds when it is very windy and the wind blows against the enemy; when you are in a higher position than the enemy [rarely the case, because the Austrians controlled the mountains]; when you are separated from the enemy by a wide stream of water; in all other cases, be always careful and alert, do not ever overlook precautions."[478] In WWI meteorology became a vital concern, and having personnel knowledgeable about the discipline became necessary in order to remain alive.

The war made the Aerological Service even more important than the Central Meteorological Office in many respects. It was in charge of building anemometers for the study

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[470] Filippo Cappellano and Basilio Di Martino, *La Guerra dei Gas: Le armi chimiche sui fronti italiano e occidentale nella Grande Guerra* (Vicenza: Gino Rossato Editore, 2006).
[471] *Ibid.*, 141.
[472] *Ibid.*, 176.
[473] *Ibid.*, 203.
[474] *Ibid.*, 172.
[475] *Ibid.*, 223.
[476] "Comando della Seconda Armata. Doveri degli Ufficiali vedette speciali da trincea," reprinted in Cappellano and Di Martino, *La Guerra dei Gas*, 233.
[477] *Ibid.*, 225 and 228. Quoted in "Relazione a S.E. il Ministro circa I gas asfissianti e le maschere protettive, s. d., but presumably end of 1917.
[478] Comando Terza Armata, Stato Maggiore, Sezione Gas. "Consigli al soldato perché sappia difendersi dai gas asfissianti," 2nd edition, March 1917. Reprintedd in Cappellano and Di Martino, *La Guerra dei Gas*, 234.

of the wind, collaborating with the artillery for ballistic corrections, and providing information to the first aircrafts used for reconnaissance and combat missions. Starting in 1915, the Aerological Station of Vigna di Valle was assigned to Raffaele Giacomelli and his assistants Giuseppe Crestani and Mario Tenani who also produced climatological studies of the regions affected by the conflict.[479] They also issued meteorological instruction to military personnel and pilots.[480] The Director of the Aerological Service, Lieutenant Colonel Luigi Matteuzzi, published an Atlas of Clouds, while Cesare Fabris produced a classification of 18 isobaric types that was extremely useful for weather forecasting.

In addition to the Aerological Service, the army created its own network of weather stations in the valley of the river Isonzo, where most of the fighting took place, under direct control of the Chief of Staff.[481] The meteorological service of the army was created when soldiers started suffering from hypothermia while it was still summer, because the Italian front was for the most part in the Alps.[482] This meteorological section issued a daily weather bulletin for the entire area of the conflict, under the name Bollettino Meteorico della Zona di Operazioni. Captain Ferrari was in charge of organizing the meteorological section of the army and it was established in Padua, replacing—and damaging—the ancient astronomic observatory. Civilian observers, in particular local school teachers, contributed as well.[483] Palazzo and Eredia visited the organization of the meteorological network on the frontline of the river Isonzo in 1917. In short, the war produced a multiplication of observations and observers.

[479] Servizio Meteorologico del Comando Supremo, *Notizie sulla Bora Friulana e Triestina* (Rome: Tipografia del Comando del Corpo di Stato Maggiore, 1917).
[480] Raffaele Giacomelli, "L'Opera della R. Stazione Aerologica Principale di Vigna di Valle durante la Guerra" in *Atti dell'Associazione Italiana di Aerotecnica* (Rome: Stabilimento Poligrafico per l'Amministrazione della Guerra, 1922), 186-191.
[481] The army also set up a brand new meteorological network in the valley of the river Adige organized by the Command of the 1st Army and centered in Trento, and another one centered in Salò that proved particularly useful for the analysis of Italy's biggest lake, the Lake of Garda.
[482] U.S.S.M.E., C. 42/3, "Studi Particolari," f. 3, "Il Servizio Meteorologico nella Guerra 1915/1918." Unfortunately, the documents preserved in the archive of the army offer only a retrospective view on the events of the Great War, see in particular f. 66, "Comando Supremo, anno 1918, Categoria Ufficio Tecnico, Specialità Sezione Meteorologia. Elenco argomenti da esporsi alla Quarta Riunione Meteorologica persso il M. di Agr. Ind. Comm. Roma, 31 V e 1 VI 1918."
[483] Prof. Dott. Canestrelli (R. Scuola Normale di Cividale), Prof. Dott. Pierpaoli, (R. Istituto Tecnico di Udine), Prof. D. Schiavon (Oss. meteorologico-sismico Seminario di Treviso), Prof. D.F.S. Zanon, Osservatorio Seminario Patriarcale di Venezia).

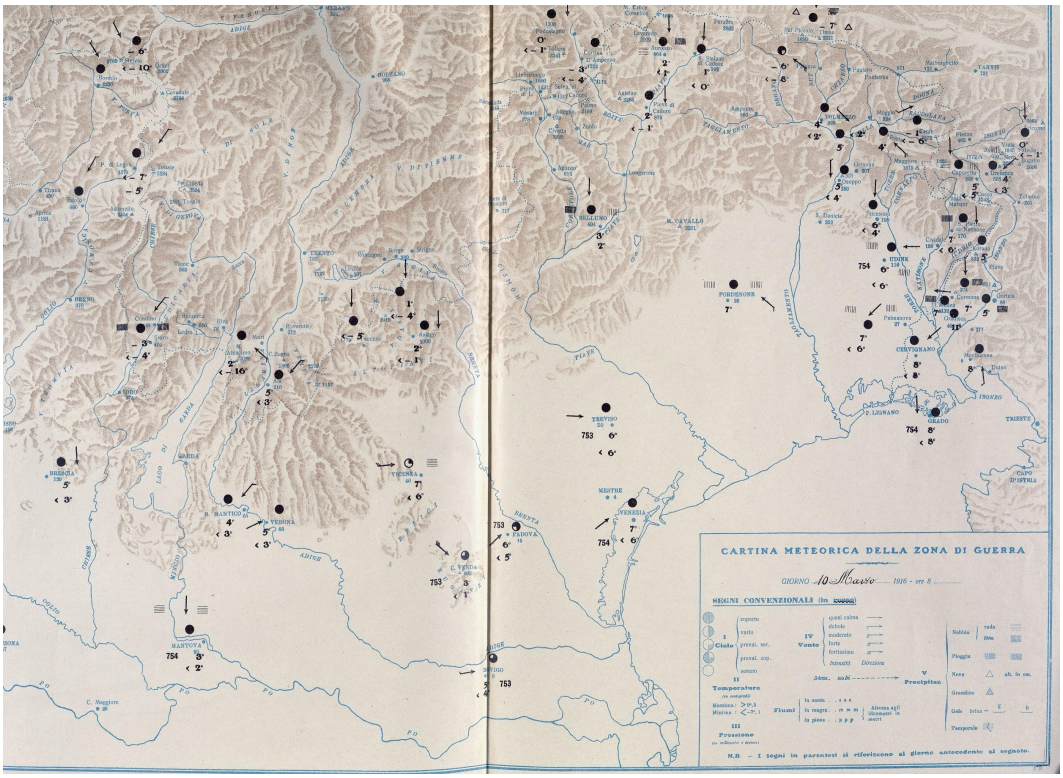

Fig. 3.14: An example of meteorological weather map on the Austro-Italian front in 1916. The Great War forced European meteorologists to focus on weather forecasting in local environments. As this map shows, most military weather stations were located in the valley of the Isonzo river (north-eastern corner of the map), where the fighting was taking place.[484]

The most important feature of the meteorological knowledge produced by this massive war effort was its local focus in the interest of the troops on the ground. The army's meteorological service set up a seasonal avalanche-warning service for the Alpine winter that was in charge of reconnaissance missions to study the areas more often affected by avalanches, drew special maps of the Alps, and produced an atlas of avalanches. The same office studied the regimen of the rivers in the area of the conflict and their fluctuation with changes of rainfall. An extraordinary enterprise was a "catalogue of local climates" (called *schedario dei climi locali*) of regional climates and the production of several local monographs connecting morphological and climatological characteristics of certain Alpine localities. At the end of the conflict, the general report about this service argued proudly that "the army had inaugurated *local climatic literature*."[485] Local climate mattered more than the global "big picture" of meteorology produced by the international collaboration the early twentieth century.

[484] From the *Bollettino Meteorico della Zona di Operazioni*, March 10, 1916. Courtesy of the Library of the *Central Meteorological Office* at the C.R.A.-C.M.A., courtesy of Maria Carmen Beltrano.
[485] U.S.S.M.E., C. 42/3, "Studi Particolari," f. 3, "Il Servizio Meteorologico nella Guerra 1915/1918." Emphasis in the original report by Ettore Ricci, 6.

In fact, internationalist meteorologists—especially those who used to collaborate with Germany—were marginalized, as their modern science was suddenly seen with suspicion. In England, the British meteorologist Gustav Lempfert was excluded by the Meteorological Field Service due to his German ancestry and his career came to a halt, without recovering even after the war. In the post-war period, the world of "international meteorology" of the beginning of the century was wiped out as Napier Shaw (66 years old) and Alfred Angot (72 years old) were forced to resign from the British and French weather offices respectively.

In Italy, Luigi Palazzo (59 years old) remained Director of the Central Meteorological Office by adopting a centrifugal strategy, namely by giving increasing autonomy to the weather forecasting section of the office directed by his most capable collaborator, the same Filippo Eredia he had previously sent to Libya. Eredia worked closely with the army for the study of synoptic meteorology and the training of aviators and army meteorologists. Despite the pressure to produce forecasts, in 1916 he still believed that "forecasting weather phenomena is subordinated to their exact knowledge."[486] Yet Eredia understood that aviation was the future of meteorology and succeeded in becoming the most important Italian meteorologist of the twentieth century by making his forecasting section increasingly part of the Ministry of Aeronautics, eventually splitting in 1925 from the civilian Meteorological Office.

Fig. 3.15: The meteorologist and weather forecaster Filippo Eredia (third from the right, in civilian clothes) with military officers during their training in meteorology during the Great War in Rome. Eredia became the most important Italian meteorologist of the twentieth century and the first to grasp that the future of Italian meteorology lay in the development of military aeronautics.[487]

[486] Filippo Eredia, *Aviazione e Meteorologia - Prolusione per l'inaugurazione della Scuola Civile d' Aeronautica* (Rome: Evaristo Armani, 1916) 7.
[487] Filippo Eredia Archive, courtesy of Mirella Petitto-Eredia.

In general, the scientific profile of the Central Meteorological Office was compromised by its previous collaborative work with Germany. From being at the forefront of international developments before the war, it became suddenly obsolete as the international importance of research in terrestrial magnetism shrank and its aerological research was monopolized by the army and the aerological service of the nationalist Comitato Talassografico. The internationalist scientific paradigm in which Luigi Palazzo prospered collapsed under his eyes. He also came out of the war personally wounded by the loss of his two sons. Pericle Gamba, the geophysicist of the Pavia observatory collaborating with Hergesell before the war, did not become part of any military service despite his good record of publications about aerology.[488] Still in 1919 Palazzo asked Bjerknes, as President of the Commission for the Exploration of the Upper Atmosphere, to include Gamba among the members of the commission and called him "the Italian scholar that works particularly on aerology."[489] Yet Gamba was clearly marginalized during and after the Great War.

Unlike the meteorologists of the Central Meteorological Office, the meteorologists of the Comitato Talassografico that had emerged at the time of the war in Libya now worked even more closely with the army and its Aerological Service. They could finally be explicit about their strongly nationalist program centered on Italy's expansion in the north east, where they were mostly based. Four scientists in particular emerged as the beneficiaries of their nationalist faith and their work with the army in meteorology in this period: Vito Volterra (1860-1940), Luigi de Marchi (1857-1936), Giovanni Magrini (?), and Francesco Vercelli (1883-1952).

Volterra is definitely one of the most important Italian scientists of the early twentieth century, especially as an organizer of an Italian national scientific community. Unlike Palazzo's activities of collaboration with Germany, Volterra strongly believed in modeling Italian national science on the example of England and France, and was a vocal interventionist.[490] He promoted the Italian Society for the Advancement of Science (Società Italiana per il Progresso delle Scienze) in 1906, funded the Comitato Talassografico Italiano in 1909 to strengthen maritime meteorology, foster collaboration with the navy and take over the study of aerology from the Central Meteorological Office with the creation of Vigna di Valle. He finally joined the corps of military engineers during the Great War as volunteer, and would later become the founder of the National Research Council until he was removed by the fascist regime.

Luigi De Marchi was a prominent meteorologist and geographer at the University of Padua in the North East of Italy, a university at the forefront of the culture of irredentism, namely the movement requesting the conquest of Italian-speaking regions under Austrian rule. He had competed with Palazzo to become the director of the Central Meteorological Office in 1901, and later became a crucial member of the Comitato Talassografico. He was a passionate nationalist, irredentist, and interventionist. After the war, he became the founder of the section of

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[488] R. Ufficio Centrale di Meteorologia e Geodinamica, "Pubblicazioni sull'Aerologia eseguite dal Personale del R. Ufficio Centrale Meteorologico e degli Osservatori Dipendenti di Pavia e del Monte Rosa," in *Elenco Presentato alla Esposizione Internazionale di Marina, Igiene Marinara e Mostra Coloniale Italiana, Maggio 1914* (Roma: Tipografia Nazionale Bertero, 1914).

[489] Letter from Palazzo to Bjerknes, November 16, 1919. Oslo National Library, V. Bjerknes archive, brevs 469B.

[490] Sandra Linguerri, *Vito Volterra e il Comitato talassografico italiano: imprese per aria e per mare nell'Italia unita, 1883-1930* (Florence: Olschki, 2005).

the fascist party in Padua, the author of the entry "meteorology" in the *Enciclopedia Italiana* edited by the fascist philosopher and minister of education Giovanni Gentile, and according to historian of meteorology Cantù, a skeptical opponent of the Norwegian "Polar Front Theory" in Italy.

Like Volterra and De Marchi, Giovanni Magrini was part of the Comitato Talassografico and was the director of the hydrographic office of the Magistrato alle Acque, the special institution overseeing the hydrology of the lagoon of Venice and Italy's North-Eastern region.[491] The Magistrato alle Acque was part of all the meetings between Italian meteorologists and the army for the coordination of wartime meteorology. Magrini became the crucial organizer of the National Research Council (CNR) in the post-war period as Volterra's secretary. After Volterra was dismissed by the fascist regime, Magrini continued his work under the presidency of Guglielmo Marconi.

Finally, Francesco Vercelli (1883-1952) was the geophysicist who organized the system of weather forecasting for the Italian Chief of Staff during the Great War.[492] Vercelli had developed this method while he was serving in 1917 in the meteorological office of the 3rd Army. Before the war, he had studied the periodical variation in the levels of lakes, such as the lake of Garda.[493] His method was based on the periodical analysis of barometric observations of a certain location and allowed to produce long-term forecasts, even if it did not offer any theoretical explanation for such barometric movements.

It is no coincidence that Vercelli's method worked well in Italian aerological stations, whose main centers (Vigna di Valle, Padova, and Taranto) were near shallow bodies of water (the Lake of Bracciano, the lagoon of Venice in the Adriatic Sea, and the basins of the Small and Big Sea respectively). In short, the Vercelli method was the opposite of Bjerknes' polar front theory: rather than aiming at a universal law explaining the dynamics of the atmosphere and producing weather forecasts, it focused on the mathematical analysis of local barometric data. Moreover, rather than imagining the atmosphere as an "ocean of air," it studied the Mediterranean and its adjacent areas as if it were a great lake.[494]

Vercelli's method had two crucial advantages: first, it allowed to forecast local weather not for 24 hours, but for a period from one to two weeks; second, it claimed to be "objective" because it did not require any particular skills from the observers. At that time, Vercelli was a lieutenant in the army. His method was successfully tested in 1917 and instructions for the

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[491] See Giovanni Piero Magrini, "Gli Scopi e l'attività del R. Comitato Talassografico Italiano" *Memorie R. Comitato Talassografico Italiano* XXI (1916).

[492] Vercelli was the assistant of Carlo Somigliana, Professor of Mathematical Physics at the Polytechnical School of Turin and close friend of Vito Volterra, since they both studied in Pisa with Betti and Dini. Vercelli studied the hydrodynamic theories of George Chrystal ("Transactions of the Royal Society" 1905). Vercelli studied the lake of Garda and individuated periods of change of water levels called "sessa" (seiche) based on the oscillations of barometric pressure (see Giovanni Magrini, *Limnologia: Studio Scientifico dei Laghi* (Milan: Hoepli, 1907), xiv-xv.

[493] Linguerri, *Vito Volterra*, 86-7.

[494] *Ibid.*, 145-46. Other experiments with the same methods were carried out by the director of the Military Aerological Service, Com. Ten. Col. Luigi Matteuzzi and professors Fabris, Levi, Silva, and Tavanti. Francesco Vercelli, *Presagi Meteorici in Rapporto alle Operazioni di Guerra*, quoted in Francesco Vercelli, *L'Aria nella natura e nella vita* (Turin: UTET, 1933) 393. Id., "La Previsione del Tempo: di una Possibile Utilizzazione del Metodo Vercelli," *La Meteorologia Pratica* no. 1 (1922).

application of the method were printed in a flyer to all commands of the army and shared also with allied chiefs of staffs.[495] As a reward for his effort, he became director of the new Italian Geophysical Institute of Trieste, the city recently conquered from Austria-Hungary, which is still one of the most important geophysical institutes in Italy today.

To summarize, the Great War balkanized the organization of meteorological services rather than simplifying and improving them. Since scientific information was controlled and obscured, the war blurred the boundaries between politics and science along new lines, especially by closing the global space that colonial expansion had previously provided to smooth international conflicts. Instead, it divided an international community in national camps. The isolation of wartime years and the disparate local environments of the battlefield produced a series of national methods of weather forecasts. Before the war, there were differences in the institutional affiliation of meteorological services, but meteorological information was translatable. Meteorologists had been working for decades to simplify the process of translation and transmission of data. In the early twentieth century, speaking of a "Norwegian school" or a "French method" for weather forecasting made no sense. After the war, European meteorologists no longer spoke the same language. They had been directly involved in fighting on opposite sides. Long-term and short-term weather forecasting were the most compromised sections of meteorology, because they had been the most involved in military operations. The war isolated scientific communities almost completely for the first time in history in national camps.

The emergence of national camps in scientific debates shows that meteorologists' efforts to become epistemic communities working with the State—in continuity with their previous conduct throughout decades of colonial expansion—turned into a poisonous Faustian deal destroying their shared international epistemic culture, as the previous paradigm of liberal meteorology was shattered along with the international community that constituted its social fabric. The war produced a massive amount of data, but the problem became how to interpret them. Here national cultures and differences produced by the war emerged.

The end of the war did not automatically entail the restoration of pre-WWI friendly cooperation. For example, on January 20 1918 Lyons—the British director of the Meteorological Field Service—rejected the Norwegian request of forwarding telegrams with weather data to Germany through Hesselberg's Norwegian Meteorological Institute, because no communications with Germany were yet allowed from England.[496] On one hand, a return to normality was desired by all scientists. On the other, the new balance of power should have taken new forms. During the Peace Treaty of Versailles in 1919, winning powers established the International Commission of Air Navigation (CINA - Commissione Internazionale di Navigazione Aerea), a sign that the European governments' involvement in aeronautics and meteorology was meant to remain a legacy of the Great War. A return to the free associations and meetings of civilian meteorologists that characterized the period before the war was impossible.[497]

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[495] Comando della 3 Armata - Stato Maggiore, no. 800, January 8, 1918. The method was supported by the member of the royal family and Ten. Gen. Emanuele Filiberto di Savoia.

[496] England resumed agricultural forecasts in April 1919 and information to the public began on November 15, 1918. Walker, *History of the Meteorological Office*, 224.

[497] A meteorological committee within this institution was created at its meeting in Rome in 1923, but it clashed with the resurrection of the International Meteorological Organization.

Meteorologists faced huge challenges in the vain effort of restoring the international community that existed before the war and some international projects, such as the International Commission for the Study of Clouds and the Central Meteoric Bureau, were permanent casualties of the conflict.[498] Napier Shaw tried to resume international cooperation by resurrecting the International Meteorological Organization (IMO) that had stopped functioning in 1914, when he was President of the International Meteorological Committee (IMC).[499] Shaw also held a Conference of Meteorologists of the British Dominions in London from September 23 to 27, 1919.[500] Palazzo travelled to London for that meeting, but the Directors from England, France, and Italy decided to invite only allied and neutral countries to the following Extraordinary Conference of Directors of Meteorological Institutions in Paris (September 30-October 6, 1919).[501] German and Austrian scientists were not invited.

Palazzo's trips in 1919 reveal precisely the impossibility of a return to pre-war normality. He traveled to England, France, and Belgium to meet the representatives of Canada, Holland, Switzerland, France, Denmark, Portugal, Sweden, and the United States on July 3, 1919.[502] After his arrival in London, Palazzo wrote back to his Office: "I had a good trip, but very uncomfortable because the great number of travellers between Paris, Boulogne, Folkestone and London forced [authorities] to increase twofold the number of trains. There must have been more than one thousand people on the boat to England, many of them British soldiers returning to their fatherland. Most of them travelled standing on the boat against each other, so that they almost could not move. There were also a lot of annoying stops for the control of passports. I have never seen so much formality and control [*fiscalismo*]."[503] After London, Palazzo travelled to Brussels for the meeting of the Inter-allied Conference of Scientific Organization on the behalf of the Accademia dei Lincei.[504] As historian Elisabeth Crawford wrote, the interwar period saw the rise of "international science" without internationalism, as a set of international institutions such as the International Research Council were set up in 1919 based on the exclusion of the Central Powers.[505]

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[498] Elisabeth Crawford, "The Universe of International Science 1880-1939," in *Solomon's House Revisited: The Organization and Institutionalization of Science*, ed. Tore Frängsmyr, 251–69. Nobel Symposium (75th: 1989: Stockholm, Sweden) (Canton: Science History Publications/USA, 1990), 261.

[499] Walker, *History of the Meteorological Office*, 230. Shaw wrote to the previous members of the Committee that were still alive on June 3, 1919, inviting them to an informal meeting in London to consider the Meteorological Codex. The meeting took place in South Kensington from July 3 to July 9, 1919. It was attended by the Directors of France, Holland, Italy, Denmark, Norway, Sweden, and India with the Superintendent of the Admiralty's Meteorological Service and the U.S. Weather Bureau. Ernest Gold was the secretary of the meeting.

[500] The attendees were New Zealand, Australia, Egypt, South Africa, Canada, Ceylon, and India and C.E.P. Brooks, in charge of the meteorological stations in the Empire.

[501] The last Conference of Director took place in Innsbruck in 1905, but the meeting that should have taken place in 1915 was cancelled because of the war.

[502] C.R.A.-C.M.A., Fondo Palazzo, "Palazzo Personale" Letter Ministero dell'Agricoltura to Palazzo, June 25, 1919.

[503] C.R.A.-C.M.A., Fondo Palazzo, "Palazzo Personale", July 4, Palazzo noted how the research about clouds produced by Luigi Taffara during the war was well accepted in London. See L. Taffara, *Le Nubi*, Ufficio Centrale di Meteorologia e Geodinamica, 1917.

[504] C.R.A.-C.M.A., Fondo Palazzo, "Palazzo Personale", Letter to Antonio Roiti (Presidente della Classe di Scienze Fisiche della R. Accademia dei Lincei), June 29, 1919.

[505] Crawford, "The Universe of International Science 1880-1939," 261.

Fig. 3.16: The Directors of the Italian and French meteorological offices Luigi Palazzo (left) and Alfred Angot (right) at their first post-war meeting in England in 1919. Angot was forced to retire shortly after with the creation of the Office National Météorologique directed by General Émile Delcambre. Meteorologists from the Central Powers were not invited to join the meeting and resume international cooperation.[506]

Nationalized scientific communities started partitioning the spoils of the war vanquished. In 1919, the French government occupied the University of Strasbourg and created the Institut de Physique du Globe (still functioning today). Edmond Rothé (1873-1942) became director of the institution where before the war the German Director Hugo Hergesell had directed the international research of the Upper Atmosphere.[507] The French pushed for the transformation of Strasbourg into a new international hub, since they now had control of German instruments in addition to those produced by the French from the war.

Italians proved as odious with the Austrians as the French were with the Germans. The 1919 meeting of the Italian Society for the Advancement of Science in Pisa decided that the following meeting would take place in the newly conquered city of Trieste, "city of our aims" as the program read, from October 3 to 9, 1920. The point was to "show the admirable progress that Italy achieved even amid the martyrdom of war and to display the ardor of how Italy is getting ready to face the urgent challenges that are tormenting the nation. In the great port of the

[506] Courtesy of the Archive of the Department of Terrestrial Magnetism at the Carnegie Institution for Science, Washington D.C.
[507] He also became the Director also of the Bureau Central Sismologique (Central Seismological Bureau) for France and its colonies in 1921.

Adriatic, forever returned to the fatherland, Italian science must shed new light so that Italy can take back its winning role in world civilization."[508] The meeting was organized in collaboration by the Italian Geographical Society, the Comitato Talassografico Italiano, and the Italian Society for the Advancement of Science.[509] In that meeting, Italians decided to dismantle the observatory of the Austrian Navy in Pola and appointed Francesco Vercelli as director of the Geophysical Institute of Trieste as a reward for his contribution to the war effort in the army.[510] In such a hateful atmosphere, there could not be any consensus among European meteorologists about the adoption of any method of weather forecasting.

Meteorologists had huge stakes in the reorganization of the international scientific cooperation in meteorology, as they could finally resume international communication and publish papers about their own methods of weather forecasting. The reception of "Polar Front Theory" shows precisely the importance of local environments and the breakdown of the internationalist scientific community of meteorologists that had existed before the war.

The only way Bjerknes' method of weather forecasting and his Norwegian school of meteorology could be extended beyond Norway was to convert both British and German meteorologists, traditionally the two countries with which Norway had most of its cultural and scientific relations. Bjerknes started a hectic proselytizing campaign in a divided post-war Europe to build consensus for his theory. In fall 1918, he started recruiting new personnel in Sweden and Norway, in particular Tor Bergeron and Gustav Rossby. He travelled in the summer 1919 to the geophysical observatory in Leipzig where he had worked before the war, but did not manage to convince his previous assistant and now successor, Wenger, about his method. Like Palazzo, in fall 1919 he travelled to London and Paris, where he attended from September 30 to October 6 the first meeting of the International Meteorological Committee after the war. In the absence of German meteorologists, Bjerknes managed to be appointed director of the Commission for the Exploration of the Upper Atmosphere. "I am the new Hergesell!" he exulted when he replaced the German meteorologist that had dominated the field of aerology before 1914.[511]

German scientists wanted to start again international cooperation, but not in the terms imposed by their enemies. On July 5, 1921 German meteorologists had, in fact, created a parallel form of collaboration in Central Europe "until international collaboration will be restored."[512]

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[508] Congresso della Società Italiana per il Progresso delle Scienze, Undecima Riunione, Trieste, October 3-9, 1920.
[509] Palazzo took part at the meeting with Filippo Eredia, Pericle Gamba, Giuseppe Gianfranceschi, Ludovico Marini, and Francesco Vercelli. They presented respectively on: "La Meteorologia e la navigazione aerea attraverso l'Atlantico"; "Prelevamento di aria a grandi altitudini a mezzo di palloni sonda e risultato delle analisi dei campioni ottenuti-Sulla struttura dell'atmosfera terrestre"; "La distribuzione statistica della grandezze nella fisica corpuscolare"; "L'organizzazione dei servizi e delle ricerche meteorologiche in Italia"; "I recenti progressi della dinamica atmosferica"; Palazzo presented about "La geofisica nell'insegnamento superiore."
[510] R. Comitato Talassografico Italiano. "La Sistemazione Degli Istituti Talassografici Della Venezia Giulia," *Bollettino Bimestrale Del R. Comitato Talassografico Italiano* X, no. 1–2–3 (January-June 1921): 10–13.
[511] Friedman, *Appropriating the Weather*, 180-81.
[512] Members of this working group were Ångström (Sweden), Bjerknes (Norway), Capelle (Deutsche Seewarte, Hambourg), E. van Everdingen (Holland), Exner (Austria), Hellmann (Berlin), Hergesell (Lindenberg), Linke (Frankfurt), Schmauss (Munich), Wilhelm Schmidt (Austria). See *Ergebnisse der Aerologischen Tagung vom 3. Bis*

Hergesell protested that German and Austrian meteorologists were not even invited to the meeting in Paris in 1919 and they had been excluded from general international relations.

As director of the Commission for the Exploration of the Upper Atmosphere, Bjerknes organized the following meeting of the Commission in the summer of 1921 at Bergen, but the pre-WWI European scientific community was still divided between the allies and the Central Powers. Bjerknes was forced to organize two meetings: one in English at the end of July with representatives from Britain, France, Iceland, Norway, Sweden, and the United States; the other one in German in early August, with scientists from Germany, Austria, and Finland.[513]

Bjerknes tried to take a reconciliatory approach: "On one hand, international cooperation is a necessity. On the other, personal cooperation among subjects from countries until recently in war presents some challenges, or even some risks."[514] Bjerknes argued that in this climate of suspicion, neutral countries had to step forward in order to work as intermediaries between the two previously belligerent blocs, and claimed that this was the reason why he replaced Hergesell in 1919. Therefore, countries like Norway wanted to be part of the International Commission founded in Paris in 1919, but also collaborate with German scientists. "I repeat, the goal is simply to complete geographically our work, not to stir rivalries."[515] However, the reception of "Polar Front Theory" became a victim of post-World War I tensions.

Historians have not yet produced a complete account of the reception of "Polar Front Theory" in Europe, with the exception of Norway, the United States, and to a certain extent Austria. Three historians in particular have contributed to the debate concerning the reasons why the Norwegian School met a great deal of resistance: Jim Fleming, Deborah Coen, and Robert Marc Friedman.

Friedman's wonderful biography of Bjerknes points to several reasons that made the ideas and practices of the Bergen school controversial. He showed that the Norwegian School was selling the theory of cyclones as an "incomplete product" whose details were still to be worked out. Additionally, "the change amounted … to a total shift in how cyclones were conceived" because it was necessary to educate European meteorologists to see cyclones in three dimensions, rather than on bidimensional synoptic maps.[516] The more opposition they faced, the more dogmatic the School became, removing to the backstage of private correspondence disagreements about the features of the polar front.[517] Moreover, the forecasting practices of the Norwegian school left a great deal of space to the individual creativity and intuition of the forecaster whose practical skills could be learned only at Bergen—or through direct teaching by a member of the school. In other words, the Norwegian school enacted an aggressive hegemonic program to spread its forecasting techniques and "Polar Front Theory."

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6 Juli 1921 im Preussichen Aeronautischen Observatorium Lindenberg (Leipzig and München: Keim und Nemnich Verlag, 1922), 36-7.

[513] Friedman, *Appropriating the Weather*, 196. The British delegation consisted of Shaw, Goldie, Douglas, Richardson, and the Air Ministry's Controller of Communications (L. F. Blandy). See Walker, *History of the Meteorological Office*, 228.

[514] Friedman, *Appropriating the Weather*, 12.

[515] *Ibid.*, 13.

[516] *Ibid.*, 197-99.

[517] *Ibid.*

Deborah Coen describes the contrast between the Norwegian Bjerknes and the leaders of the Austrian school Felix Exner and Heinrich von Ficker as the clash between different cultural visions of meteorology, namely the rift between probabilistic and deterministic weather predictions. Should meteorology limit itself to issuing probable or certain forecasts? From the Austrian perspective, the Norwegians did not provide enough credit to Exner's contribution to the theory of discontinuous air masses and offered a naïf model that simplified reality, because it did not take into account instabilities and turbulences of cyclones: "To the Austrians, the Norwegian version of the polar front was neither original nor wholly credible."[518] Coen highlights how Austrian meteorologists found the dogmatism and determinism of Bjerknes' marketing campaign repulsive, thus contrasting Austrian focus on contingency against the Norwegian hegemonic bid. Moreover, the theory was imbued with concepts and terms (such as "fronts" and "masses") clearly borrowed from the description of the war that destroyed their empire. In the following years, Austrian meteorology started "scaling down" and focusing on the analysis of micro-climates as their empire had dissolved.

James Fleming has recently provided a synthesis of the historiographical debate focusing in particular on the animosity between the Austrian and the Norwegian schools.[519] Fleming's analysis is the first to flesh out explicitly the importance of post-war geopolitical conflicts in the organization of the marketing of "Polar Front Theory" in the scientific community. He focuses on the internalist differences between the Norwegian and German theory of cyclones and concludes that "it was an argument about the 'seat' of atmospheric activity, with the Scandinavians moving upwards and the Germans, who had initially been dazzled by the discovery of the stratosphere, starting to move downward."[520] Thus, Fleming argues that disagreement among meteorologists was due to their way of envisioning movement across space.

A broader European survey of the reception of the theory reveals a spectrum of disagreements and conciliatory attempts, as consensus among European meteorologists had eroded with their international community and the previous geopolitical order of the age of empire.

Belgium played the role of mediator between the Norwegian Polar Front theory of the Bergen school and Southern Europe with the translation of Bjerknes' theories into French in the pages of the Belgian journal *Ciel et Terre*, directed by the military officer Eugene Lagrange (1855-1936).[521] The journal had wide circulation, because it collected scientific contributions in all European languages, including English, French, German, Italian, and Spanish. Belgium was in fact the first country to implement Bjerknes' theories.[522] French meteorologists accepted

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[518] Deborah R. Coen, *Vienna in the Age of Uncertainty: Science, Liberalism, and Private Life* (Chicago: University of Chicago Press, 2007), 282-92.
[519] Fleming, *Inventing Atmospheric Science*, 46-50.
[520] Ivi, p. 49.
[521] *Ciel et Terre* was founded in 1880 as journal of the Belgian Royal Observatory and became the journal of the Royal Belgian Society of Astronomy in 1910.
[522] See J. Jaumotte, "Eugène Lagrange (1855-1936)", *Ciel et Terre*, v. 53, pp. 33-45. For the translation of Bjerknes work in French, see J. Bjerknes, "Sur la structure des cyclones en mouvement" *Ciel et Terre*, v. 36, (1920), pp. 237-243; continuation in xxxvii année, *Bulletin de la Société Belge d'Astronomie*, 21 année (1921), p. 22. *Ciel et Terre* announced the article already in 1921 from the English version "On the structure of moving Cyclones" Kristiania, 1920, Bröggers Boktrykkeri. The preface by J. Jaumotte and E. Lagrange makes clear that Bjerknes' method "opens

partially Bjerknes' theories but tried to reconcile them with their "systems of clouds" which they never actually gave up completely until World War II.[523]

Italy offers a microcosm of European disparate positions concerning "Polar Front Theory," as Italian scientists were divided among themselves in the three competing institutions of the Central Meteorological Office, the Comitato Talassografico, and the Aerological Service. In summer 1920, Vilheilm Bjerknes sent his son Jacob to the first post-war international Congress of Geography in Venice, where a meteorological congress was held as well. Among the meteorologists present at the meeting there were the Austrian Felix Exner and the Italians Luigi De Marchi, Pericle Gamba, Giuseppe Crestani, Cesare Fabris, Francesco Vercelli, Luigi Matteuzzi, Filippo Eredia, and Ludovico Marini. Bjerknes presented about the life cycle of cyclones, but Italian scholars were scarcely interested in polar fronts and more in secondary fronts, as the shelter of the Alps effectively prevented them from "seeing" any polar fronts.[524] Venice was also the worst location to proclaim "polar theory," as it was precisely one of the places where the Vercelli methods worked well. The group of meteorologists of the Comitato Talassografico were not well disposed to subscribe to Bjerknes' theory, and Vercelli continued to publish weather forecasts from Trieste with his method for years, despite the fact that his method had failed to gain national consensus.[525]

The personnel of the Central Meteorological Office failed to grasp the revolutionary features of Polar Front Theory, with the exception of the forecaster Filippo Eredia. In 1921, the Director of the Meteorological Office Luigi Palazzo missed the crucial meeting hosted by Bjerknes in Bergen as the post-war financial crisis (which would soon bring Fascism to power) prevented him from undertaking trips abroad. Even if before the war they corresponded in German, Bjerknes invited Palazzo in French to the session with British and French

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the doors to a general vision completely new on long term weather forecasting" p. 237. Belgium had a connecting role between northern and southern Europe - but also between belligerent countries - during World War I. For example, Palazzo contacted Svante Arrhenius, the most important Swedish physicist at the time, to sign a petition of scientists in 1918 to pressure the Belgian government and the German government to let Lagrange leave Belgium for a trip to Switzerland for his health. C.R.A.-C.M.A., Fondo Palazzo, "Svezia" Stockholm, Palazzo to Arrhenius 27 Juillet 1918.

[523] Schereschewsky, and Werhlé. "Éléments d'une synthèse des méthodes de prévision française et norvégienne." *Comptes rendus hebdomadaires des séances de l'Académie des sciences* 176 (1923): 994–97.

[524] "Riassunto delle principali comunicazioni e discussioni svolte al Congresso Meteorologico di Venezia," *La Meteorologia Pratica* (July-December 1920), 169-76.

[525] Vittorio Cantù argues that only two Italian scientists were ready to understand Bjerknes' theory, namely Luigi De Marchi and Cesare Fabris. They both belonged to the nationalist group of the Comitato Talassografico. Still in the 1930s De Marchi commissioned to the meteorologist Lucia Venturelli a critical test of Bjerknes' theory based on Italian upper air data. Vittorio Cantù, "Meteorologia. Climatologia. Cambiamenti Di Clima. Storia Della Meteorologia Nel Sec. XX in Tre Saggi," *Quaderni Di Geofisica* 37 (2004): 22-23. Cesare Fabris, *Teorie moderne su l'origine e su la struttura dei cicloni* (Pisa: R. Scuola di Ingegneria, Pubblicazioni Comitato Nazionale Italiano di Geodesia e Geofisica, 1933). Lucia Venturelli, Contatti di masse d'aria calda e aria fredda nell'atmosfera in relazione alla situazione barica (Venice: C.Ferrari, 1934). Only the fifth edition of De Marchi's manual of meteorology, published after his death in 1944 and edited by Agostino Puppo, included in the appendix Bjerknes' theory of development of the cyclone. Further tests were carried out by Maria Lombardini and Anna Roncali at the Ministry of Aeronautics in the 1930s. See Servizio Meteorologico dell'Aeronautica Militare, *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, vol. 1, (Rome: 1975) 181.

meteorologists on July 25-31, 1921, and asked him to forward the invitation to the Director of the Aerological Service, Matteuzzi. Yet Palazzo's funding was denied for lack of funding by the Ministry of Agriculture. Moreover, the Bergen meeting overlapped with a new magnetic campaign to be organized in the Adriatic.[526] Palazzo apologized to Bjerknes, explaining that scientific missions abroad were made difficult by the depreciation of the Italian currency after the war.[527] The correspondence between Palazzo and Vilhelm Bjerknes is very fragmented both in Rome and in Oslo, but it is significant that the only documents available deal with their missed encounter in 1921.

Surely this was a missed opportunity, but traditional meteorologists such as Emilio Oddone and Luigi Palazzo, who still operated in the previous paradigm of terrestrial magnetism and instrumental accuracy, were not well positioned to fully understand Bjerknes' hydrodynamic model even if they had been there. After the Venice conference, Oddone devoted more attention to Bjerknes' instrumental innovations than to his theory.[528] When Bjerknes asked for some data from the Italian Meteorological Office, their transcription was assigned to a minor employee, the physicist Tommaso Fattorosi-Barnaba, who had worked on "meteorology" from the perspective of terrestrial magnetism and atmospheric electricity, not the dynamic meteorology produced during the war.[529] In the following years, Palazzo never mentioned "Polar Front Theory."

The meteorologist Filippo Eredia was a significant exception, but he preferred a syncretic approach to the problem of weather forecasting. Eredia proclaimed the importance of Bjerknes' theory during a conference on June 16, 1922, at the meeting of the National Association of Italian Engineers and the Italian Society of Aeronautics.[530] He accepted Bjerkens' observations, translated the model of the cyclone developed by Bjerknes into Italian for the first time, and summarized his theories for a broader audience in 1925.[531] In 1927 Eredia requested to send to Bergen younger meteorologists to learn the Norwegian method, but he was not heeded until 1937, when three geophysicists were sent to Germany.[532] In short, he continued to use a variety of methods rather than subscribing to a single one.[533]

A syncretic "whatever works" approach to weather forecasting dominated the practices of the Weather Forecasting Office of the Ministry of Aeronautics that absorbed the Aerological

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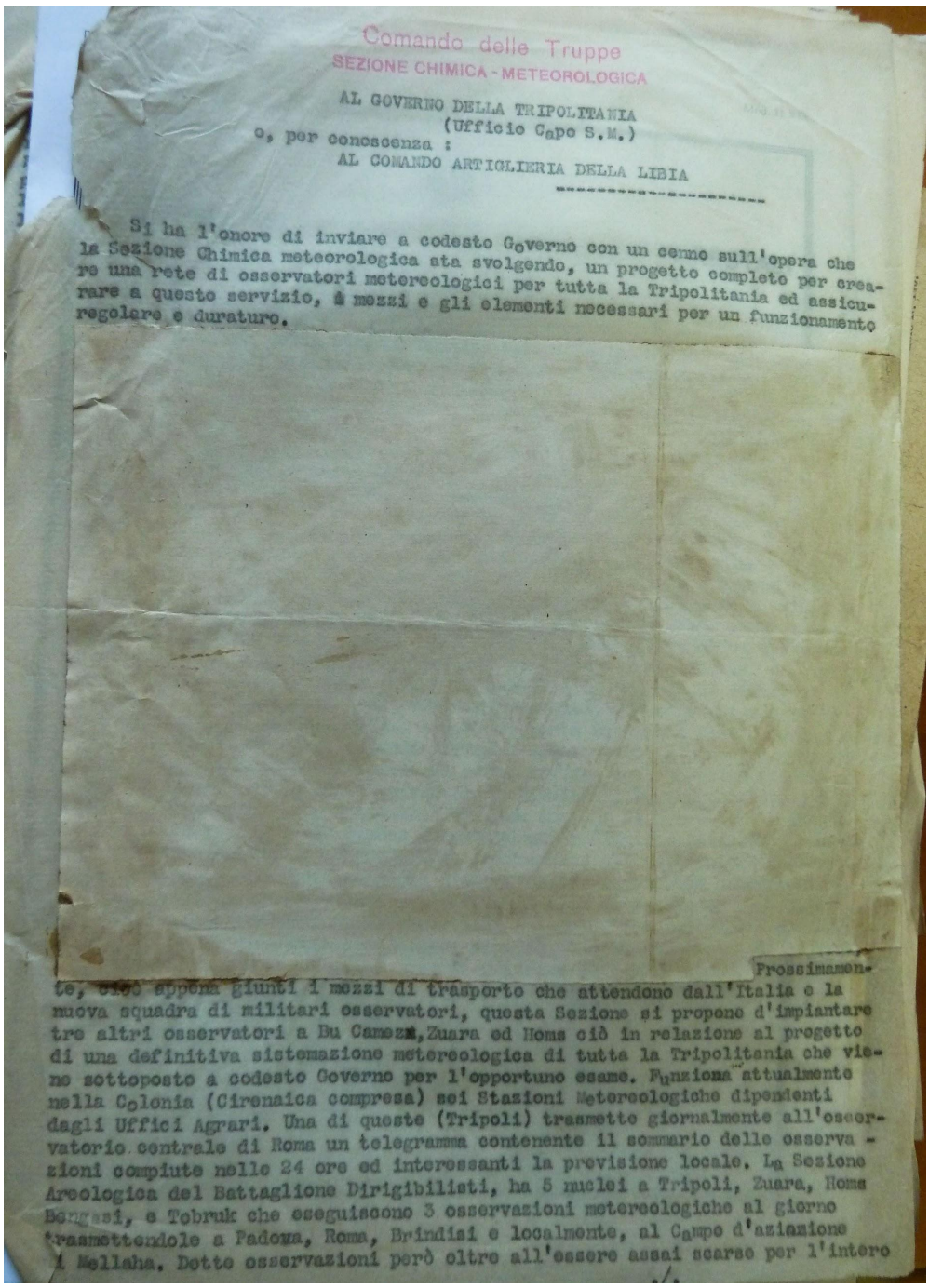
[526] International Commission for the Investigation of the Upper Air, *Report of the Proceedings of the Seventh Meeting held in Bergen, 25th-29th July, 1921* (Bergen: John Grieg, 1921).
[527] Letter from Palazzo to Bjerknes, April 29, 1921, Oslo National Library, V. Bjerknes archive, brevs 469B.
[528] The meteorologist Emilio Oddone, for example, did not focus at all on Bjerknes' theoretical contributions. Instead, he reported about his invention of an instrument called "distance meter" to calculate the distance of clouds at higher altitude. See Emilio Oddone, "Per lo studio della Previsione del Tempo. Distanziometro del Bjerknes," *La Meteorologia Pratica* (July-December 1920), 159.
[529] Tommaso Fattorosi-Barnaba, *I fenomeni elettro-magneto-tellurici* (Catania: Tip. V. Giannotta, 1917). Id., *Osservazioni meteorologiche fatte al r. Osservatorio di Catania nel 1916* (Catania: Tip. C. Galatola, 1919).
[530] Filippo Eredia, "L'organizzazione Meteorologica Internazionale in Relazione Con L'aeronautica," *Atti Della Società Italiana Di Aerotecnica* II, no. 1–2 (1922).
[531] Filippo Eredia, "I Fenomeni Aerologici nella Navigazione Aerea," *Atti Della I Settimana Aerotecnica (Roma 23-29 Novembre 1925)*, 1926.
[532] Cantù, "Meteorologia. Climatologia," 23.
[533] Still in 1929, Eredia published a simplified version of Bjerknes' model of the cyclone alongside the French model of "systems of clouds" and the "Vercelli method." Filippo Eredia, *La Meteorologia* (Rome: Paolo Cremonese Editore, 1929), 221-62.

Service. According to the meteorologist Tito Alippi, the Italian office in the interwar period used a combination of the Vercelli, French, and Norwegian methods, depending on the circumstances: "We do not follow a single method, but everyone tries to catch whatever he can from the development of present isobaric data and their variations... It is impossible to say how much of the forecast comes from each method."[534] As a matter of fact, Italian meteorologists were to adopt Bjerknes' method through the mediation of German meteorologists in the second half of the 1930s, after the war in Ethiopia marked the Italian alignment with Nazi Germany.

3.5 Libya's New Techno-Politics

On a cold and bright December morning in Rome, my hands were shaking for the excitement rather than the temperature. A taped report addressed to the Government of Tripolitania and the Italian Command of Artillery in Libya was partially censored with paper and glue. At the top of the front page, faded red-turned-pink ink revealed the origin of the text from the Chemical-Meteorological Section of the army. The author of the report was Amilcare Fantoli, the founder of the colonial meteorological service in Libya and Italy's most prominent colonial meteorologist. I had previously interviewed his sons Ugo and Annibale.[535] They told me that their father was a member of the special chemical company X during the Great War as a meteorologist. At the end of the conflict, he was sent to Libya as Italians considered using chemical weapons during the reconquest of the colony. At first, I doubted his account. I could not believe that historians had overlooked such a project of colonial chemical warfare as early as 1919, considering the importance of the long debate about the Italian colonialism and the use of poison gas in Africa.[536]

[534] Servizio Meteorologico dell'Aeronautica Militare, *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, vol. 1, (Rome: 1973-1975), 180. See also Tito Alippi, *La previsione del tempo* (Bologna: Zanichelli, 1930).
[535] Oral interviews with Ugo Fantoli, July 2012; and Annibale Fantoli, April 4, 2013.
[536] Simone Belladonna, *Gas in Etiopia: i crimini rimossi dell'Italia coloniale* (Vicenza: Neri Pozza, 2015).



Comando delle Truppe
SEZIONE CHIMICA - METEOROLOGICA

AL GOVERNO DELLA TRIPOLITANIA
(Ufficio Capo S.M.)
e, per conoscenza :
AL COMANDO ARTIGLIERIA DELLA LIBIA

Si ha l'onore di inviare a codesto Governo con un cenno sull'opera che la Sezione Chimica meteorologica sta svolgendo, un progetto completo per creare una rete di osservatori metereologici per tutta la Tripolitania ed assicurare a questo servizio, i mezzi e gli elementi necessari per un funzionamento regolare e duraturo.

Prossimamente, cioè appena giunti i mezzi di trasporto che attendono dall'Italia e la nuova squadra di militari osservatori, questa Sezione si propone d'impiantare tre altri osservatori a Bu Camezz, Zuara ed Homs ciò in relazione al progetto di una definitiva sistemazione metereologica di tutta la Tripolitania che viene sottoposto a codesto Governo per l'opportuno esame. Funziona attualmente nella Colonia (Cirenaica compresa) sei Stazioni Metereologiche dipendenti dagli Uffici Agrari. Una di queste (Tripoli) trasmette giornalmente all'osservatorio centrale di Roma un telegramma contenente il sommario delle osserva - zioni compiute nelle 24 ore ed interessanti la previsione locale. La Sezione Aereologica del Battaglione Dirigibilisti, ha 5 nuclei a Tripoli, Zuara, Homs Bengasi, e Tobruk che eseguiscono 3 osservazioni metereologiche al giorno trasmettendole a Padova, Roma, Brindisi e localmente, al Campo d'aviazione di Mellaha. Dette osservazioni però oltre all'essere assai scarse per l'intero

Fig. 3.17: Censored report describing the project of the second meteorological network in Libya in 1919 integrating the needs of agriculture, artillery, and aviation in order to study the possible use of chemical weapons against Arab rebels.[537]

[537] Archive of the Central Meteorological Office, "Libya."

Historians' attentions had focused on East Africa and the most infamous episode of Italian colonialism, when Mussolini authorized the deployment and use of poison gas, in violation of international law, during the 1935 aggression of Ethiopia. The Italian State denied these events for decades until historian Angelo Del Boca published Mussolini's telegrams ordering the deployment of poison gas in combat in order to settle a controversy with the famous journalist of the prestigious *Corriere della Sera* Indro Montanelli (who had been in Ethiopia in his youth) and demolish the stereotype called "Italiani brava gente"—the myth that Italians were better, more humane colonizers than the British, French or Germans.[538] The document in my hands could probably confirm Annibale Fantoli's story about the origin of his father's mission to Libya.

I tried to peel the layer of paper and glue from the text, but it was staunchly stuck together despite the fact that almost a century had passed by. I feared that too much tension might break the paper and that I would never learn the secret hidden under the glue. Then I had an idea: I moved closer to the window, pushed the document against the glass, and started reading. The light revealed in transparency the text under the glue, still legible albeit not perfectly:

> To the government of Tripolitania
> To the Command of artillery of Libya
>
> The mission of the chemical-meteorological mission has mainly the task of studying data that could be useful to possibly execute launches of special projectiles [chemical weapons] on coastal or internal areas. In preparation, … [not readable] it has studied everything that has been collected so far in local observatories despite the lack of some data… To improve such early notions, the Section must create a network of its own observatories, which with different methods, more rigorous criteria and especially more daily and nocturnal observations could provide more reliable information… A checkpoint has been also placed at… [name of an area, poorly readable] so that the artillery could take advantage of it to correct its shots. The same thing gave good results when it was executed on the Austrian-Italian front. From what I just wrote, in case of launches of special projectiles we have generic meteorological information, which can be improved and completed when the observatories will produce entire series of especially anemometric and anemoscopic observations. Definitely, in case of launch of special projectiles a lot should depend on the

[538] Angelo Del Boca, *I Gas di Mussolini: il Fascismo e la Guerra d'Etiopia* (Rome: Editori Riuniti, 1996).

> circumstances and it should be currently subject of an immediate decision more than rigorous planning.[539]

Finally, I had found the link between liberal and fascist techno-politics behind a covered-up sheet producing one more layer of ignorance about Italy's colonial past. Had it not been for the fortuitous finding of this report, military archives do not seem to have traces of this plan connecting chemical warfare with the birth of the Italian meteorological service in Libya. Confirming the oral account by Fantoli's son, the hidden paragraph revealed that the Italian liberal State considered using chemical weapons against colonial insurgents in Libya in 1919, years before fascism took over power.

Fig. 3.18: Undoing colonial and post-colonial ignorance. My fingers (on the left) while I try to read the report in the censored section by placing it against a source of light at the window. No other copies of this document were found in military archives.

By referring to the experience of the Austrian-Italian front in World War I, the report proved what my oral history sources mentioned, but must have been later removed from military archives (there was no trace of any other copy) and censored even in this report to the Central Meteorological Office. The blueprints for the use of poison gas in Africa, authorized by Mussolini in Ethiopia in 1935, were not an entirely new idea. Their origin could be traced back to the very metamorphosis of Italian liberal imperialism into a new, more violent techno-political regime. The Great War had eroded the scientific paradigm of liberal meteorology abroad. The failure of Italian liberal techno-politics in the colonies foreshadowed the rise a new regime back in Italy. The roots of Italian fascism came from the poisonous combination of the legacy of the

[539] C.R.A.-C.M.A., Fondo Palazzo, "Libia," Relazione Fantoli, April 2 1919.

Great War, the failures and transformations of the liberal techno-political regime, and the challenges of African colonization.

As we have seen in the third section of this chapter, at first Italian meteorologists operated in Libya according to the same nineteenth-century scientific paradigm of meteorology as an agricultural science that we have seen operating in the Horn of Africa in chapters 1 and 2. Military conquest in 1911 set the stage for the first encounter between meteorology, aviation and warfare. The Great War tightened that connection and eroded the spirit and intention of liberal meteorology by opening new scenarios of violence that were unthinkable before. The reconquest of Libya completed the transformation of Italian liberal techno-politics into a fascist techno-political regime whose genocidal practices found the first application in the destruction of the *Senussi* Order and the Libyan resistance between 1919 and 1931.

During the Great War, Libya was a secondary front from the Italian perspective. Supported by the Ottoman Empire and German submarines, the Libyan resistance took back control of most of the country, so that the Italian military remained trapped in a few coastal cities. Italy's Mediterranean colony was almost entirely lost, and its meteorological network created in 1913 by Eredia for agricultural purposes. While dealing with wartime meteorology in Italy, colonial agriculture was Luigi Palazzo's last thought. The agronomist Emanuele De Cillis asked him for new thermometers for the agricultural experimental institute of Sidi el-Mesri in vain. On January 13th, 1916, Palazzo wrote to De Cillis that he could not provide any instruments, because "neither this Office nor our suppliers have thermometers anymore, of any kind. Those instruments were provided by Germany and now, due to the war, we can no longer find them. For a while now, we ourselves cannot satisfy the requests of thermometers that we receive every day from our correspondents. We are negotiating to get supplies, but we have not been able to get anything so far."[540] The war with Germany interrupted collaboration with the most scientifically advanced country in the field, a link that had been vital for the Central Meteorological Office, as we have seen. Palazzo satisfied De Cillis' requests only five months later "after many difficulties due to the war."[541] While military meteorology was becoming more and more important, agricultural climatology was completely neglected, especially in the colonies.

Under siege in a few fortified camps along the coast of North Africa, Italians tried to make the best of the poor aircraft available to them in the hope that technology could make up for the lack of soldiers. Aviation in Libya took during the Great War increasing autonomy and began acting more independently from the army. Airplanes were used less for reconnaissance missions and more as offensive tools, for example when in April 1917, 1270 kg of incendiary bombs were dropped on barley fields to starve the local population.[542] However, the performance of colonial aviation was very limited, and it took the end of the Great War in Europe to change the balance of forces.

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[540] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter from Palazzo to De Cillis.
[541] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter from Palazzo to De Cillis, May 8, 1916.
[542] Andrea Curami and Gianluca Balestra, "L'aeronautica italiana nelle campagne coloniali libiche," in *Le Guerre Coloniali Del Fascismo*, ed. Ḥabīb Wadā'ah Ḥasnāwī and Angelo Del Boca (Rome: Laterza, 1991), 197-213, 200.

As the conflict in Europe ended, resources and aircraft deployed against the Austrians could now be turned against Italy's colonial enemies. On December 4, 1918, the entire organization of aeronautics was restructured and a great deal of attention was reserved for the colonies, with new airplanes sent to Libya.[543] By the end of March 1919, soldiers from Italy and Eritrea landed in Tripoli with 200 cannons, 1000 machine guns, 40 aircrafts, aerostats, electric and chemical sections to put the war with Libyans to an end.[544] However, there was disagreement about the use of this machinery of destruction. Military officials craved revenge on Libyans who could not be defended by the now-extinct Ottoman Empire. Governor Garioni instead intended to use the army as deterrent, negotiate with local elites and experiment with a form of indirect rule, due to the dramatic changes in the international situation. Liberal and military policies were still in balance.

At the Paris Peace Conference (1919), Italian politicians were anachronistically and unsuccessfully trying to receive more colonies against the principles proposed by the President of the United States, Woodrow Wilson. In the atmosphere of the "Wilsonian moment," local Libyan leaders had declared at the end of 1918 the "Tripolitanian Republic" and asked international powers to recognize them as an independent state after the collapse of the Ottoman Empire.[545] Not only did Italy not get any new colony, it even had to be careful about losing forever the land conquered in North Africa in 1911.

The outrage over the mistreatment of Italian colonial interests spread also among scientists, including Italian meteorologists who continued to see colonial expansion as a crucial element of their international standing, in continuity with the internationalist and imperialist paradigm of liberal meteorology described in section 1. Both Luigi Palazzo and Filippo Eredia presented their views about colonial meteorology at the National Colonial Conference for Postwar Colonies, a venue for supporters of Italian colonialism in Africa irritated by the "mutilated victory," namely the frustration of Italy's colonial ambitions at the Peace Conference in Paris and the failure of the liberal government to get its interests respected by its former allies.

Eredia proclaimed that the study of the weather was connected with the advancement of Western civilization: "Countries of advanced civilization accumulate meteorological data and specific institutions collect and analyze them. Unfortunately, there are still several regions of the world whose meteorological phenomena we do not know… Averages of meteorological elements… provide the fundamental elements for the knowledge of the climate, which is one of the crucial aspects of the colonization... Knowing those elements means to beckon clever colonists and shrewd industrialists; it entails directing to the colonies people with productive tasks that can be planned on the model of what has been already observed."[546] Eredia concluded that since Roman times the climate in North Africa had not changed. Archeological findings of

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[543] Del Boca, *Gli Italiani in Libia*, v. 1, 360.
[544] *Ibid*.
[545] Erez Manela, *The Wilsonian Moment. Self-Determination and the International Origins of Anti-Colonial Nationalism* (Oxford: Oxford University Press, 2007).
[546] Filippo Eredia, "Compiti e fini del servizio meteorologico coloniale" in *Relazioni dei Professori Filippo Eredia e Luigi Palazzo al Convegno Nazionale Coloniale per il Dopoguerra delle Colonie, 15-18 Gennaio 1919*, ed. Filippo Eredia and Luigi Palazzo (Rome: Tipografia dell'Unione Editrice, 1919).

cisterns showed that a better use of water was possible through the constant work of storing rainfall, like the Romans did. Of course, Italians identified as the new Romans in North Africa.[547]

Similarly, Palazzo proposed a new colonial meteorological network with two main observatories in Libya (Tripoli and Benghazi) and two in East Africa (Asmara and Mogadishu), using personnel chosen through public contests of graduates in physics, mathematics, natural or agrarian sciences.[548] Palazzo's project—drafted in continuity with his previous work in Africa in a liberal techno-political regime—remained on paper, whereas events on the ground wiped out the design and expectations of the old Director of the Central Meteorological Office.

The main architect of the new colonial meteorological network was Amilcare Fantoli, at the time a twenty-eight-year old lieutenant. According to his sons Ugo and Annibale, he studied physics at the University of Genoa and later at Heidelberg. He had also been vice-director of the meteorological observatory of San Remo, when he joined the army in World War I. He fought in the chemical-meteorological special companies formed during the war and he remained injured with a chronic irritation in his eyes due to the gas for the rest of his life.[549]

On April 2, 1919, Fantoli sent to the Central Office the "project of the future meteorological establishment of Libya already approved by the government" with the censored report quoted above, and a map of Libya in attachment.[550] In a significant inversion of roles, the ex vice-director of a provincial observatory was able to dictate the future of meteorology in Libya to the old director. Palazzo noted in pencil for his secretary: "If the correspondence with this chemical-~~climato~~ meteorological section in Tripoli will continue, put it in a folder on its own".[551] Even if it was presumably due to a moment of personal distraction, Palazzo's striking out the word "climatological" points to the post-war division between nineteenth-century liberal meteorology meant as climatology for agriculture, and twentieth-century meteorology for military weather forecasting.

Fantoli envisioned a meteorological network that "regardless of its military purposes, could help two other services, namely aviation and agriculture."[552] Fantoli complained that previous observations had been carried out by scarce personnel and with different purposes, so that "currently, they are more materials of curiosity than a practical tool. In order to create a complete and perfectly functioning organism, it is recommended to merge everything that deals with meteorology in the colony. Such an organism should take into account different needs of all the institutions involved (Artillery, Aviation, Agriculture), but at the same time it should turn all observations into a unique scheme; it should increase their number; it should complete them; it

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[547] This is a theme recurring in both Italian and French colonialism in Libya and Algeria respectively. See Diana K. Davis, *Resurrecting the Granary of Rome: Environmental History and French Colonial Expansion in North Africa* (Athens: Ohio University Press, 2007); Mia Fuller, *Moderns Abroad: Architecture, Cities and Italian Imperialism* (London and New York: Routledge, 2007).

[548] Luigi Palazzo, "Proposte per il pratico ordinamento del servizio meteorologico nelle colonie," in *Relazioni dei Professori Filippo Eredia e Luigi Palazzo al Convegno Nazionale Coloniale per il Dopoguerra delle Colonie*.

[549] Oral interviews with Ugo Fantoli, July 2012; and Annibale Fantoli, April 4, 2013.

[550] C.R.A.-C.M.A., Fondo Palazzo, "Libia," Letter from Fantoli to Palazzo, April 2, 1919. Fantoli had previously announced from Tripoli in February 1919 that "as soon as our advance will allow that, we will establish new meteorological stations."

[551] *Ibid.*, Letter from Fantoli to Palazzo, April 7, 1919.

[552] *Ibid*.

should transmit them quickly and spread them appropriately."[553] Fantoli was proposing an integrated meteorology, a combination of the old and new goals of meteorology. Libya became the laboratory of the transformation of Italian colonial meteorology from a liberal to a fascist techno-political regime.

In short, Fantoli suggested the application of the efficiency of World War I to the organization of the colony. He proposed the unification of a meteorological network that had been growing haphazardly and was later disrupted by the war. Rather than climatic information being sent to Rome every ten days (the method used by the agronomist De Cillis from Sidi el-Mesri), he built a quick and efficient system of communication based on the rigor and discipline that only the army could provide: "If these points will be implemented, we would realize the unity of the service with improved strength; the unity of method with undeniable advantages… and the diffusion of information so that it will not remain purely in the sterile scientific domain."[554] A new era of efficiency and rationalization had been ushered in by the war. The modernity that fascism attempted to impose on Italy in 1922 began in Libya three years in advance. Building on his previous forms of collaboration with colonial officers, Palazzo did not realize the qualitative change of the proposal drafted by Fantoli and welcomed its "quick implementation."[555]

Between April and May 23, 1919, Fantoli travelled to Italy to choose meteorological instruments for the colony through arrangements with the Central Meteorological Office and explain to the Supreme Command the real character of the final organization [of the meteorological network]." While claiming to conform to Palazzo's project proposed at the National Colonial Conference for Postwar Colonies, which described the service as a civilian enterprise that could occasionally rely on the military, Fantoli interpreted the role of the army very differently: "In the presentation to that conference a meteorological system, however established, it was decided to count on military elements as the only ones that for some time will be able to penetrate in the interior [of the country] and the only ones that could effectively direct, police, and control the stations rising in far regions."[556] The program was quickly approved by the government of Tripolitania, the Ministry of the Colonies and the Ministry of War as early as May 26, 1919, only three days later.[557] After only a month, Fantoli had already established the first coastal belt of stations in Tripolitania for "scientific-practical needs."[558]

The demobilization of the army at the end of World War I in Italy strengthened rather than weakened the military/agricultural meteorological program in Libya. In July 1919, the High Command established that all meteorological instruments used during the war and the meteorological stations on the Alpine frontline depended on the Central Meteorological Office.[559] The Central Meteorological Office caught immediately the opportunity to divert to Libya all

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[553] *Ibid*.
[554] Ibid.
[555] *Ibid.*, Letter from Palazzo to Fantoli, April 7, 1919.
[556] *Ibid.*, Report from Fantoli, May 23 1919.
[557] *Ibid.*, Letter from Fantoli to Palazzo, May 26 1919.
[558] *Ibid.*, Report from Fantoli to Palazzo, June 22, 1919.
[559] U.S.S.M.E., C. 42/3, "Studi Particolari," f. 3, "Il Servizio Meteorologico nella Guerra 1915/1918. Report from Trento, 28 July 1919 (Comando della Prima Armata, Stato Maggiore).

meteorological instruments decommissioned by the army at the end of the Great War in Europe. Only two days later, the Ministry of the Colonies authorized the transfer between artillery laboratories and the Office.[560]

As the return of the chemical-meteorological section from Libya to Italy was approaching, Fantoli asked Palazzo to intervene to maintain his position in Tripoli. Diligently, Palazzo interceded with the Ministry of the Colonies and the Government of Tripolitania in order to secure Fantoli's stable employment. Thus, even if the Meteorological Service of Tripolitania became a civilian office on October 3, 1919 under the Agricultural Office, Fantoli remained the Director of the meteorological network, which never returned under the agronomists' control in the inland location like Sidi el-Mesri.[561] The main meteorological observatory was in the city of Tripoli, in the castle dominating the city as residence of the governor, a location that was crucial for communications by radio and telegraph with Italy.

Palazzo thought that the service would be eventually turned again to "agrarian purposes" at the end of the war. However, even if Fantoli worked in theory for Tripoli's agricultural office, he became increasingly independent and his familiarity with the army allowed him to extend the meteorological network in Libya beyond Palazzo's expectations. By December, Fantoli created the stations of El Hassa (at the border with Tunisia) and Zauia and promised to continue with Tarhuna, Casr Garian and Nalut, whereas it was not possible to set Misurata and Sirte due to Libyans' opposition.[562] The entire network followed the expansion of Italian colonization and the data were sent to Tripoli, not Sidi el-Mesri. Fantoli strongly opposed moving the center of the network from Tripoli back to Sidi-el Mesri.[563] A return to the previous techno-political regime of pure agricultural meteorology was impossible.

The expansion of the meteorological service in Cyrenaica shows that Fantoli as man on the spot was able to gain increasing autonomy from Palazzo's authority and the Central Meteorological Office. At the end of 1919, Fantoli informed Palazzo that he was designing a meteorological network for Cyrenaica "for reasons of scientific opportunity and economic advantage [...]. Considering the character of the territory, which is suitable for intense agricultural exploitation, the importance of meteorological observations is beyond any doubt".[564]

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[560] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter from Ministero delle Colonie to Ufficio Centrale di Meteorologia, July 30 1919.

[561] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter on October 3, 1919. R. Ufficio Agrario della Tripolitania a: Segretariato Generale Comando delle Truppe Ufficio Capo S.M. Comando Artiglieria Tripolitania; Comando Piazza e Presidio Comando d'Aeronautica; Comando Genio Militare; Ufficio Centrale di Meteorologia e Geodinamica Roma; Ufficio Agrario Bengasi; Ufficio Agrario Asmara; Ufficio Agrario Mogadiscio; Consolato Francese Tripoli; Campo Aviazione Mellaha', 286 Squad. Idrovolanti Comando Base Navale; RR. Poste e Telegrafi Tripoli. Previously, in a letter dated May 23, 1919 to De Cillis, director of Sidi-el Mesri, Palazzo announced the creation of the chemical-meteorological station in Libya "with the goal of providing troops on the ground with all the necessary information about the atmosphere". Palazzo told De Cillis that he had planned with Fantoli the extension of the meteorological service "as soon as it will be possible to go further inland."

[562] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter from Fantoli to Palazzo, December 2, 1919.

[563] In June 1921 Fantoli asked Palazzo to prevent the transfer of the meteorological observatory from Tripoli to Sidi-el Mesri. Fantoli argued that this decision would make "the transmission of daily telegrams to the Central Office and the quick reception of isobaric conditions in Europe impossible." *Ibid.*, letter from Fantoli to Palazzo, June 8, 1921.

[564] Letter from Fantoli to Palazzo, December 30, 1919.

Fantoli asked Palazzo to intervene at the Ministry of the Colonies to begin the meteorological conquest of Cyrenaica in the same way the Italian army had started the conquest of the region from the Senussia Order. At the same time, Fantoli informed the Italian Agronomic Institute in Florence of his missions in the region for the study of the fertile "Green Mountain."[565]

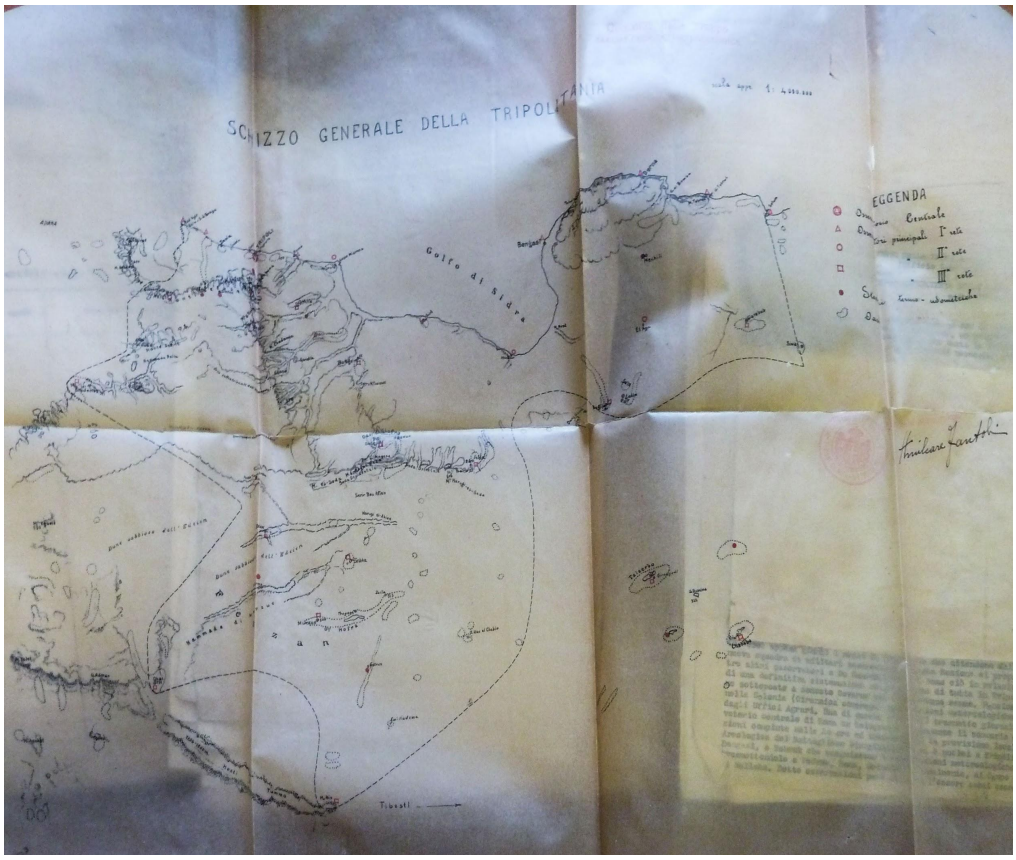

Fig. 3.19: Draft map of Libya and the project of a meteorological service in 1919.
Fantoli's signature in on the right side.[566]

Palazzo followed the standard bureaucratic procedure and proposed to submit the project to the Ministry of the Colonies first.[567] However, Fantoli acted faster and more efficiently than the central administration. He directly contacted the director of the Agrarian Office in Benghazi, Armando Maugini (who later became the most powerful planner of Italian colonization in Africa). The Central Meteorological Office was only asked to provide some instruments and was

[565] Two reports are at the archive of the Istituto Agronomico per l'Oltremare, f. 2412: "Relazione della missione meteorologica Fantoli, compiuta in Cirenaica nel settembre-ottobre 1921" and "Relazione della missione meteorologica compiuta nel settembre-novembre 1923 in Cirenaica."
[566] From the Archive of the Central Meteorological Office, "Libia."
[567] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter from Palazzo to Fantoli, January 19, 1920.

presented with the *fait accompli*.[568] Fantoli went to Cyrenaica before the rainy season to establish the first meteorological stations.[569] The contrast between center and periphery became a fight about who would plan the meteorological conquest of Cyrenaica: Tripoli or Rome? Fantoli or Palazzo?

The control of meteorological data from Cyrenaica strengthened Fantoli's position. In theory, Cyrenaica and Tripolitania were still two distinct colonies under separate administrations, as they had been under Ottoman rule, until 1934. Thus, Tripoli and Benghazi should have sent data directly to Rome if the meteorological service was to follow administrative boundaries designed in Rome. Fantoli, as director of the Meteorological Service in Tripoli, should have had a peer in Benghazi equally corresponding with Palazzo. However, Fantoli's activity anticipated Palazzo's slow approach and "unified" Libya as a meteorological unit, despite the deep environmental differences between the two regions.

Palazzo still followed the nineteenth-century paradigm of liberal meteorology that privileged accuracy over the rapidity of communication of data and expansion of stations spurred by Fantoli's hectic work. Arguing that Fantoli had placed a barometer in the wrong location in Cyrene, Palazzo reproached him: "As you well know, the Section of Colonial Climatology of this Office has controlled the observations in each colony for several years… Such arrangements correspond to the instructions of superior authorities and it matters very much to me that programs that have been already agreed upon do not change. Now, from what I read in your report, stations in Cyrenaica should send data to the Agricultural Office in Benghazi, which should send them again to Tripoli… This means that our section of colonial climatology would not deal with whatever concerns Cyrenaica. I cannot accept your instructions, written without previous agreement with me. Thus, I beg you to send to this office the observations gathered in Cyrenaica after using them, as it is the procedure for Tripolitania, Eritrea and Somalia."[570]

Frictions between Rome and Tripoli—and between different techno-political regimes—took several forms. Palazzo placed the meteorological observations in Libya under closer scrutiny and contested multiple times rainfall data arriving from Libya between the end of 1920 and the beginning of 1921. He also started paying Fantoli late, as the colonial meteorologist protested multiple times, without receiving any answer.[571] However, by the end of the year Fantoli was actually collecting data from Cyrenaica and demanded a remuneration for such work.[572] Palazzo had had enough of such protests: "You insist to have from this Office a special wage for the observations in Cyrenaica. Because such wages are given directly to civilian observers, it is unacceptable that you have them as you live in Tripoli… Since you voluntarily assumed the jurisdiction of observations in Cyrenaica, that is not a good reason why extra wages should be assigned to you… Thus, I have always felt embarrassed to reply to all your previous letter on this subject."[573] Palazzo agreed to send some money for Fantoli's work in Tripoli, "but

[568] *Ibid.*, letter from Fantoli to Palazzo, July 1, 1920.
[569] *Ibid.*, letter from Fantoli to Palazzo, October 30, 1920.
[570] *Ibid.*, Letter from Palazzo to Fantoli, November 6, 1920. Facing such a strong reaction Fantoli claimed at the beginning that the report had been misunderstood. Letter from Fantoli to Palazzo, November 21, 1920
[571] *Ibid.*, Letter from Fantoli to Palazzo, February 24, 1921.
[572] *Ibid.*, Letter from Fantoli on September 15, 1921 and July 13, 1922.
[573] *Ibid.*, Letter from Palazzo to Fantoli, July 13, 1922.

different stipends for two different titles, no!"[574] Despite Palazzo's protests, Fantoli centralized in Tripoli the meteorological service of Libya under the Ministry of the Colonies and gained full independence from the Central Meteorological Office.

There were two main reasons why the Meteorological Service of Libya worked so efficiently. First, the expansion of the network followed the reconquest of Libya by the Italian army between 1921 and 1931. Most of the times, military officers were directly instructed to collect weather data. Fantoli published a booklet of practical instructions for the use of troops on the ground concerning instruments and the collection of data. It built on the previous instructions by Eredia, as well as manuals that were used for aeronautical meteorology, in order to satisfy requests of different types of data.[575]

While protesting that *he* should be paid for his work rather than local observers (as it was the norm in the metropole), Fantoli told Palazzo that they could not be assigned regular stipends as meteorologists, because they changed often as they belonged to the army. There were not civilian observers. Fantoli travelled often across Tripolitania and Cyrenaica to teach new soldiers and military officers how to make observations.[576] "Everything that has been accomplished in Libya (Tripolitania and Cyrenaica) in the last four years is thanks to me" he wrote.[577] The data from Cyrenaica were published in the *Meteorological Bulletin of Cyrenaica* from Tripoli until 1931, when Fantoli unified the collection of data in the *Meteorological Bulletin of Italian Colonies*. Announcing the editorial change, Fantoli wrote: "The constant increase of the size of the Bulletin, the growing number of stations and their date mirror the course of the events that led to the conquest of the remotest localities of Libya in less than fifteen years."[578]

These activities were fully supported by the entrepreneurial Governor Giuseppe Volpi who carried out most of the reconquest of Tripolitania in a seamless transition from the liberal to the fascist period. He even wrote personally to Palazzo to insist that Tripoli's temperatures had to be published in Italian newspapers, because "this can become a great climatic station, with many benefits for Tripolitania."[579] As the army pushed farther inland, more data arrived to Tripoli and Rome, allowing Fantoli and Eredia to publish several local studies about the climate of new regions occupied by the Italian army. One can follow the trail of Italian expansion by looking at the emergence of new colonial data.[580] These measurements gained international fame on

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[574] *Ibid.*

[575] Amilcare Fantoli, *Cenni Di Meteorologia e Norme per l'uso degli Strumenti* (Tripoli: R. Ufficio Agrario della Tripolitania, Sezione Meteorologica, 1919).

[576] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter from Fantoli to Palazzo, August 9, 1922.

[577] *Ibid.*, letter from Fantoli to Palazzo, March 13, 1923.

[578] Amilcare Fantoli, "Avvertenza," in *Bollettino Meteorologico della Cirenaica. Riassunto delle Osservazioni 1931*, Governo della Cirenaica. R. Ufficio Meteorologico (Tripoli: Stabilimento Poligrafico Editoriale Plinio Maggi, 1934).

[579] C.R.A.-C.M.A., Fondo Palazzo, "Libia," letter from Volpi to Palazzo, September 8, 1921.

[580] Filippo Eredia, "Il Clima Di Zuara," *Bollettino Di Informazioni Ministero Delle Colonie* VI (1919); Id., "Alcuni Nuovi Aspetti Del Clima in Tripolitania," *Rivista Della Tripolitania* (1925); Id., "Climatologia Ed Idrografia Della Tripolitania," in *Rinascita Della Tripolitania* (Milan: Mondadori, 1926). Id. "Contributo Al Clima Di Orfella," *Bollettino d'Informazioni* X (1922); Id., "Il Clima Di Azizia," *Bollettino Informazioni Ministero Delle Colonie* XI (1923); Id., "Il Clima Di Gariàn." *Bollettino d'Informazioni* IX (1921); Id., "Il Clima Di Jèfren." *Agricoltura Coloniale*, Istituto Agricolo Coloniale XIII (1919); Id., "Il Clima Di Misurata." *Bollettino d'Informazioni* X (1922);

September 13, 1922, when the Italian army recorded the purported hottest world record temperature in El Azizia, south of Tripoli.[581] The hybrid nature of the network serving military as well as agricultural and aeronautical purposes created an extremely successful infrastructure for the collection of data.

The second reason for the success of the Meteorological Service of Libya was that Italians were actually planning on living in Libya and turning the country into a settlement colony, especially in Cyrenaica where the fertility of the region was particularly promising. Italian colonial meteorology was functional to the military conquest of the region by use of airplanes and the agricultural "reclamation" of Libya. Reliable observations were possible because a new settled and agricultural society was soon to replace the indigenous nomadic and pastoral population. Libya was about to become Italy's "Fourth Shore" in the Mediterranean.[582]

As Angelo Del Boca explained, the rise of fascism only accelerated the rhythm of colonial repression. The struggling liberal regime turned violent in Libya before fascism. Mussolini visited Tripoli in 1926 and promised that Libya would become one of the priorities of the new regime. More importantly, the discovery of new underground sources of water in 1926 revolutionized Italy's approach to the land in Tripolitania as Italians started drilling the soil for water on an unprecedented scale.[583] In 1926 Armando Maugini, the Director of the Colonial Agronomic Institute and future architect of all major agricultural schemes in the empire, praised Fantoli because "we owe him the fact that today Libya has a network of weather stations that is a honor to our country."[584] Meteorology had finally become the infrastructure of knowledge of Italian colonialism in North Africa.[585]

The path of colonial repression, scientific research, and discovery of new water resources set by Volpi was celebrated as "the rebirth of Tripolitania" in 1926 and continued under the following governors De Bono, Badoglio and Balbo.[586] Between 1928 and 1930 Italian projects for the agricultural colonization of the country skyrocketed, a new set of laws paved the way for

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"Il Clima Di Tarhuna," *Bollettino Informazioni Ministero Delle Colonie* IX (1923); Id., "Il Clima Di Zàuia," *Bollettino d'Informazioni* VIII (1920); Id., "La Pressione Barometrica a Tripoli," *Bollettino Della Società Geografica Italiana* (1919). Id., "La Temperatura dell'aria e le Precipitazioni Acque dell'oasi di Zanzur," *Bollettino Della Società Geografica Italiana* (1919); Id., "Sulla Precipitazione Annua Normale a Tripoli," *Agricoltura Coloniale* XV (1921); Id., "Il Clima Di Kussabàt," *Bollettino d'Informazioni* IX (1921).

[581] Khalid I. El Fadli *et al.*, "World Meteorological Organization Assessment of the Purported World Record 58°C Temperature Extreme at El Azizia, Libya (13 September 1922)," *Bulletin of the American Meteorological Society* 94, no. 2 (September 13, 2012): 199–204.

[582] Claudio G. Segrè, *Fourth Shore: The Italian Colonization of Libya* (Chicago: University of Chicago Press, 1974).

[583] Del Boca, *Gli Italiani in Libia*, v. 1, 128-29.

[584] Armando Maugini, "Il Servizio Meteorologico della Libia," *L'Agricoltura Coloniale* XX, no. 8–9 (1926). The detailed functioning of the meteorological service is described in Amilcare Fantoli, "L'Organizzazione Meteorologica in Libia," *Rassegna Economica Delle Colonie*, no. 3–4 (1929).

[585] See also Amilcare Fantoli, "Di Alcuni Fattori Meteorologici in Libia ed i loro Rapporti con L'agricoltura," *Rassegna Italiana* CXII (September 1927). Fantoli also studied the potential use of wind power to produce electricity, see Amilcare Fantoli, "Le Correnti Atmosferiche in Tripolitania e la loro Utilizzazione," *Bollettino Di Informazioni*, no. 1–2 (1921).

[586] Angelo Piccioli, ed., *La Rinascita Della Tripolitania; Memorie e Studi Sui Quattro Anni Di Governo Del Conte Giuseppe Volpi Di Misurata* (Milan: Mondadori, 1926).

land-grabbing and the expropriation of land in Tripolitania, and the military campaign to deport the indigenous population reached its most extreme and violent points in Cyrenaica.

In Cyrenaica, the resistance against Italian occupation was exterminated by wiping out the nomadic and pastoral way of life based on the natural regimen of rainfalls described in section 3. In order to isolate the population from guerrilla fighters, Italians created concentration camps in the arid region south of Benghazi and violently relocated the nomadic tribes of Cyrenaica, exposing them to inhumane environmental conditions in the desert. In the process, they also annihilated their livestock, namely the main source of their livelihood.

As Cyrenaica was emptied and "pacified", fascism could replace a new techno-political regime in the region and implement projects of demographic colonization for small landowners inspired by Franchetti's myth of Italian colonialism as a demographic empire in the late nineteenth century (see chapter 1). As historian Federico Cresti has revealed, massive state intervention and expensive projects of land reclamation from the desert through the *Ente Colonizzazione della Libia* and the *INFPS* made Libya the crown jewel of the Italian empire and fascist propaganda at once.[587]

The new techno-political regime was based on the belief that Italian scientific expertise and work could slowly transform the environment of Libya with projects of sand dunes control, reforestation, and irrigation. As they perused the geographical literature of antiquity and carried out archeological diggings uncovering Greek and Roman towns, cisterns, and aqueducts, Italians became convinced that the climate of North Africa had not changed in historical time. What made the difference was the transformative role of Roman and Greek civilization that Italians were simply picking up again.[588] The roots, institutions and ideology for this expensive work had started in the liberal period, but fascism continued this effort on a new scale and embraced the voice of the scientific personnel that had witnessed the failures and limits of the liberal techno-political regime.

The Italian scientific community discovered that Libya was not just the "big sand box" that they had seen through the lenses of the cheaper liberal techno-political regime, since now they were supported by state funding and they felt that they constituted an essential part of the regime's expansionist program, unlike their feeling of marginality in the underfunded liberal state. A number of scientific missions took place in the interwar period to study the geology, biology, anthropology, and geography in Libya. Del Boca called the Fezzan "an authentic laboratory" where the Italian Geographical Society alone sent seven expeditions between 1932 and 1936. Fantoli directed a number of climatological and meteorological studies culminating in the publication of the Meteorological Atlas of Libya in 1930 where he divided five climate zones

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[587] Federico Cresti, *Oasi Di Italianità: La Libia Della Colonizzazione Agraria Tra Fascismo, Guerra E Indipendenza (1935-1956)* (Turin: Società editrice internazionale, 1996). Id., *Non Desiderare La Terra D'altri: La Colonizzazione Italiana in Libia* (Rome: Carocci, 2011).

[588] Amilcare Fantoli, *La Libia negli scritti degli antichi: brani geografici e naturalistici* (Rome: Sindacato italiano arti grafiche, 1933); Benedetto Bonacelli, *Nei tempi storici variò il clima della Libia?* (Borgo S. Lorenzo: Mazzocchi, Off. Tip. Mugellana, 1922); Benedetto Bonacelli, Paolo Revelli, and Amilcare Fantoli, *L'Africa nella concezione geografica degli antichi* (Verbania: Airoldi, 1942).

based on the Köppen classification (maritime, grasslands, highlands, pre-desert, desert).[589] Until 1941, meteorological data from Libya were collected at the Ministry of the Colonies in the sophisticated distinction in climate zones created by Fantoli.[590]

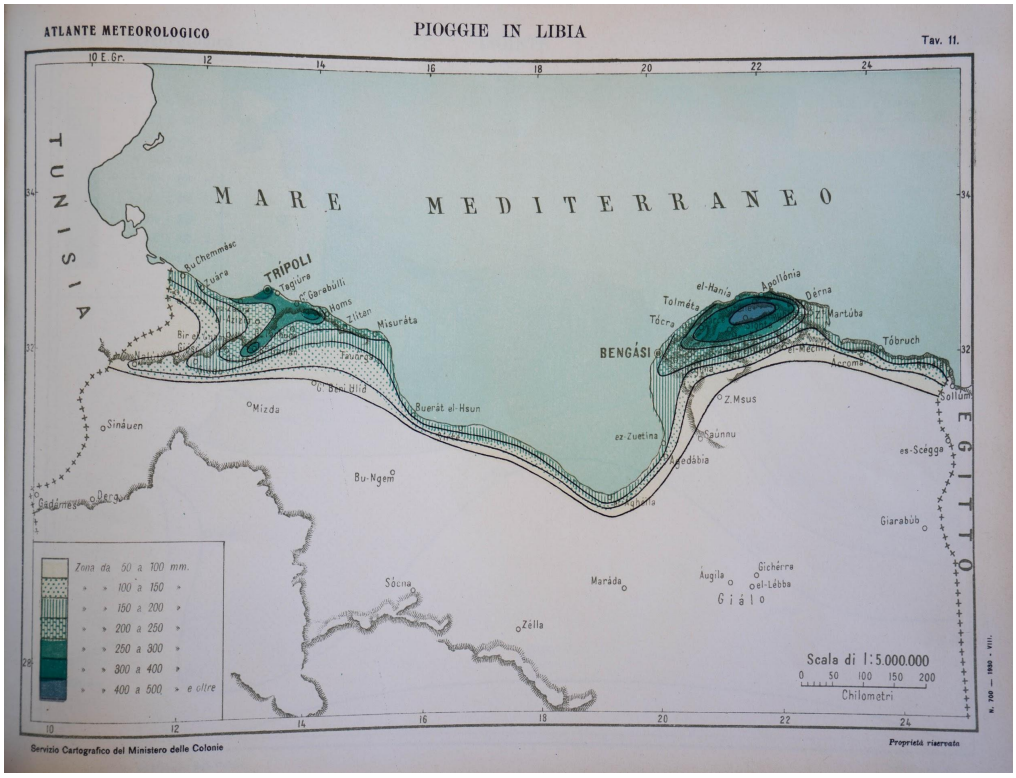

Fig. 3.20: Rainfall in Libya. Most rainfalls are concentrated in the plateau of Cyrenaica, where fertility increases with altitude and Italians planned agricultural settlements by removing semi-nomadic population. In Tripolitania, settlements were limited to the coast and much more vulnerable to climate variations.[591]

The Ministry of the Colonies also published a detailed weather report specifically devoted to agriculture, with further details about the life and production cycle of olive trees, grapes, almond trees, date palms, citruses, bananas, cereals, and other plants. The report noted how climate trends, and especially drought, impacted local production month by month, as well as pastures for animal husbandry. Between 1920 and 1940 the number of new olive trees grew from 68,000 to 2,226,500, along with 1,646,000 almond trees, 36,826,000 grapes, 300,000 citrus plants.[592] On the eve of World War II, Italians had confiscated 900,000 hectares of land and more than 6,000 Italian families lived in Libya.

[589] Amilcare Fantoli and Ministero dell'Africa italiana, Ufficio studi e propaganda, *Atlante meteorologico della Libia* (Rome: Servizio cartografico del Ministero delle colonie, 1930).
[590] ACS. M.A.I., b. 704, f. 2: "Meteorologia 1940-1941" and f. 3. "Notiziario agricolo."
[591] From the Meteorological Atlas of Libya by Amilcare Fantoli, 1931, table 11.
[592] Del Boca, *Gli Italiani in Libia*, v. 1, 266.

This scientific and imperialist fever culminated in 1936 with the meeting of the Italian Society for the Advancement of Science (SIPS) and the opening of a brand new museum of Natural History in Tripoli. A land considered impossible to colonize in the liberal techno-political regime became a new "Italy in Africa" under the new fascist techno-political regime.[593]

Yet the fascist project of colonizing Libya with twenty thousand Italian settlers was a major demographic revolution of the country that was based on very shaky environmental foundations. Its modernist hubris clashed with the actual availability of water in North Africa and the recurring threats of drought and famine. For example, a massive drought in 1936 forced the Governor, Balbo, to organize a monumental state-driven transhumance by moving 300,000 heads of cattle from Tripolitania to Cyrenaica on 50 ships in order to prevent their death by thirst and starvation.[594] In 1939 a new drought threatened again the very existence of Italian settlements.[595] The fascist regime had overestimated its modernist power to transform North Africa and its climate.

Fantoli had been pivotal in ushering in the new modernist techno-political regime of speed and colonial expansion, but his scientific research and beliefs led him to criticize fascism's environmental practices and demographic policies in Libya. In fact, he became one of the most explicit critics of the fascist project of planned migration that disregarded the natural limits to the amount of population that Libya could sustain, especially when it came to water resources. It was unclear how long the drilling of groundwater could possibly last, and rainfalls in Libya remained the most determinant factor in agriculture and animal husbandry.[596] The example of the American Dust Bowl in the 1930s was alarming enough to solicit interwar concerns about the exhaustion of natural resources and the human production of natural disasters.[597] Fantoli warned against the modernist hubris of stressing Libya's fragile environment with a sudden migration that disregarded the limits of nature.

Fantoli studied how nomadic and pastoral practices of the indigenous population were a form of adaptation to the environment, rather than a racial feature of Arabic population.[598] As the migratory projects of the regime intensified, he highlighted the volatility of Libya's environment. Climatic transformations in North Africa in the past were due to the negative impact of human activities, such as deforestation and overgrazing that accentuated the irregularity of the regimen of rainfalls and the hydrology of the region.[599] However, Fantoli pointed out that the irregularity of rainfall—rather than its complete lack—had plagued the region since Roman times and only human carefulness in managing the environment of North Africa could avoid major disasters.

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[593] Del Boca, *Gli Italiani in Libia*, v. 1, 271-78.
[594] *Ibid.*, 243.
[595] *Ibid.*, 267.
[596] Amilcare Fantoli, "La Disponibilità Delle Acque Meteoriche Nel Sottosuolo Della Libia," *Bollettino Informazioni Ministero Delle Colonie* IX (1921); Id., "Le Acque Sotterranee in Tripolitania," *Rassegna Economica Delle Colonie* (1931); Id., *La siccità in Libia* (Florence: Le Monnier, 1935).
[597] Donald Worster, *Dust Bowl: The Southern Plains in the 1930s*, 25th anniversary edition (New York: Oxford University Press, 2004 [1979]).
[598] Amilcare Fàntoli, Ministero delle colonie, and Ufficio studi e propaganda, *L'ambiente fisico delle colonie Libiche nei suoi riflessi demografici e nelle sue influenze sul lavoro indigeno* (Rome: Istituto Poligrafico dello Stato, 1932). Amilcare Fantoli, "Ambiente e Popolazione Indigena della Libia," *Agricoltore Italiano* (1932).
[599] Fantoli, *La siccità in Libia*, 8-9.

The analysis of rainfall data collected by Italians since the nineteenth century revealed that it was not a question of whether droughts would occur, but when.

Meteorology in North Africa had the crucial concern of collecting weather data in order to forecast drought cycles in the long-term, rather than just seasonal rainfalls. Yet as we have seen in section 4 and Fantoli himself pointed out, "perhaps there is not a more unreliable part of contemporary meteorology than long-term forecasts, due to the lack of rigorous bases and good data sets, so that the most disparate hypotheses have been advanced and the most contrasting judgements have been produced. Each and everyone of them might equally seem true."[600] As the war had shattered the paradigm of international meteorology, Fantoli conducted his own studies about different methods to possibly forecasts rainfall oscillations and droughts. Fantoli believed that some periodicity existed because indigenous weather folklore seemed to point in that direction.[601]

Fantoli examined several theories, such as Brückner's theory of the periodicity of rainfall patterns in cycles of 33-35 years due to solar activity, and tried to use multiple methods himself.[602] He complained that the wide range of weather-forecasting methods in post-war Europe (described in section 4) did not offer a universally accepted scientific method to define the laws of the variation of rainfalls. He reported the disappointing results of French meteorologists in Algeria that tried to examine the relationship between weather and solar spots, as well as to combine the French method of "systems of clouds" with the Norwegian method based on the claim that "both methods have pros and cons."[603] As a matter of fact, the possibility of periods of drought and famine was a very real threat in North Africa that had often recurred even in recent history.

Population management was the only way to prevent a catastrophe, since the majority of the people lived on the coast and agricultural projects for the reclamation of the interior from the desert were a slow process.

> As the land is reclaimed, agriculture expands, cultivations become more diverse and specialized, and the unknown factor of the climate tends to have an even greater influence. *Annus fructificat, non tellus*. This issue matters not just for Italians, but also for indigenous people, because the introduction in Libya of new demographic flows leads to the shrinking of available land and the need of the highest possible yield from them becomes more urgent than ever… The faster we transform the land in

[600] *Ibid*., 55.
[601] Amilcare Fantoli, *L'arabo nei suoi proverbi* (Milan, 1923).
[602] Id., "Se Esista Una Relazione Fra Il Ciclo Undicennale Dell'attività Solare e Le Piogge in Libia," *Bollettino Geografico del Governo Della Tripolitania* 4 (1933).
[603] Luc Petitjean, *Le Temps et La Prévision Du Temps en Algérie et au Sahara*, Collection Du Centenaire de l'Algérie. [Sect. II]: Études Scientifiques, t. 8 (Paris: Masson et cie, 1930), 8; Id., "Sur L'application de La Frontologie Aux Dépressions Sahariennes," *Comptes Rendus de l' Academie Des Sciences* (1924); Id., *Application À l'Afrique Du Nord de La Méthode Norvégienne de Prévision Du Temps* (Alger: J. Carbonel, 1927); Flotte (De) Roquevaire, "Recherches Sur La Relation Entre Le Taches Solaires et La Pluie À Algier," (Alger,1928).

> Libya and settle new immigrants from the fatherland (on top of the foreseeable growth of indigenous population), the more serious will be the challenge of periods of drought and the chance of wasting a lot of money.[604]

Fantoli critiqued the colonists' widespread practice of growing grain that needed irrigation and was more vulnerable to climatic fluctuations, rather than investing in dry farming and the cultivation of plants that would pay off in the long term. In modern terms, Fantoli questioned whether the fascist settlement scheme of a vast population of Italian colonists would be environmentally sustainable in the long term.

The transformation of Libya from a pastoral and nomadic society with limited consumption of water to a settlement colony was a revolution of the demography, society, economy, and environment of the colony that made it more unstable and vulnerable to climatic fluctuations.[605] Fantoli's intellectual honesty stands out in a period when fascist propaganda extolled the colonization of North Africa as one of the greatest accomplishments of the regime. Yet it also made him clash with Italo Balbo, the last Governor of Libya. Balbo, who was previously Minister of Aeronautics, envisioned meteorology as a service to aviation, not as a form of environmental critique of his highest accomplishments as fascist governor. He decided to split the meteorological service of aeronautics in the colony from the integrated meteorological network created in 1919 by Fantoli and managed to obtain his removal from Libya in 1934 with his appointment as Director of the Meteorological Service of Italian Colonies in Rome. As we will see in the next chapter, Fantoli was sent on a mission to East Africa, as Italy was preparing for the 1935 invasion of Ethiopia.

3.6 Conclusions

In 1947, Fantoli was sent on a mission to examine the condition of Italian settlements in Libya under British military occupation. In a long report more concerned about racial relations between Italian colonists and Arabs under British rule than about meteorology, Fantoli informed the Italian Colonial Agronomic Institute about the destructions of the war, the increase of desertification vis-à-vis stalled Italian agricultural projects of land reclamation, and the danger of the imminent collapse of Italian villages and settlement schemes.[606] The resilience of the colonists on the land had an essential political value, as the metropolitan government struggled to claim that at least Tripolitania should be returned to Italy despite the defeat in World War II.

In Cyrenaica, where most of the fighting had taken place, the colonists' abandonment of the settlements had caused their destruction. In Tripolitania, instead, the persistence of Italian population and administrators ensured their continuity, but without a state willing to support

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[604] Fantoli, *La siccità in Libia*, 78-80.
[605] *Ibid.*, 82.
[606] I.A.O., f. 2232: Amilcare Fantoli, "Relazione della Missione in Libia del Capo del Servizio Meteorologico (20 Febbraio - 10 Maggio 1947)."

expensive settlement projects their future was in danger. Commenting on the attitude of British administrators, Fantoli described wonderfully their lack of understanding for a colonial project that belonged to a techno-political regime that was so different from the liberal techno-politics of the British Empire. It is a worth quoting the text at length:

> [Settlers] found themselves resisting against nature and the occupants. The latter (I am referring to the [British] occupants) were at first unaware of the value and meaning of what they saw; then they were uncertain about what to do; finally, they realized that they had to deal with [the settlements] somehow. We cannot say that they were happy to do that. Even those better disposed [toward us], those that know how to evaluate the amount of effort and sacrifice of the work of regenerating the land in Tripolitania, cannot grasp its spirit. Even if they praise the authors and results of the job, they oppose its idea and condemn its economic criteria.
> It is a matter of mentality. Most of them cannot understand why a demographic colonization was possible, useful, and necessary. Even a few experts with the best intentions point out with irony that everything is possible, if you want to, but it is a matter of being lavish [with funding]; and that such a great job has a lot of choreography [propaganda], and especially, it would be difficult to conceive of it without a supportive state on its back.
> There is certainly an aspect of truth in these criticism, but they do not take into account the conceptions setting the work. These economists failed completely to understand, for example, that it was necessary to make the life of the colonists easier… in order to attach them to an environment that could have given them many challenges.[607]

As Fantoli pointed out, British experts such as Evans-Pritchard did not understand that the Italian colonization of Libya was the result of a completely different techno-political regime. The way British and Italian experts understood Libya's environment and weather data mirrored the opposite mechanisms of their techno-political regimes. For Evans-Pritchard, the instability of rainfall patterns made Libya the ideal environment for the bedouin. For Fantoli, the challenge of colonial environments required more state management, more scientific control over agricultural production, more coordination of a vast meteorological network. Italian colonialism in Libya made no sense through the lens of the political economy of a liberal techno-political regime like the British Military Administration.

[607] *Ibid.*, 20.

Yet we have seen that British and Italian meteorologists in the early twentieth century worked and operated in the same scientific paradigm of liberal international meteorology. Why did Italian and British colonial and scientific experts move so far apart that they could no longer understand each other's efforts?

In this chapter, I have shown that the Great War destroyed the scientific paradigm of international meteorology. For centuries, the spaces offered by extra-European expansion had smoothed the contradiction between national competition and internationalist division of labor. As Italians faced challenging colonial environments, the seeds of the transformation from liberal to fascist techno-politics could be found already in the war for the occupation of Libya in 1911. Libya was the laboratory of the militarization of meteorology, with the first use of airplanes in combat and the transformation of liberal meteorology from an interest of Italian civil society into an infrastructural science of the colonial government.

The field of meteorology changed dramatically before and after the World War I. What makes Italy exceptional was the fact that the country was constantly at war before and after the Great War, as the conquest and reconquest of Libya began in 1911 and finished only in 1931. The rise of the nationalist group of scientists of the Comitato Talassografico, the weakening of the Central Meteorological Office with the creation of an independent colonial meteorological service originally designed for the use of chemical weapons against Arab rebels, and the creation of an infrastructure of knowledge intended to overcome the environmental challenges of the desert point to the same answer: Libya paved the way for the collapse of the paradigm of a liberal techno-political regime in World War I and planted the seeds of a fascist techno-political regime even before Mussolini took power in 1922.

As we will see in the next chapter, Fascism operated in continuity with the techno-politics of the liberal state in East Africa until 1935, where the transition from one regime to the other was radical and sudden. In Libya, the liberal state had already turned violent and changed techno-political gears in 1919. The plan to use poison gas in Tripolitania—even if not illegal yet in terms of international law—makes precisely the point of the continuity between Italian experiences of the Great War, the beginning of the reconquest of Libya under the liberal state, and the final use of poison gas in Ethiopia in 1935.

Libya was the laboratory of the transformation of Italian techno-politics, the only region where we can find continuity between the liberal colonialism of the early twentieth century and the fascist imperialism that turned to far more violent and devastating practices with the fascist deportation of the people of Cyrenaica, the invasion of Ethiopia in 1935, and finally the fascist assault to the world order in World War II. Italian scientific experts found in Mussolini a good interpreter of their frustrations with the previous order and with the environmental challenges of the "big sand box." In short, what made the difference between Italian and British experts was their faith in liberal techno-politics, the challenge of extremely arid environments like Libya, Somalia and Eritrea, and their availability of new colonial spaces. These three elements will turn out to be pivotal again for understanding the dramatic rise of fascist techno-politics in the 1935 conquest of Ethiopia in the next chapter.

CHAPTER 4

From Liberal to Fascist Techno-Politics: Ethiopia and the Militarization of Italian Meteorology (1919-1940)

4.1 Introduction: From Liberal to Fascist Techno-Politics

How did a fascist techno-political regime emerge from its liberal predecessor in the Horn of Africa? A vast literature in the history of science, focusing in particular on Nazi Germany and the Soviet Union, has highlighted the impact of the rise of totalitarian dictatorships on science in the twentieth century.[608] Yet most histories of science and fascism assume the rise of dictatorship as an external political factor, pressuring and biasing the world of science from outside.[609]

More recently, Tiago Saraiva has focused on the ontology of fascism, namely the manipulation of nature and the production of biopolitical objects as essential to constitute fascism.[610] Even if this approach brings us closer to understanding how fascist politics and science constituted one another, Saraiva still presents fascist scientific projects as driven by external, ideological principles, born with the regime itself. As he focuses on transfers of wheat, potatoes, pigs, coffee, and sheep, the very environments and spaces that fascist techno-politics tried to subdue with these objects disappear from the view. Moreover, the main question remains without answer: if fascism advanced a project of modernity so alternative to liberalism, how did fascist techno-politics emerge from previous liberal techno-politics?[611]

In this chapter, I argue that Italians' switch from a liberal to a fascist techno-political regime in the Horn of Africa was due to environmental as much as political reasons. By examining Italian colonial practices in the Horn of Africa between 1919 to the conquest of Ethiopia in 1935 from the perspective of scientific experts (agronomists, hydraulic engineers, geographers and meteorologists), I show that a new fascist techno-political regime emerged in East Africa from the environmental challenges of dominating the hydrography of the region as much as from the political competition with the British Empire for the hegemony over Ethiopia, Africa's last independent state. In particular, I argue that the transformation from a liberal to a fully fascist techno-political regime was due to Italy's inability to harness the hydrography of its

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[608] For a synthesis, see David Holloway and Riccardo James Vargiu, "Totalitarianism and Science: The Nazi and the Soviet Experience," in *Totalitarian Societies and Democratic Transition*, eds. Tommaso Piffer and Vladislav Zubok (Budapest: Central European University Press, 2017), 231–50.

[609] Roberto Maiocchi, *Scienza e fascismo* (Roma: Carocci, 2004).

[610] Tiago Saraiva, *Fascist Pigs: Technoscientific Organisms and the History of Fascism* (Cambridge, MA: MIT Press, 2016).

[611] The literature on fascism as alternative modernity has been one of the strongest revisionist trends of the last decades, as historians rejected previous notions of fascism as reactionary and conservative movement. See Emilio Gentile, *The Struggle for Modernity: Nationalism, Futurism, and Fascism* (Westport: Praeger, 2003); Roger Griffin, Roger and Matthew Feldman, eds., *A Fascist Century* (New York: Palgrave Macmillan, 2008); Ruth Ben-Ghiat, *Fascist Modernities: Italy, 1922-1945* (Berkeley: UC Press, 2001); Jeffrey Herf, *Reactionary Modernism: Technology, Culture, and Politics in Weimar and the Third Reich* (Cambridge, UK: Cambridge University Press, 1984).

formal empire by following the rules of liberal and capitalist colonialism and to compete with the liberal hydro-politics of the British Empire for the economic penetration in Ethiopia through the Blue Nile basin.

I argue that the completion of Italy's fascist techno-political regime occurred with the 1935 war in Ethiopia, after the exhaustion of liberal techno-political strategies to develop the environments of Italian Eritrea and Somalia. As Italians looked beyond the limits of their formal empire toward Ethiopia, they could not compete with the liberal hydro-political strategy of the British Empire for their penetration in Ethiopia. In short, Italians' environmental struggles with the hydrography of the Horn of Africa and their perception of inferiority against British and Ethiopian competitors drove them to change the rules of the game and switch from liberal to fascist techno-politics.

In particular, I believe that a techno-political and environmental approach allows us to understand an unresolved question in the historiography: why did Mussolini decide to attack Ethiopia on October 3 1935? The military accident of Walwal, a clash at the border between Ethiopia and Somalia for the control of a group of wells in the desert, is unanimously recognized to be a pretext chosen by Mussolini to unleash the invasion. Yet surprisingly, political and military historians have not provided a convincing answer for the timing of the war: why did Mussolini decide to prepare the attack for the fall 1935, rather than before or later?

Political and military historians have provided two opposite explanations. On the one hand, historians have highlighted that imperialism was part of Mussolini's agenda since the birth of the fascist movement. Since the fascist party adopted the agenda of the nationalist movement in 1921, the revision of the Versailles Treaty and Italian colonial expansion were two of the most important points of fascist ideology and agenda.[612] Historian Angelo Del Boca stressed the "perfect continuity between the liberal-democratic and the fascist state" in the Horn of Africa and argued that Mussolini pulled the trigger, but the war was part of fascism's imperialist project since its birth in 1922.[613] Having inherited from the liberal state the pressure to vindicate the battle of Adwa (see chapter 1) and two poor colonies, Eritrea and Somalia, whose possession was only functional to Italy's siege around the fertile Ethiopian highlands, Del Boca dismissed as "idle" the debate "to find out the exact year, month, day when Mussolini decided to attack

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[612] The nationalist movement coined the expression "mutilated victory" when Italians were denied any new colonial possession in the partition of the German colonial empire from their former allies in World War I. Fascism inherited from the liberal state this awkward diplomatic conundrum of requiring a revision of the Versailles Treaty, a request very popular domestically, while *de facto* being forced to go along with the new geopolitical order dominated by England, France and the United States, while Germany and the Soviet Union were out of the picture. Angelo Del Boca writes that "from the very beginning the regime tried to make the colonies interesting to Italians and give them imperial awareness." Del Boca, *Gli italiani in Africa Orientale* (Milano: Mondadori, 1992), vol. 2, 18-19. The pressure to find an outlet for Italian emigration continued to be another popular theme of Italian nationalist circles in the immediate post-war period. It gained even more momentum after the change in immigration policies forced by the banning of Italian emigrants from the United States in 1924. See Mario Foscarini, *Emigrazione italiana e colonialismo italiano: il valore delle colonie italiane di dominio diretto, considerate come sbocchi per l'emigrazione italiana* (doctoral thesis, University of Basel, 1929); Nallo Mazzocchi Alemanni, *Della nostra emigrazione in rapporto alla valorizzazione agraria delle colonie di diretto dominio: comunicazione fatta alla R. Accademia dei Georgofili nell'adunanza del 5 marzo 1922* (Firenze: Tipografia di M. Ricci, 1922).

[613] Del Boca, *Gli italiani in Africa Orientale*, vol. 2, 127.

Ethiopia [...]. Whether it was in 1925… 1930… 1932… or 1934, such fact is scarcely interesting. Rather than a date, we need to verify the relentless offensive desires of the regime, the slow but constant preparation to the war, and the inevitability of the conflict."[614] While useful for understanding the continuities in personnel, ideology and bureaucratic structures between liberal and fascist colonialism, Del Boca obviously offered an overly deterministic explanation for the outbreak of the war in 1935.[615]

On the other hand, political and military historians casting the invasion of Ethiopia in the broader international context of the erosion of Versailles Order have explained Mussolini's decision to attack Ethiopia in 1935 as a choice that considered as fundamental requirement for an African conflict peace in Europe for a few years.[616] Historians Giorgio Rochat and Nicola Labanca support this interpretation based on the analysis of correspondence between Mussolini and his generals, as well as the broader diplomatic implications of the war.[617] The fascist aggression against Ethiopia exposed the powerlessness of the League of Nations to maintain peace and preserve the Versailles Order. In particular, the use of poison gas mocked liberal international law. As a result of the war, Mussolini strengthened his ties with Nazi Germany and abandoned Italy's traditional alliance with Britain. Based on later international developments, this interpretation argues that Mussolini's plans to invade in 1935 intended to seize the opportunity offered by a few peaceful years, when Germany's rearmament was not yet powerful enough to begin World War II, but at the same time England and France were willing to appease Italy with colonial concessions in Africa in order to gain Mussolini's mitigation of the German dictator.

While this interpretation deserves great credit for placing Italian in a broader context—there is no doubt that Mussolini and his chief of staff considered peace in Europe and French and British neutrality essential to conquer Ethiopia—such an argument implies teleologically that Mussolini "knew" that Hitler would sooner or later trigger World War II. This was clearly impossible, considering that he found himself utterly unprepared to join the war in 1939.

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[614] *Ibid*., 128.

[615] Del Boca demonstrated that, at first, fascism's colonial policies followed closely those of the liberal state in terms of personnel, political goals and economic projects: "The liberal-democratic state left as heredity to fascism in Eastern Africa only two scraps of colonies [Eritrea and Somalia] and a handful of pioneers waiting to be canonized [by the propaganda]. [This was] a meager result seen from the perspective of colonialist interests. Yet a heavy one, because full of sinister meanings, of insults to be revenged, and dangerous instructions [...]. The liberal state handed over to fascism the potential for aggression, a long experience with genocidal practices, the despise for the people of color, ambitious programs already defined in some detail, legions of preachers of expansionism, military and administrative quadres for future colonial enterprises. Despite its despise for the lack of determination of liberal democracy, fascism will have nothing new to invent about the colonies that the liberal state had not already imagined and tested. It will only be more efficient thanks to the mechanism of dictatorship, new (legal and illegal) weapons, new means of communication and propaganda, and the support of the masses for the myth of the place in the sun." Del Boca, *Gli italiani in Africa Orientale*, vol. 1, 880.

[616] See for example, Robert Mallett, *Mussolini in Ethiopia, 1919-1935: The Origins of Fascist Italy's African War* (New York: Cambridge University Press, 2015).

[617] Giorgio Rochat, *Militari e politici nella preparazione della campagna d'Etiopia. Studio e documenti, 1932-1936* (Milano: Angeli, 1971); Nicola Labanca, *La guerra d'Etiopia: 1935-1941* (Bologna: Il Mulino, 2015).

Moreover, this view does not take into account of Mussolini's intervention in the Spanish civil war immediately after the conquest of Ethiopia.

Even local military reasons are not enough to explain why Mussolini went to war in 1935, decided to challenge Versailles' powers, and unleashed a full transformation of Italian imperialism in the region from liberal to fascist techno-politics. Since Ras Tafari became emperor of Ethiopia as Haile Salassiè in 1930, Ethiopia began a process of modernization and centralization, but its military was a very unlikely threat to Italy's colonies. Ethiopia's goal was to remain independent—not to attack Eritrea and Somalia, as fascist propaganda argued. Military and diplomatic interpretations agree that the entire responsibility of the conflict should be attributed to Mussolini, but do not provide any significant explanation for the deeper reasons for such a radical move, with the exception of a generic fascist "will to power."

In this chapter, I intend to offer an alternative explanation for the reasons and timing that pressured Mussolini to attack Ethiopia. By examining the 1935 Italo-Ethiopian war as an infrastructural conflict about the hydropolitical regimen of the Nile and the infrastructures to access Ethiopia, I suggest that Mussolini realized that Italy could not compete against England according to the traditional rules of a liberal techno-political regime in Africa. In order to prevent Ethiopia's independent development, he decided to tear apart the Versailles Order and and trigger the only war that Italian fascism ever won through an invisible technological infrastructure: the use of aviation and a meteorological network for its deployment. This radical move required the reorganization of Italian techno-politics in the region from a liberal to a new, fascist techno-political regime.

In order to highlight the relationship between environment, empire, and science, the chapter is structured in three sections devoted to each of these topics. In section 1, I show that fascist techno-politics emerged from the failure of liberal projects, as Italian scientific experts struggled against nature to make Eritrea and Somalia productive in the 1920s. Three Italian plantation projects designed in the early 1920s (Tessenei in Eritrea, Genale, and Villaggio Duca degli Abruzzi in Somalia) pursued the logic of liberal techno-political regimes, meaning that they were meant for the production of cash crops such as cotton, sugar and bananas, rather than a settlement colony such as Italian colonization efforts in the 1890s (see chapter 1). Yet, despite being planned according to the scientific rules of the time, Tessenei, Genale, and Villaggio Duca degli Abruzzi could not compete with their British and French counterparts. Left at the mercy of unstable market flows and even more irregular flows of water from the Ethiopian highlands, Italian plantations did not improve the budget of Italian colonies. A series of floods coming from Ethiopia and the crash of the international market of cotton frustrated Italian efforts.

Unable to dominate the hydrographic problem of the Horn of Africa (whose rivers came from across the Ethiopian border), Italian developmental projects—similar to contemporary agricultural projects in British Sudan—swallowed a great amount of resources without ever being entirely successful. Historians of empire and development are familiar with the failure of great schemes imposed by colonial empire in Africa and Asia as typical of the colonizers' misunderstanding of African landscapes, societies and ecologies. Yet the British and French colonial empires were vast enough that such losses could be balanced by other forms of revenue or the exploitation of other forms of trade and natural resources. In contrast, Italian imperialism was short of cash and, more importantly, short of vast colonies rich in natural resources. If they

failed on the Shebelle and Juba rivers in Somalia, they could not easily move on to a different project or river. It is in this period that Italian colonial and scientific experts forged the narrative that their efforts were doomed against a miserable nature in miserable countries. Such a narrative dominated the post-war account of Italian efforts in Africa after World War II and is still very much present today.

Of course, such a narrative hides the predatory nature of Italian colonialism and the switch from liberal to fascist techno-politics that I describe in section 2 dealing with the conquest of Ethiopia as infrastructural war. By the early 1930s, Italian scientific experts were all on board with the regime's propaganda machine in believing that the only way to make Italian colonialism in East Africa actually productive was to conquer the Ethiopian Highlands, whose water and land were crucial to actually sustain an empire. Negotiations with the British Empire to gain recognition of Italian interests in Western Ethiopia and the Negus' efforts to secure the country's independence by attracting American and British interests for the construction of a dam at Lake Tana came to a halt in the early 1930s. Thus, Mussolini decided to turn the "problem" of Ethiopia from a diplomatic and economic issue to a matter of force.

Ethiopia was the first historical case fully displaying the fascist techno-political logic of conquest of resources before the actual realization of any economic colonization plan. As Nazi Germany planned the exploitation of land and raw materials in the East regardless of their actual feasibility during World War II, fascist Italy focused on the violent appropriation of Ethiopia to prevent British and American projects without having a clear plan for the development of Ethiopia, or even without knowing whether Italy was capable of actually controlling and exploiting a country almost four times its size.

I am not arguing that environmental disasters of geographical features of the Horn of Africa dictated the invasion of Ethiopia to Mussolini. Other options were open, such as his political efforts to revise the Versailles Treaty. Yet such political efforts turned out to be fruitless, most notably in the case of the British handover to Italy of the Jubaland in Southern Somalia in 1926. The humiliation of being given an arid and miserable piece of land—along with increasing competition with the British Empire for the control of the water of Lake Tana in Ethiopia—alienated Italians from their historic alliance with the British in the Horn and gave them the perception of being betrayed, regardless of how much effective control London actually had on the Blue Nile and Lake Tana project.

Finally, in section 3, I show how the very reasons of the success of fascist techno-politics paved the way for the collapse of Mussolini's empire. Favoring quick and authoritarian technological solutions to an actual understanding of Ethiopia mediated by indigenous culture and negotiated with Ethiopian society, Italians tried to govern an immense empire through a brutal form of direct rule while they were still largely ignorant of the local environment. The rhetoric of an "integral" approach to colonialism was dictated by the lack of trained colonial personnel rather than by an actual vision of the empire, as I will show by focusing on the making of the hydrological and meteorological service. As I will demonstrate, Mussolini did not have a plan for Ethiopia's reconstruction because his attack was to prevent Ethiopia's and Britain's projects for the control of the hydrography of the Horn of Africa.

Despite the meteoric rise and fall of Mussolini's empire, the war in Ethiopia changed dramatically the relationship between science and the state back in Italy. As I will show, the need

of exploiting quickly the empire drove Mussolini's effort to regiment Italian scientists, whether through direct forms of institutional control in the National Research Council, through calls to contribute to Italy's autarchy (economic self-sufficiency), or by impeding the development of a civilian meteorology in favor of a militarized, aeronautical meteorology. As Aitor Anduaga has explained for the case of meteorology in Franco's Spain, the fascist "militarization" of meteorology did not just entail its mobilization in war, but a transformation of scientific paradigm and scientific practices. Investigating the hydro-politics of meteorology and hydrology in the Horn of Africa reveals the techno-political switch of Italian colonialism from a liberal to a fascist techno-political regime that transformed Italy itself.[618]

4.2 Environment: The "Hydrographic Problem of Ethiopia"

Italy's switch from the liberal techno-politics of economic development to a new techno-political regime of military aggression was due to the environmental challenges that Italians faced in developing Eritrea and Somalia, as well as the competition with the British Empire for economic penetration into Ethiopia. These political and environmental tensions converged in what I call the "hydrographic problem of Ethiopia" to connect the hydro-politics of water management in the Horn of Africa with the broader techno-politics of Italian colonialism, and in particular the transformation of the relationship between climate sciences and the state from a liberal to a fascist regime of power and knowledge.

The hydrographic problem of Ethiopia was the challenge of European colonial powers to control the water coming from the Ethiopian Highlands into British Sudan and Italian Eritrea and Somalia. The hydrography of Ethiopia projects its influence as far as Egypt, as the Blue Nile—called Abbai River in Ethiopia—flows from Lake Tana in Western Ethiopia to Khartoum in Sudan. Because of the two rainy seasons in Ethiopia described in chapter 1, the *Belg* and *Kremt* (small and big rains), the Blue Nile is responsible for the flooding of Nile that granted Egyptian fertility for centuries by carrying a huge amount of silt and fertilizing sediments.

Ruinous floods tend to follow the arrival of precipitations in the highlands, a process made worse by the lack of forests in Ethiopia and the huge amount of soil erosion. The problem has such a vast scale that triggered efforts from Ethiopian rulers, such as Menelik II's introduction of eucalyptuses to control the washing downstream of Ethiopian soil. As James McCann noted, Ethiopian forests are actually man-made mostly around human settlements and churches are often surrounded by sacred forests.[619] Millennia of human presence and agricultural

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[618] Aitor Anduaga, "Towards a New Sphere of Practices and Knowledge: The Militarization of Meteorology in Francoist Spain," *Science in Context* 26, no.1 (2013): 31–59. For a methodological example of the study of colonialism and hydro-politics, see Sara B. Pritchard, "From Hydroimperialism to Hydrocapitalism: 'French' Hydraulics in France, North Africa, and Beyond," *Social Studies of Science* 42, no. 4 (2012): 591–615.

[619] Badege Bishaw, "Deforestation and Land Degradation in the Ethiopian Highlands: A Strategy for Physical Recovery," *Northeast African Studies* 8, no. 1 (2001): 7–25; Zemenfes Tsighe, "The Political Economy of Land Degradation in Ethiopia," *Northeast African Studies* 2, no. 2 (1995): 71–98; James McCann, *A Tale of Two Forests: Narratives of Deforestation in Ethiopia, 1840-1996* (Boston: African Studies Center - Boston University, 1998); Richard Pankhurst, "The History of Deforestation and Afforestation in Ethiopia Prior to World War I," *Northeast African Studies* 2, no. 1 (1995): 119–33.

practices have produced a vastly deforested landscape in Ethiopia, with particular acceleration since the early twentieth century. As a result, soil erosion due to rainfall intensity is particularly severe. In the 1990s, it was calculated that Ethiopia's forests constitute only 3% of the surface of the country and 1 billion tons of soil are eroded annually.[620] Based on modern data spanning from 1935 to 2008, hydro-meteoric erosion is from moderate to generally high, especially in the central and northern highlands. European sources were always astonished by the amount of mud produced during the rainfall season, which made traveling impossible and turned small creeks into dangerous rivers.

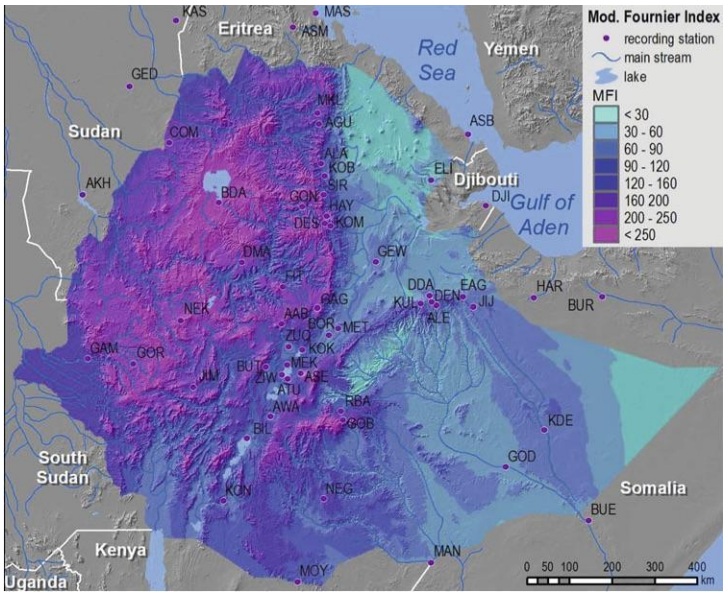

Fig. 4.1: Spatial Distribution of rainfall erosivity expressed by the Mod. Fournier Index. [621]

The hydropolitics of the Horn of Africa are crucial to understanding the competition between Italy and England in the region, the failure of Italian liberal techno-politics to harness the regimen of the rivers coming to Eritrea and Somalia from Ethiopia (in particular the Juba and Shebelle river in Somalia, and the Gash [Mareb] and Setit [Tekezé] in Eritrea), and Mussolini's decision to invade Ethiopia in 1935.

Lake Tana, the origin of the water of the Blue Nile, was the epicenter of the rivalry between British, Italian and Ethiopian interests, the latter supported by French diplomatic efforts to hamper their adversaries. The French railroad between Addis Ababa and Djibouti was the lifeline of Ethiopian rulers that made French influence in the region independent from Ethiopia's rivers. Italian and British efforts intended to produce alternative infrastructures for their

[620] Taddesse Berisso, "Deforestation and Environmental Degradation in Ethiopia: The Case of Jam Jam Province," *Northeast African Studies* 2, no. 2 (1995): 139–55.

[621] Massimiliano Fazzini, Carlo Bisci, and Paolo Billi, "The Climate of Ethiopia." In *Landscapes and Landforms of Ethiopia*, ed. Paolo Billi (Dordrecht: Springer Netherlands, 2015) 80, fig. 3.14.

penetration in Ethiopia, in particular by using the hydrography of Ethiopia as leverage against the last independent African state.

The British were the first to tackle the hydrographic problem of Ethiopia in their effort to colonize Sudan and organize the Gezira scheme for the production of cotton. As early as 1902, the British established an agreement with Ethiopia in order to gain hydraulic rights in the regions of Lake Tana, the Blue Nile, and the Sobat river. After the reconquest of Sudan, they had sent four missions to the Nile by Garstin (1899, 1900, 1901, 1902-4) and the mission by Dupuis to Lake Tana (1902-1903).[622] As we have seen in chapter 2, they also collaborated with Italian meteorologists in order to gain weather data collected in Addis Ababa. In 1915, a mixed committee with representatives from Sudan, Egypt and Ethiopia travelled again to the lake, and a new Egyptian mission reached the lake in 1920.[623] British pressure on Ethiopia and Egypt persisted by monitoring the waters of the river throughout the 1920s and early 1930s.[624]

In the immediate post-war period, the British Empire was a much more serious threat to Ethiopian independence than Italy. In 1919, The British rejected the French proposal of allowing Ethiopia to join the League of Nations. The Foreign Office created the Abyssinian Corporation with the goal of monopolizing trade in the Horn and launched a violent press campaign to delegitimize the Ethiopian Government by denouncing its support for the slave trade and lack of control over its territory.[625] As Del Boca makes clear, "the goal [was] the inclusion of Ethiopia in the British sphere of influence in order to solve first of all the problem of the regimentation and exploitation of the Nile by controlling Lake Tana."[626] British efforts became even more insistent after Egypt gained independence in 1922, when controlling the Nile entailed holding sway on Cairo. As Terje Tvedt has pointed out, "Nile control and the Tana Dam were regarded as the carrot and stick against Egypt in London."[627]

Italians were as interested as the British in the hydrography of Lake Tana. They had already sent there an expedition in the early twentieth century under the direction of Alfonso Tancredi, the military officer who was the main promoter of the first meteorological service of

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[622] In 1908, they created the Assuan dam. Carlo Giglio, "La questione del lago Tana (1902-1941)," *Rivista di studi politici internazionali* 18, no. 4 (1951): 643–86, 643.

[623] *Ibid*, 673. There was also a previous expedition by Buckley. Reports of the Egyptian mission were published by G. W. Grabham and R. P. Black, *Report of the Mission to Lake Tsana (1920-1921)* (Cairo: Government Press, 1926).

[624] Phillips Hurst, *The Nile Basin*, voll. 3, suppl. 2 (Cairo: Government Press, 1931-1935); Terje Tvedt, *The River Nile in the Age of the British: Political Ecology and the Quest for Economic Power* (London: I.B. Tauris, 2004); Daniel Kendie, "Egypt and the Hydro-Politics of the Blue Nile River," *Northeast African Studies* 6, no. 1/2 (1999): 141–69.

[625] Del Boca, *Gli italiani*, vol. 2, 98.

[626] *Ibid*., p. 99.

[627] Terje describes the "double character" of the Lake Tana dam by reporting a secret memo from the time of Egypt's independence: "His Majesty's Government are indeed in the position of being able to threaten Egypt with the reduction of her water supply, and this is sufficient in itself to create a feeling of anxiety and resentment in Egyptians; on the other hand, His Majesty's Government cannot offer to increase the water supply of Egypt unless the construction of the Tsana reservoir is undertaken. Once this work is completed they will be able, without in any way abandoning their power to damage Egypt by reducing the supply, to tranquillise Egyptian anxiety by offering to increase that supply to a very large extent" Quoted in Terje, *The River Nile,* 117-118.

Eritrea under Governor Martini (see chapter 2).[628] A new expedition led by Vittorio Tedesco Zammarano travelled there in 1922.[629] In October 1922 they protested against British pressure on Lake Tana by reminding angrily the Foreign Office of the Tripartite Pact of 1906, when Britain, France and Italy had agreed to respect their interests in Ethiopia before acting unilaterally and threatening Ethiopia's sovereignty.[630]

In order to protect Ethiopia's independence, Ras Tafari—the future Negus Hailè Salassiè—applied again to join the League of Nations on July 30, 1923. After issuing Ethiopia's first constitution, he managed to gain access to the League on September 28, despite British opposition.[631] Reluctantly, Mussolini agreed to support Ethiopia's membership to the League in 1923 "in order to prevent the British threat to Ethiopia's independence," in stark contrast with his future actions against Ethiopia and the League itself in 1935.[632]

At first, the British Foreign Office was furious at Italy's support to Ethiopia's admission to the League of Nations, promised to defer communication with Italians until they could put them in front of the *fait accompli* at Lake Tana, and argued that Ethiopia's membership in the League annulled British commitment to respect the 1906 Tripartite Pact and Italian interests in Ethiopia. Yet in November 1923 they changed approach all together. After seeing their hegemonic efforts thwarted by Ethiopian, French and Italian opposition, the British took a much more accommodating position toward Italian interests in the region.

After years of Italian protest against the 1919 Versailles Treaty and Italy's exclusion from colonial acquisitions, finally the British agreed on July 15 1924 to hand over as compensation to the Italians for the missed assignment of any German colony the Jubaland, namely the region on the right bank of the Juba river flowing from Ethiopia to the Indian Ocean and marking the border between British Kenya and Italian Somaliland.[633] The deal was seen with great concern in Addis Ababa, where Ras Tafari's goal of gaining access to the Indian Ocean through negotiation with the British through the Jubaland in exchange for Lake Tana's water rights dissolved.[634] Thus, the British concession of the Jubaland aimed at hitting two birds with one stone: on one hand punishing Ethiopia, while on the other, pretending to satisfy Italian requests for a revision of the Versailles Treaty with an economically insignificant region.

In order to gain control of the Nile basin, London was also willing to make peripheral concessions on water rights with Italian Eritrea and Somalia. In December 1924, the Italian Governor of Eritrea, Jacopo Gasparini, and the British Governor of Sudan, Wasey Sterry, made an agreement for the management of the rivers Gasc and Setit, at the border between the two

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[628] Maurizio Rava, *Al lago Tsana (Il mar profondo d'Etiopia). Relazione del viaggio compiuto dalla missione Tancredi, per incarico della reale società geografica, con un'appendice di geografia agronomica del Cav. Giuseppe Ostini* (Roma: presso la Reale Società Geografica, 1913).
[629] Vittorio Tedesco Zammarano, *Alle sorgenti del Nilo Azzurro* (Roma: Alfieri & Lacroix, 1922).
[630] Tvedt, *The River Nile*, 122.
[631] Del Boca, *Gli italiani*, vol. 2, 99-100.
[632] Del Boca reports such a statement by Luca dei Sabelli, *Storia d'Abissinia*, vol. IV (Roma: Edizioni Roma, 1938), 185.
[633] Del Boca, *Gli italiani*, vol. 2, 74-77. The annexation took place on July 1, 1925.
[634] *Ibid*., 98.

colonies. Such an agreement made possible the exploitation of the plantation of Tessenei, thus fulfilling plans that Italians had charted since the governorship of Ferdinando Martini.[635]

The agreement between Italy and England for the partition of economic interests in Ethiopia spanned from local deals for the management of border water rights to the highest political level. In December 1925 Mussolini and Graham secretly recognized their reciprocal interests in the region, namely British projects for the building of a dam at Lake Tana and Italian sphere of economic influence in Western Ethiopia meant to connect Eritrea and Italian Somaliland through a railroad.[636] Both powers pledged to support their economic interests with the Ethiopian Government, in a secret protocol that was later made public. The ambiguous deal assigned the control of water in Western Ethiopia to the British and land to the Italians, disregarding implicitly Ethiopian sovereignty.

The expansionist intent of the two powers pushed Ras Tafari, Prince Regent and future Negus Haile Salassiè, to file a complaint with the League of Nations, denouncing that the two members were plotting against another member state: "This agreement was concluded behind our back and the notification of these two governments has deeply worried us. When we have been admitted to the League of Nations, we were told that all nations had to be at the same level and their independence had to be respected by everyone."[637] Facing the opposition of Ethiopians and their resistance at the League of Nations, the Italians and British backed out in the short term, and for the time being Italians tried to focus on the use of the water available in their colonies, Eritrea and Somalia.

One thing was to agree on the use of African rivers with the British, and a completely different matter was to actually control African environments. When Italians followed the rules of a liberal techno-political regime and their scientific experts operated in the space allowed by the entente with the British Empire to realize agricultural projects previously drafted in the liberal period, their efforts met humiliating failures. Italy's liberal techno-political regime, designed in the early twentieth century, failed to harness the regimen of Ethiopia's rivers.

The history of European colonialism is full of failures of economic schemes, plantations, and the imposition of modernist projects disregarding or misunderstanding natural environments. Yet the challenges offered by the environments of Eritrea and Somalia had more devastating consequences on Italian scientific experts and their imperial imaginary because of the limited natural and economic resources that they operated with. The Italian state had smaller pockets than the British empire and supporting agricultural projects against hostile environments was more expensive than in immediately productive regions.

In terms of natural resources and water supplies, the same rivers that looked marginal in the British great scheme for the control of the Nile—namely the Juba, the Gash, and the Setit—were

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[635] Ivi, p. 33.

[636] Ivi, pp. 129-130. The secret deal became public in 1926, producing a very awkward diplomatic moment with Ethiopia.

[637] A.S.M.A.E.: Pos. 54/16 "Accordi Italo-Inglesi" (1926-1935), Letter from Ras Tafari to the League of Nations, June 19, 1926: "Cet accord conclu en dehors de nous et à notre insu et la demarche collective de ces deux governments nous le notifiant, nous ont profondément émus. En effet, en premier lieu, quand nous avons été admis dans la Société des Nations, on nous a dit que toutes les Nations devaient y être sur le même pied, et que leur independence dévait être respectée par touts…" English translation is mine.

actually essential for Italians, as these were the only significant sources of water flowing from Ethiopia into their colonies other than unreliable rainfalls and the highly seasonal Shebelle river. Italian scientific experts' room for failure without consequences for the metropole was much smaller than their British colleagues in Sudan.

In order to illustrate this point, I will focus here on three projects to highlight their characteristics: Tessenei in Eritrea on the Gash river; Genale in Southern Somalia; and the Villaggio Duca degli Abruzzi on the Shebelle river in Somalia, by far the most important of the three from the scientific point of view because designed according to the best scientific information available at the time. The projects for all of them started before the fascist regime took power, but they all prove why Italian scientific experts had grown increasingly disillusioned with a colonial policy aligned with the British Empire and with liberal techno-political practices of colonization by the early 1930s, as they were exposed to uncontrollable international markets, unruly populations, and irregular hydrological regimens.

Unlike Franchetti's plan for an African settlement colony for Italian emigrants discussed in chapter 1, all plantation projects that began in the 1920s aimed to produce cash crops for international markets, such as cotton, bananas, and sugar. Because they were all located in areas where the climate was considered unsuitable to Europeans, they had been overlooked in the late nineteenth century and required the exploitation of indigenous labor.

The agricultural district of Tessenei for the production of cotton was first singled out by the engineer Nicola Coletta under the Governor Ferdinando Martini in the liberal period. Improved again by engineers Nobile and Averani in 1907, the project entailed the construction of a dam on the Gasc river at the narrows of the Togolel mountain [Jebel Tuglal] for the land reclamation and irrigation of 15 thousand hectares in the plain at the border with Sudan, near Kassala. Sponsored by the new Governor of Eritrea, Jacopo Gasparini, a northern Italian businessman-bureaucrat from the area of Treviso, construction works started in 1923 while a scientific mission studied the hydrography of the rivers Gash and Setit.[638]

A dam of 153 meters allowed the deforestation and land reclamation of the plain, despite the loss of lives of indigenous population hit by the malaria affecting the region. However, in 1927 and 1928 violent storms caused the flooding of the Gasc river and the destruction of most of the agricultural district. Three million lire were estimated as necessary to repair the damage.[639] Moreover, the plantations were attacked by a parasite, the *Heliothrips Indicus*, probably as a consequence of the flooding. The collapse of cotton prices in 1928 threatened the very existence of the agricultural district.[640] Despite ending his time as Governor in 1928, Gasparini maintained controlled of the enterprise as president of the Società Imprese Africane starting in 1931.[641]

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[638] Guido Corni, *Tra Gasc e Setit: note di viaggio: missione Corni-Calciati-Bracciani* (Roma: Sindacato italiano arti grafiche, 1930); Cesare Calciati, "Spedizione Corni-Calciati-Bracciani nell'Eritrea Occidentale 1922-1923," *B. S. G. I.* 61, no. 5-6 (1924): 271–81.

[639] Del Boca, *Gli italiani*, vol. 2, 33.

[640] Del Boca, *Gli italiani*, vol. 2, 32-34. On February 13, 1928, Prince Umberto inaugurated it again in person. See Nicola Malizia, *L'Africa orientale italiana e l'Abissinia* (Napoli: Chiurazzi, 1935), 200.

[641] Del Boca reports that Gasparini managed to find the capital to keep Tessenei going as senator, administrator of the Province of Treviso, president of the local bank (Cassa di Risparmio). Additionally, he was the president of the Ente per il Cotone dell'Africa Italiana, a company for the production of cotton in Ethiopia, and the company

Tessenei survived only thanks to robust state funding and support from the metropole. In general, between 1927 and 1932 locusts repeatedly destroyed crops in Eritrea, slashing the production of wheat from 62,000 *quintali* in 1926 to 5,000 in 1927.[642]

The most interesting and scientifically-engineered plantation of Italian colonialism was the Villaggio Duca degli Abruzzi in Somalia. Because the promoter of the enterprise was Luigi di Savoia, a member of the Royal family and cousin of the king, this agricultural business could not fail at any cost and plenty of scientific studies and economic resources were funneled into this project whose major challenge was the irregularity of rainfalls and the flooding of the Shebelle river, or Uebi Scebeli, flowing from Ethiopia to the Indian Ocean.

The coast of Somalia had become an Italian protectorate in the late nineteenth century, with the main goal of securing any possible access route to southern Ethiopia. Italians had never tried to turn Somalia into a settlement colony because the climate was unsuitable to Europeans. Only Southern Somalia had significant water resources thanks to the Shebelle and the Juba rivers, whereas the rest of the country was arid or desert.

Somalia is the only Italian colony where we have an extraordinary account of how indigenous culture understood and predicted the weather, thanks to anthropological information collected at the time of decolonization in 1960.[643] It is worth describing their beliefs in some detail in order to reveal the crucial importance of rainfall prediction in Somalia and highlight the gulf between Italian agricultural schemes and Somali pastoral and nomadic society that struggled for their livelihood with the extremely harsh desert environments.

Somalis had a sophisticated cultural understanding of weather and astronomy and their beliefs predated Islamization. Locals divided Somalia in seven distinct "weather districts" with different experiences of the weather cycle, and different words for seasons and lunar months.[644] "In each of these regions, the terminology of weather prediction, astrology and of the celestial bodies themselves—as well as the local geography, medicine and other traditional studies—tends to be unique."[645] Dominated by the monsoon coming from the Indian Ocean, there are two regular rainfall seasons: the *Gu* rains (April, May and June) and the *Dayr* secondary rains (September, October, November) and two dry seasons, the *Hagai* and *Gilal*. Seasons shift in different locations, with particular difference between coast and interior.[646] The timing of the rains, the amount of rainfalls, and the duration of the season vary dramatically geographically as well as year by year, with rainfalls occurring occasionally with very strong intensity and in just a few days.

A crucial figure of Somali pastoral groups was the weather lore expert, knowledgeable of astronomical, astrological, and climate predictions. Usually at least 40 years old, the weather lore

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S.A.P.I.E. (Società Anonima Patto Italo-Etiopico) in charge of the construction of the road Assab-Dessiè. (Del Boca, *Gli italiani,* vol. 2, 34, n. 31.

[642] Del Boca, *Gli italiani*, vol. 2, 32; Isaia Baldrati, *Mostra delle attività economiche della Colonia Eritrea* (Asmara: Fioretti, 1932), 15.

[643] Muusa H. I. Galaal, *Stars, Seasons Weather in Somali Pastoral Tradition* (Niamey, Niger: CELHTO, 1992).

[644] *Ibid*., 28.

[645] *Ibid*., 53.

[646] Eredia, *Sul clima della Somalia Italiana Meridionale* (Rome: Ministero delle Colonie. Direzione Centrale degli Affari Coloniali, 1913), 43.

expert was "a human calendar, collating the observations of sky and weather with the oral record of past years to define the start and end of specific seasons, and to calculate the exact days on which certain events, holy days and so on should occur. This is more complicated than it sounds, because one year does not exist as an independent stretch of time, but as part of a cycle of years. And in making his calculations and predictions, he must refer not only to previous years, but to previous cycles. Much of this lore, of which he is the keeper and transmitter, is memorized in the form of riddles and proverbs, and can thus be readily called to mind… For example: 'By the time the first two stars of the Great Bear sink below the horizon, the animals should also be sinking their front legs into rain water.'"[647] Connecting lunar calendar, seasonal weather patterns, and local climate histories through proverbs, weather lore experts were fundamental for the life of a society constantly on the move depending on where and if rainfalls would move.

Based on his observations of sky and weather with seasons, the weather expert gave nomadic groups practical advice "in much the same way a modern meteorologist does to a different kind of audience. He understands the winds, and their changes, and how they bring rain and where the rain will fall… He knows the land and what happens to it in each season. He knows which areas are best for grazing at any given time of the year; and he knows which types of grass are best for the animals, and the kinds of soil on which they will best grow."[648] He was also considered an expert of the behavior of animals and the principle of *Nuro*, the grazing nourishment that animals knew and humans ignored. By observing animals' drinking and grazing behavior, the weather expert knew the timing and location of the *Nuro* and understood if it was going to be a bad or good year.

Somalis used lunar astronomy to find direction in the bush and flat arid plains of the region and as a form of weather prediction for both seasonal and short term forecasts. Moreover, weather experts were also knowledgeable of the *Nabsi*, "the pre-Islamic concept of destiny that ensures some regularity and order amid the uncertainty of natural phenomena."[649] The *Nabsi* guaranteed that natural order would be restored in the face of droughts, floods, and extreme meteorological phenomena. In short, Somali weather folklore factored ecological crises, droughts, and variable geographies of rainfalls as cyclical phenomena that a mobile, pastoral society needed to understand and predict in order to rationalize nature and survive.

No Somali population could live off agriculture alone, and no area of Somalia was strictly or entirely agricultural, but rain was as vital to nomads as to agriculturalists.[650] Depending on rainfalls and the seasonal flooding of the Shebelle river, whose hydrographic basin began in the Ethiopian highlands, Somali herders would plant seeds wherever the river would break its banks flooding the plains, in the bed of its previous course, or they would cut them on purpose

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[647] Muusa H. I. Galaal, *Stars, Seasons Weather in Somali Pastoral Tradition* (Niamey, Niger: CELHTO, 1992).
[648] *Ibid*., 3.
[649] Galaal claims that the concept reminds the Medieval wheel of fortune, and the alternation of positive and negative moments. See Galaal, *Stars, Seasons Weather*.
[650] While most Somalis were herders and their weather folklore was pastoral, there were a few additional applications of weather folklore for Somalis practicing also agriculture in the south of the country. The *Gu* rains are more regular than the *Dayr*, so much more attention is devoted to the Dair rains before sowing. If the forecast is of a failure of *Dayr* rains, Somalis do not sow at all for half a year. Also, the timing of planting different seeds differed region by region, depending on the moisture on the terrain.

themselves in order to irrigate whenever and wherever possible. Clearly this system of natural and man-made canals called *Farthe* was highly mobile, seasonal, and could be practiced with very little investment by pastoral societies as complementary economic resource.[651]

Quite contrary to local geographical features and the indigenous practices, Italians tried to establish in Southern Somalia monocultural plantations requiring intensive irrigation, rigid investments, and the quantification of rainfall to evaluate water resources. In the early twentieth century, the area was studied by the agronomist Romolo Onor, but his activities had never gone beyond experimental tests. As in the Eritrean case examined in chapter 2, Italian scientific experts tried to build a meteorological network for the study of local climate in this period that later fell in disrepair for lack of oversight and support by the colonial government.[652]

In particular, Doctor Macaluso, director of the Agricultural Office in Benadir (Southern Somalia), proposed in 1908 to the Ministry of Foreign Affairs to study the climate of the colony by producing more data and building at least four meteorological stations. In 1909, the Ministry of Foreign Affairs purchased the instruments from the Central Meteorological Office. These were installed by the Director himself, Luigi Palazzo, during his aerological campaign in the Indian Ocean. Complete observatories were set up at Mogadishu, Brava, Giumbo, under the control of the personnel in charge of radio-telegraphic stations. Additional smaller stations were created in Balad, Bardera and Afgoi.[653] Most observatories along the Somali coast were controlled by the Navy which dominated Somalia before World War I in same way the army was instead hegemonic in Eritrea.

In the immediate post-war period, the hydrology of Somalia was immediately singled out as the main obstacle to the development of the colony.[654] The Italian geographer Giuseppe Stefanini argued that the improvement of pastoralism, rather than agriculture, was the easiest source of economic revenues in the region due to the hydrography of the country. "The future of industrialized agriculture in Somalia is tightly connected with irrigation" and irrigation required huge amounts of capital and careful study of the regimen of local rivers and rainfalls.[655]

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[651] See Ernesto Queirolo, *La Somalia italiana*, 198. The great amount of sediments coming from the highlands made the river run at a higher elevation of the plain, so seasonal floods were recurrent and they were a typical feature of indigenous agricultural practices. The indigenous population had adapted by occasionally cultivating the regions that received water from the floods or former meanders of the river. The indigenous population would often cut the natural banks of the river through canals called *farthe* to flood the plains and cultivate them, depending on need and appropriate location. Queirolo writes: "There is beautiful black soil, so beautiful that it would attract the desire of any farmer. But without water, they are worth nothing and water (in the way the indigenous use it, in an unpredictable way) becomes an aleatory and uncertain benefit that does not occur in the same areas. Such a challenge is easy to overcome to the indigenous population, because they sow wherever there has been water. But it is not easy for us and for our evoluted and expensive agriculture that necessitates to rely on the land where it invests huge capitals after planning and organizing its agricultural production" (198). The natives also created intermittent lakes called *uar* (203). The problem of lack of water could be devastating also for the livestock that perished in great numbers in case of drought.

[652] Romolo Onor, *Appunti di agricoltura benadiriana* (Rome: Ministero delle Colonie, 1913).

[653] See Eredia, *Il clima*; Luigi Palazzo, *Del servizio meteorologico nelle nostre colonie* (Istituto colonial italiano: Atti del II Congresso degli Italiani all'Estero, Rome, 1911).

[654] Giuseppe Stefanini, *Le risorse idriche della Somalia italiana e l'avvenire della colonia: relazione* (Convegno nazionale coloniale per il dopoguerra delle colonie, Rome, January 15-18, 1919).

[655] *Ibid*., 9-13.

Stefanini acknowledged the importance of Somali beliefs and practices when he suggested that imposing an agricultural economy would have been much more difficult than supporting pastoralism because it was very difficult to find suitable labor for the plantations: "Among indigenous population we can find, along with some superstitious practices, a great treasure of experience with animal husbandry that would complement very well our science."[656] After his suggestion, the National Post-war Congress for Italian colonies requested the publication of data about rainfalls from meteorological stations and the levels of the Shebelle and Juba rivers. An expedition was sent to study the lower section of the Shebelle river.[657] Based on these studies produced previously in the liberal period but despite such warnings, the Villaggio Duca degli Abruzzi would be designed for irrigation and intensive agriculture.

The founder of the plantation, the Duke Luigi di Savoia, was an explorer and ex-admiral of the navy. According to Dainelli, he was also educated among others by Father Denza, the founder of the Italian Meteorological Society and one of the most important Italian meteorologists in the nineteenth century.[658] After the Great War, he decided to move to Somalia and create the S.A.I.S. (Società Agricola Italo-Somala or Italian-Somali Agricultural Company) and the settlement Villaggio Duca degli Abruzzi. In order to determine what kind of cultures to undertake, the rhythms of planting and sowing, and maintain soil fertility, the Duke sponsored the chemical analysis of the water of the Shebelle river and organized his own meteorological network thanks to instruments obtained from the Government of Somaliland, the Hydrographic Institute of the Navy, and the Central Meteorological Office. He considered meteorology crucial to organizing his own settlement project in Somalia and analyzing the regimen of the Shebelle river, the main source of water for the plantation.

[656] *Ibid*.
[657] Vittorio Tedesco-Zammarano, *Esplorazione del basso Uebi: 1921-1922* (Rome: Reale società geografica italiana, 1924).
[658] Giotto Dainelli, *Il Duca degli Abruzzi: le imprese dell'ultimo grande esploratore italiano* (Turin: Unione tipografico-editrice torinese, 1967), 13-14.

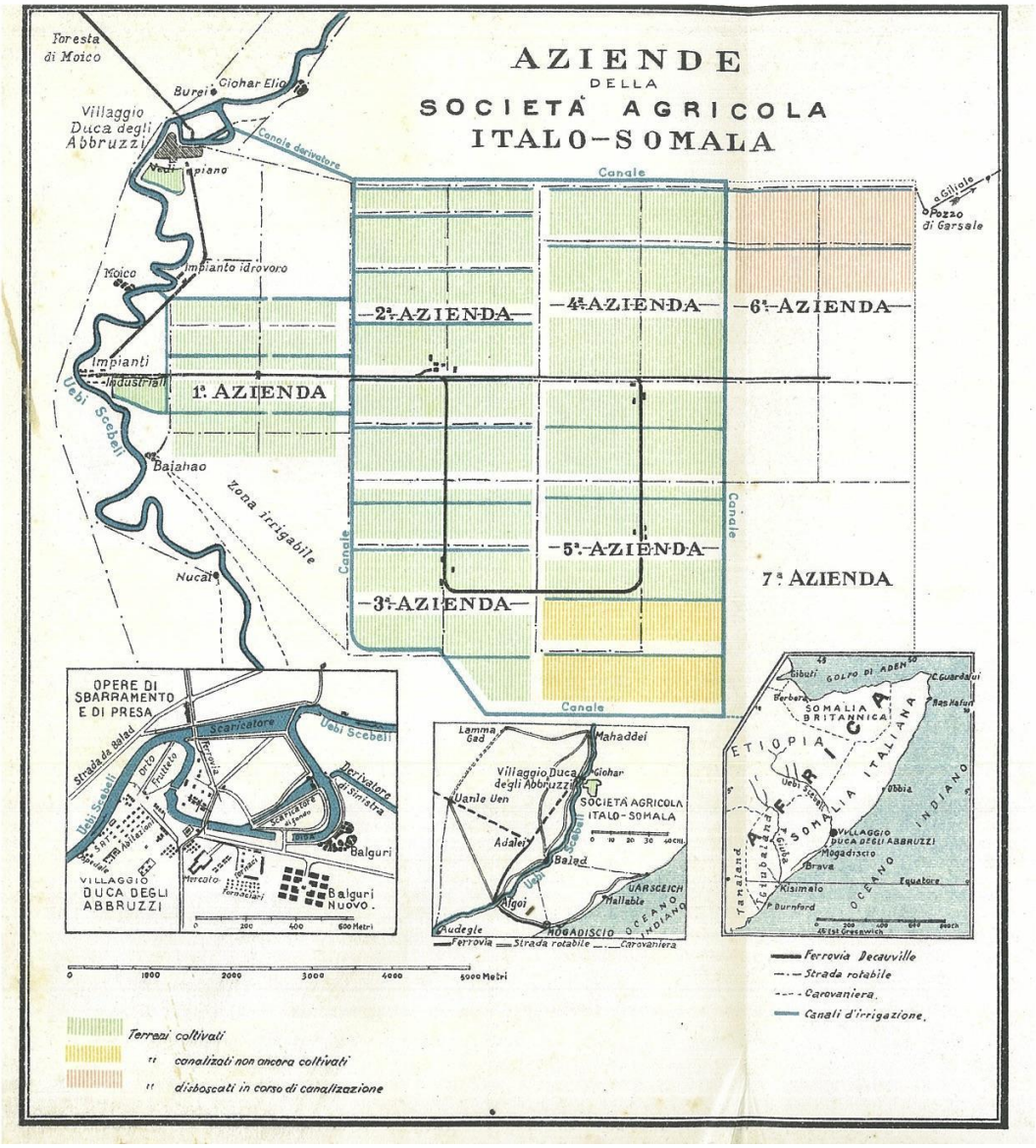

Fig. 4.2: The agricultural district Duca degli Abruzzi organized by S.A.I.S. in 1926. As it is clearly visible, the plantation depended on the control of the highly irregular regimen of the Shebelle river, coming from the Ethiopian highlands and crossing Southern Somalia in its lower course. Somali pastoral communities had very sophisticated forms of folklore for weather prediction and irregular agriculture, whereas Italians invested in a rigid grid of plantations requiring reliable irrigation that met all kinds of environmental challenges and floods.[659]

Construction works started in 1920 with the colonization of 4,300 hectares, 761 km of canals, and finally the production of 228,000 kg of cotton in 1922, despite the fact that a famine

[659] Giuseppe Scassellati-Sforzolini, *La società agricola italo-somala in Somalia* (Florence: Istituto agricolo coloniale italiano, 1926).

struck the region in 1921. The area relied on the management of the Shebelle river, controlled by a system of canals which surrounded an "island of the engineers." Six meteorological stations and nine thermo-udometric observatories functioned in the area in the early 1920s. The Duke relied especially on the agronomist Guido Rossi and Giuseppe Scassellati Sforzolini for the purchase of instruments and the study of the climate.[660] However, in 1923 the arrival of sudden and abundant precipitations caused the flooding of the river Shebelle River that destroyed the crops.[661] The meteorologist Eredia examined the data in 1923 and highlighted that the amount of rainfall recorded that year was unprecedented.[662] After floods in the spring, torrential rains came in the fall, bringing with them parasites attacking cotton plants.

[660] Scassellati-Sforzolini contacted Palazzo for the purchase of more sophisticated instruments for the station of the Villaggio Duca degli Abruzzi on November 15, 1922. See the letter from Scassellati-Sforzolini to Luigi Palazzo, 15 November 1922, C.R.A-C.M.A, "Somalia" 471/15. He asked a drosometro to measure dew (600 lire), "of the type recommended by prof. Filippo Eredia in his work "Sulla misurazione della Rugiada" (1915); an *evaporimetro* to measure the loss of water from evaporation in irrigation canals and flooded reservoirs; a series of geothermometers for the study of the temperature of the soil; a recording anemometer to record the intensity of the monsoon rather than the direction (2,500 lire). Usually, anemometers recorded the sum of wind intensity, not its dinstribution. This factor was very useful for their cultivation of cotton, sugar cane, alfalfa, tobacco, coconut, kapok. The Central Meteorological Office proved extremely inefficient: on August 29, 1923 (several months after the request), they still had not been able to produce the request anemometer (Letter from Palazzo to Scassellati, C.R.A-C.M.A, "Somalia" 897/15).

[661] Del Boca, *Gli italiani*, vol. 2, 82-83.

[662] Omodeo and Eredia, "Osservazioni meteorologiche eseguite nelle stazioni della Somalia Italiana istituite da S.A.R. il Duca degli Abruzzi," *Supplemento agli Annali dell'Istituto Idrografico della R. Marina (1911-1922)* (Genoa, 1924). The stations functioning in 1923 were: Mogadiscio, Giumbo, Brava, Afgoi, Gelib, Balad, Bardera, Villaggio Duca degli Abruzzi, Azienda 1, Azienda 2, Bur-Hacaba, Mahaddei, Iscia-Baidoa, Bulo Burti, Tigieglò, Oddur, Lugh.

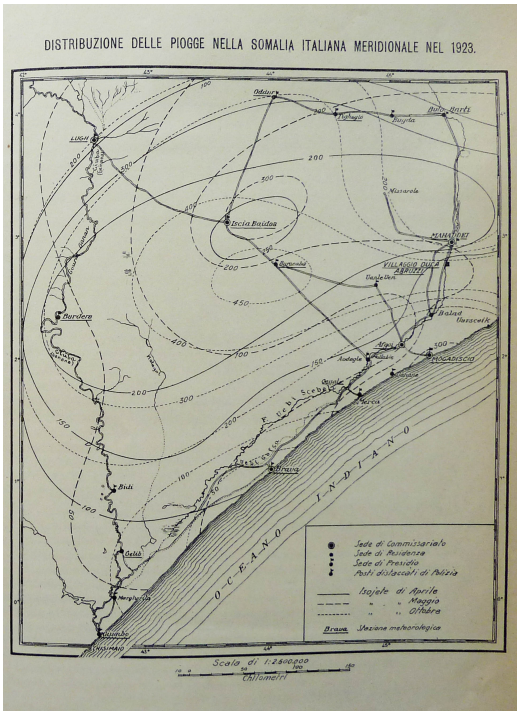

Fig. 4.3: Meteorological charts of Southern Somalia, representing the study of the sudden arrival of precipitations that caused the flooding of the Shebelle river and the destruction of plantations of S.A.I.S. in 1923.[663]

The sense that meteorology really mattered was confirmed by the increasing accuracy of the observations between 1922 and 1927 for the Villaggio Duca degli Abruzzi and between 1922 and 1925 for Mogadiscio and Bulo Burti.[664] Starting in 1923, the Government of Italian Somaliland started publishing meteorological observations in the economic bulletin of the colony that were processed by the Central Meteorological Office.[665] Other data were published by the Hydrographic Institute of the Navy and studied by Filippo Eredia for the years 1922-1925. Even if observations continued until 1930, they were not published and Eredia asked that the network be restored and continued at the Second Congress of Colonial Studies.[666] Thanks to the Italian legations in Ethiopia, in particular in Harar, Dire Dawa, and Addis Ababa, the Duke asked to receive information about the rainfalls upstream in the Ethiopian highlands as early as 1926. Yet these precautions and local weather studies in Somalia and were not enough to prevent new floods if they came from rainfalls in the Ethiopian section of the river.

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[663] Omodei, *Osservazioni meteorologiche ed idrometriche eseguite nel 1923 nelle stazioni istituite nella somalia italiana da S. A. R. Il duca degli Abruzzi* (Rome: Stab. Poligr. Dello Stato, Libreria, 1926). Courtesy of Mirella Petitto Eredia.

[664] Eredia, "Le correnti aeree del bacino imbrifero dello Uebi Scebeli," 400-403. Here Eredia studied the effect of the orography on the wind. Winds were crucial because they affected precipitations a great deal.

[665] Somalia Italiana, "Bollettino Economico del Gov. della Somalia," Osservazioni Meteorologiche (dal 1923 in poi), Mogadiscio.

[666] Eredia, "Sulle osservazioni meteorologiche della Somalia," *Atti Del II Congresso Di Studi Coloniali (Napoli 1-5 Ottobre 1934)* 3: 91–100 (Florence: Centro Studi Coloniali, Tipografia Giuntina, 1935).

A new major flood of the Shebelle river in 1926 destroyed again the plantations on a massive scale and brought malaria with their water. That year was particularly rainy in the region because there seems not to have been any break between the small and big rains in the Ethiopian highlands. The Italian traveller Guelfo Civinini in Ethiopia reported in the memoir of his trip—titled *Sotto le piogge equatoriali* ("Under Equatorial Rains")—that "everyone tells us that these rains are exceptional."[667] So much rainfall in Ethiopia produced flooding downstream, devastating the plantations of the Villaggio Duca degli Abruzzi. The agronomist Scassellati-Sforzolini returned to Italy for a period of rest in order to recover from a mental breakdown.

Requesting public funding for what had been before a private enterprise, the Duke Luigi di Savoia financed the creation of embankments of the river around the village, but he increasingly became convinced of the need of studying the entire hydrographic basin of Shebelle river. In 1927, he travelled to Addis Ababa to gain approval of the exploration of the upper Shebelle river by Ras Tafari, the future Negus.

The Duke's exploration of the Shebelle river was the most successful scientific expedition organized in fascist Italy in Ethiopian territory before the invasion of 1935. It took place between October 1928 and February 1929, crossing 1,400 km in 67 days. The Duke explained his three main goals in a communication to the Italian Geographical Society. Because the Geographical Society and the Government of Italian Somaliland had mapped only the mouth of the Shebelle river, the Duke remarked that "the importance of knowing the region that the river crosses before entering our colony is well known. Thus, after ten years working in the region of the *Scidle* [Italian Somaliland] I matured the project of organizing an expedition in order to first survey the entire course of the *Uebi Shebeli*, thus verifying the accuracy of pre-existing maps; second, examine its major tributaries, while gaining at the same time information about the rainfalls in their basins, in order to improve our knowledge of the regimen of the river; third, study the possibility of taking agricultural workers from the Somali population along the *Uebi Shebeli* under Abyssinia's sovereignty, for the colonization."[668] The conclusions of the expedition were that the river was very affected by the different amounts of rainfall in upstream sections of its hydrographic basin and they also explained the seasonal flooding of the river. Despite the study of the river, a new flood compromised the plantations in 1930 and survived only with state support.

The Duke's success of the expedition along the Shebelle river reveals also two limits of Italian colonial science in the 1920s: first, Italian scientific expeditions in Ethiopia were possible only with Ethiopians' consent, during a short diplomatic phase of appeasement between Mussolini and Ras Tafari. Second, the expedition relied largely on military personnel, whether employed by the Duke himself, the Geographic Military Institute, or the Navy.[669] Italian civilian scientific experts were pretty much left out from it and Italian civilian colonial science was struggling.

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[667] Guelfo Civinini, *Sotto le pioggie equatoriali* (Rome: Libr. Del Littorio Edit. Tip, 1930), 67.

[668] S.A.R. Il Duca degli Abruzzi, "Le sorgenti e il corso dell'Uebi Scebeli," *B. S. G.I.*, VI, no. 6 (1929): 359–71, 360-361. Scientific materials from the expedition were given to the Istituto Geografico Militare, the Hydrographic Institute of the Navy, to the Direzione Sanitaria del Regio Esercito, the Istituto Luce, while botanic and zoological collections were given to the University of Turin.

[669] Orazio Pavanello, Capo Ufficio Rilievi della S.A.I.S., was in charge of meteorological observations.

The hydrographic problem of the Horn of Africa dominated Italians' concerns. In 1926, the Colonial Agricultural Institute promoted a conference titled *Per le nostre colonie* ("For Our Colonies") that well represents the challenges and desires of Italian colonial experts. Guido Mangano described colonization in Eritrea as a set of especially hydraulic problems: "From the agrological point of view, the main factor is the lack of rainfalls, and even more the rapid flow of water after precipitations that make this region arid and allow only agriculture with very short life cycles."[670] Speaking especially of the rivers Gasc and Barca that crossed the north-western lowlands of the colony, Mangano suggested their water for irrigation, since they were used to produce cotton in Sudan, just on the other side of the border. "Despite such a great wealth of water and so much good land, Eritrea is instead a poor country when it comes to agriculture, so that it does not produce enough cereals for its own consumption. The problem of the improvement [*messa in valore*] of these vast regions is therefore essentially a problem of hydraulics."[671] Rainfall were enough to support indigenous agriculture, but insufficient for large scale production of industrial plantations. "The creeks that come down from the mountains to the plain carry considerable amounts of water that today are always completely lost. But their pattern is very irregular and torrential, with sudden and powerful floods bringing with them a great deal of materials from the erosion of the highlands, where the rain always falls impetuously. This immense reserve of water it is not usable without construction works allowing a timely and extended withdrawal of water and its use for irrigation."[672]

At the same conference, Ernesto Queirolo talked about the development of Italian Somaliland and its rivers. "The Shebelle and Juba rivers have regimens similar to the Nile, namely a regimen of overflows and shallows independently from rainfalls in the middle and lower part of their course. Instead, they are influenced by the powerful seasonal precipitations on the Ethiopian highlands. This explains […] why they lose a lot of their volume by evaporation and why they are much more impressive in the mountains than in their valleys."[673] The Shebelle river in particular was so depleted by the time it reached the coast of Somalia that it ended in a marsh, with any actual mouth into the Indian Ocean. Queirolo wished for the future establishment of hydrometric stations on the upper course of the Juba river that would allow to forecast the rise and fall of its waters. However, nothing had been done on the upper part of the river in Ethiopia.

The hydrographic problem of the Horn of Africa recurred again when Italian experts investigated the possibility of developing of the newly acquired Jubaland, after the deal with the British in 1925.[674] Italian scientists fumed against their British allies when it came to the disappointment of the Jubaland: "I cannot call 'generosity' what drove our allies to give up the

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[670] Roberto Cantalupo ed, *Per le nostre colonie. A cura dello Istituto Agricolo Coloniale Italiano di Firenze* (Florence: Vallecchi, 1927), 165.
[671] *Ibid.,* 169-170.
[672] *Ibid.,* 171. Mangano praised the intention of Franchetti's efforts, but he suggested reversing his approach. Rather than considering the highlands the most fertile part of the region and overlook the lowlands, Mangano believed that irrigation of the lowlands would allow to create cotton plantations with indigenous labor.
[673] *Ibid.,* 197.
[674] See Commissariato generale nel primo anno di occupazione italiana, ed. *Oltre Giuba: notizie raccolte* (Rome: Sindacato italiano arti grafiche, 1927), and *La Vallata del Giuba*.

territory of the Jubaland as compensation of the fraternal pact of 1913 […]. Anyone knowledgeable of the vast countries that were partitioned by our allies will not contradict me", protested the agronomist Pompeo Gorini.[675] Nallo Mazzocchi Alemanni was an isolated optimistic voice arguing that a dam on the Juba river would allow irrigation of the coastal plains, because the river was infested by tsetse flies and there was not enough local population available for such work.[676] The exploitation of the lower course of the river would have been extremely costly. In short, Italian scientists protested being deceived by the British concession.

A preview of what fascist techno-politics would have looked like in Ethiopia years later was the plantation of Genale, in Southern Somalia.[677] Heavily protected by the State, the only way to make cotton, and later, bananas, from Genale profitable was by resorting to a form of labor that did not fall short of being called slavery even by the fascist observer and critic Marcello Serrazzano. The projects of Genale began in 1924 under the control of the fascist leader Cesare Maria De Vecchi, who had become Governor of Somalia on October 21 1923.[678]

De Vecchi launched a series of violent military campaigns to reduce to complete subjection the northern Somali sultanates of Hobyo and Majeerteen and to bring the border between Italian Somaliland and Ethiopia at the region of water wells in the desert. In short, De Vecchi turned Italian Somaliland from a colony controlled through indirect rule to a colony of direct dominion.

The main qualification to be a colonist in Genale was simply to be a fascist follower of De Vecchi. Colonists were assigned by the Government local manpower (33 workers for 100 hectares). The financial burden of the enterprise was mostly taken on by the state. Like Tessenei, Genale was built after a project drafted by the Commissary of Agriculture of the Government of Somalia Romolo Onor in the previous liberal period.[679] Genale was in a flat region of 40,000 hectares between the Shebelle river, the port of Merca to export any agricultural products, and the sultanate of Bulo Marer to use local labor.[680] Irrigation was made possible by the construction of a dam 91 meters long and 7 canals 55 km long. The collapse of cotton prices in 1928 forced the new Governor, Guido Corni, to switch agricultural production from the monoculture of cotton to bananas.[681] The following Governor, Maurizio Rava, tried to curb the ruthless exploitation of local labor—to no avail.[682]

In the early 1930s, the outlook on the development of the Horn of Africa was very negative. The picture emerging from studies sponsored by the Research Office of the Ministry of the Colonies and the proceedings of the first Conference of Colonial Studies in 1931 in

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[675] Pompeo Gorini, "L' Oltregiuba com'è e come potrà essere," in *Per le nostre colonie,* 213.
[676] Nallo Mazzocchi-Alemanni, "Il Problema del Giuba," in *Per le nostre colonie,* 237-267. Mazzocchi-Alemanni had already proposed the damming and management of the river during a trip to Somalia, British and German East Africa in 1911.
[677] Andrea Naletto, *Italiani in Somalia: storia di colonialismo straccione* (Verona: Cierre, 2011).
[678] Del Boca, *Gli italiani,* vol. 2, 79-82.
[679] Onor, *Appunti Di Agricoltura Benadiriana*, 1913.
[680] Del Boca, *Gli italiani*, vol. 2, 80-81.
[681] *Ibid*., 198-199.
[682] A sentence reported by Del Boca from correspondence coming from Genale well represents the atmosphere of the plantation: "Il clima, se non è ottimo, è buono; e la razza basta un urlo e subito tace" ("The climate might not be the best, but it is good; regarding the [local] race, you just have to yell at them and they shut up"). *Ibid*., 202.

preparation for the fiftieth anniversary of the beginning of Italian colonialism with the occupation of Assab (1882-1932) was far from encouraging. The Director of the Agricultural Colonial Institute in Florence, Armando Maugini, spoke his mind when he said that "Eritrea is tormented by a hot and dry climate, extremely variable, that makes productivity very uncertain. Thus, there are poor resources for the economy of the colony and wide oscillations in productivity between good and bad years of crops, and between wellbeing and misery."[683] He was echoed by the geographer Giotto Dainelli who in 1934, right before the 1935 aggression to Ethiopia, invited Italians to look beyond the boundaries of the formal empire.

Dainelli pointed out that the study of the formal empire was just the first step toward the final destination of Italian colonialism, implicitly referring to Ethiopia. "Colonial problems are not always settled with the possession of territory. This is just a means to an end, but not the only one; and [the concept of] 'colony' overlaps with 'colonial possession' only colloquially, but not in its etymological and proper meaning. If we consider Italy's problems, we must be convinced that they revolve around colonial problems […]. We are certainly not rich. Until yesterday we did not even have enough to feed ourselves, not anymore thanks to the will of the Duce and everyone's support [referring to the battle for the wheat]. But we do not have minerals and oil […]. We also miss plants for industrialized agriculture that are found in colonial countries […]. There are regions that for geographical situation, natural production, and lack of population, can be considered colonial regions, even if they are politically independent and a high status of civilization. Their economic growth though is blocked by their lack of population. Our abundance of population can change that."[684] To summarize, in the early 1930s Italians were fully aware to be left "at the margins of Ethiopia."[685]

Nevertheless, on the eve of the 1935 war with Ethiopia, East Africa had slipped outside of the interest of many scientific experts. In the speech concluding the 1934 Conference of Colonial Studies, Dainelli complained that about 100 papers dealt with the newly reconquered Libya, about 30 regarded Somalia, 20 Eritrea, 20 the three colonies in general, and 10 the Dodecanese islands. Italians' efforts in Libya dwarfed the scientific output in the Horn of Africa.

To summarize, in order to explain the transition from a liberal to a fascist techno-political regime, it is important to highlight three factors. First, environmental factors mattered. Italians struggled to solve the hydrographic problem of Ethiopia in the space allowed by the alliance with the British Empire and according to the rules of another liberal techno-political regime. A series of environmental challenges in the 1920s and Italians' inability to solve the problem of hydrographic instability of the Horn of Africa, characterized by irregular rainfall patterns, periods of drought, and sudden floods coming from the out-of-reach Ethiopian highlands, frustrated the efforts of Italian scientific experts. This phase—when many Italian scientific experts put the best effort of their youth in the development of the colonies—would be crucial in the postwar period, when they informed the victimized stereotype that Italy had been mistreated by its allies while challenging fruitlessly a hostile environment through investments and hard

[683] Del Boca, *Gli italiani*, vol. 2, 31.
[684] Giotto Dainelli, in *Atti del secondo Congresso di studi coloniali, indetto dal Centro di studi coloniali sotto gli auspici della Società africana d'Italia. Napoli 1-5 ottobre 1934-VII* (Firenze: Olschki, 1935), 60-63.
[685] Valentino B. Vecchi, *L'Italia ai margini d'Etiopia* (Milan: Bietti, 1935).

work. The rhetoric that this was an empire of work was used as motivation and mask to Italy's colonial efforts.

Second, Italian civilian experts were focused on the formal empire in Eritrea, Somalia and Libya, rather than the study of Ethiopia. When expeditions into Ethiopia were allowed, such as in the case of the expedition of the Duca degli Abruzzi in Somalia, the Government preferred to send military experts, rather than promoting Italian civilian colonial sciences.

Third, traditional competition with the British empire for the control of Western Ethiopia and the waters of Lake Tana and the Blue Nile triggered the closing of an Italian space of action for future intervention in Ethiopia. As we will see in the next section, Mussolini decided to change the rules of the game by abandoning the previous techno-political regime for a new policy of aggression.

4.3 Empire: The Conquest of Ethiopia as Infrastructural War

The 1935 Italo-Ethiopian war marked the full transformation of Italian imperialism into a fascist techno-political regime. While they struggled against the environmental challenges of making their formal empire of Eritrea and Somalia productive, Italians had even less luck in diplomatic negotiations with Ethiopia and Britain to get a share of the economic development of western Ethiopia and Lake Tana. The decision of conquering Ethiopia and switching dramatically the gears of Italian colonialism from liberal to fascist techno-politics in Ethiopia was precipitated by Mussolini's failure to compete with British interests and their methods of economic penetration in Western Ethiopia for control of the Blue Nile Basin. As Terje Tvedt has highlighted, the diplomatic Gordian knot of the Nile was a crucial piece of British interests in Ethiopia that has been overlooked in the historiography and that Mussolini decided to cut with an act of violence and force that violated the traditional geopolitical rules of liberal international law.

Diplomatic conflicts and negotiations concerning the Blue Nile and Lake Tana continued throughout the 1920s and the early 1930s. In the immediate aftermath of the 1925 Mussolini-Graham deal granting reciprocal support against the Ethiopian Government for British rights on the water of the Blue Nile and Italy's project of a railroad between Eritrea and Somalia, the future Negus Haile Selassie did not simply protest with the League of Nations, but decided to involve American interests in order to balance the influence of Italian and British threats. This was a traditional geopolitical technique that had allowed Ethiopia to remain independent in the late nineteenth century by playing Italian, British and French interests against one another. After the Great War, the future Negus tried to involve in the Horn of Africa the United States as the new superpower that could restrain the lust of European imperialism.

The plan of the Ethiopian Government was to comply with the British request of building a reservoir at Lake Tana, but by offering the construction project to an American firm, the White Engineering Company. In August 1927, the Ethiopian engineer Dr. Martin, trained in England, traveled to the United States, met twice President Coolidge, and requested the reopening of an American embassy in Addis Ababa. In 1929, the American White Engineering Company was selected to build a reservoir at the Lake Tana basin and the decision to begin engineering studies

was taken in 1930.[686] When asked explicitly what had pushed the Ethiopian Government to turn to an American company by an Egyptian journalist, Martin explained that Britain had been requesting to build a dam on the river for twenty five years, but the Ethiopian Government feared that after spending the money for the dam the British Government would want to exert influence on the regions crossed by the Blue Nile river.

Additionally, satisfying the British request entailed triggering the Mussolini-Graham agreement of 1925, so that "if Abyssinia concedes the dam to England, [Britain] will be under pressure to concede to the Italian Government the construction of a railroad crossing Abyssinia from the North to the South... An impartial person cannot avoid finding as justified our concerns, especially since we know England and its means to get control of territories and expand those that it has."[687] By soliciting American interests, Ethiopians aimed at harnessing British pressure and stalling Mussolini's plan to connect Eritrea and Somalia through western Ethiopia at once.

Thus, the negotiations for the building of the dam became an infrastructural debate about the construction of roads to access the region of Lake Tana. As I noted in the first chapter, Ethiopia's lack of access routes had been crucial for its national security and its resistance from European invasion in the nineteenth century. Ethiopia's mountains and lack of roads had granted its independence in the past and Ethiopians had only agreed on the construction of the French railroad from Addis Ababa to Djibouti in 1906 as a way to balance British and Italian pressure with French influence.

It is no coincidence that in the 1926 letter to the League of Nations protesting against the Mussolini-Graham deal, Ras Tafari wrote that: "Our people is eager to do well and we have the firm resolution to direct them on the path of improvement and progress, but in history we have only met foreigners that wanted to seize our territory and threaten our independence. With the help of God and thanks to the strength of our soldiers, we managed to always remain free and independent on our mountains despite everything." [688] In short, the underdevelopment of Ethiopia's infrastructure among its mountains was a deliberate choice to preserve Ethiopia's independence.

The priority of the Ethiopian Government was to prevent the construction of roads for the shipment of construction materials that would connect Lake Tana with the colonies of the two enemies, namely British Sudan and Italian Eritrea. The techno-politics of such construction projects were clear and explicit: the British, after fuming against the Ethiopian Government for involving Americans behind their back, supported the construction of a road from Sudan to Lake Tana. However, when this project became impossible due to Ethiopian opposition, they tried to gain control of the capital of the American White Engineering Corporation and exclude Italian participation.

As the collapse of cotton prices in 1928 cooled British pressure for the construction of the dam that should have benefited their Sudanese plantations, Ras Tafari decided instead to

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[686] MacGregor, vice-president of the company at the time, met with Belatingeta Heroui, Director General of Foreign Affairs in Ethiopia in 1930.

[687] Interview by Dr. Martin to the Egyptian journal *Al Ahram*, reported by the Ministry of Foreign Affairs to the Ministry of the Colonies, the Italian Embassy in London and in Addis Ababa, on December 27, 1927. In A.S.M.A.E., Pos. 54/15 (1914-1935): "Lago Tana."

[688] Ras Tafari, June 19, 1926. In A.S.M.A.E., Pos. 54/16 (1926-1935): "Accordi Italo-Inglesi."

accelerate the project in order to catch this favorable moment thanks to Americans without activating the 1925 Mussolini-Graham deal.[689] The British tried to drag their feet about the project and the Ethiopians responded increasingly involving the Egyptian Government rather than the Sudanese and British Governments. The Negus managed to impose the more expensive decision of shipping construction materials from French Djibouti to Addis Ababa by railroad (rather than from Sudan or Eritrea) and commissioned the White Corporation with the project of a highway from Addis to the Lake in addition to the actual reservoir, despite the fact that this path was the least economical due to the length of transportation and the need to cross the most mountainous regions of the Ethiopian Empire.

From the Italian point of view, these projects were equally seen with the greatest concern. At first, Mussolini tried to appease the Ethiopian government with a 1928 "Friendship Deal" that promised to develop trade between Eritrea and Ethiopia, including the construction of a road from Assab to Dessié, a project that never took off. Then, as the negotiations with the White Corporation moved forward in 1932, Mussolini lobbied with the president and vice president of the company, respectively Mr. D. Larner and Mr. Y. G. White, the American Government, and the American ambassador in Addis Ababa. His goal was to participate at least in construction projects with Italian skilled labor and the use of the road from Eritrea to the lake, by far the closest geographically and most economically convenient.

Yet Mr. Lardner, the vice president of the White Corporation, admitted confidentially that "despite the best dispositions of his company toward us, the choice of the railroad for the transportation of materials will be eventually determined by political rather than economic considerations" and Mr. White confirmed the following August that "he had neither the possibility nor the interest to change that choice"[690] [of the road] despite the fact that the road from Massawa would have been more convenient. By the middle of 1932, it was known that construction works were planned for the end of 1933 or the beginning of 1934 and the White Corporation engineering report was ready in early 1933. At the very same time, Mussolini began to solicit the first military projects for the aggression of Ethiopia and replaced Grandi as Minister of Foreign Affairs, taking the matter completely in his hands.

In April 1933, the clash between Italian, British and American interests in Ethiopia was apparent. The Ministry of Foreign Affairs—namely Mussolini in person—ordered in a confidential note to the Ministry of the Colonies to follow the negotiations for the dam and road at Lake Tana with the greatest attention in order to ensure the respect of the 1925 Mussolini-Graham pact. In the same year, classified instructions to the Italian embassies in London and Addis Ababa ordered to make pressure in order to get Italian participation to the International Commission of Experts that was in charge to approve the projects of the White Corporation. The Italian ambassador in London, Leonardo Vitetti, asked the British Foreign Office to see a copy of the White Company engineering report, but he was denied access to the documents. The

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[689] Tvedt writes that, in 1931, "the roles of London and the emperor of Ethiopia were reversed" after the 1928 crash of cotton prices and the ensuing lack of capital in Sudan" Tvedt, *The River Nile*, 163-164.

[690] Ministry of Foreign Affairs to De Bono (Ministry of the Colonies), June 28, 1932. A.S.M.A.E., Pos. 54/15 "Lago Tana" (1914-1935).

diplomatic and geopolitical trick was that if Italy—which technically did not control any country on the Nile river and could not lay geographical claims to participate in the commission—was excluded from negotiations and scientific studies, it could not satisfy the requirements of the Mussolini-Graham deal and ask British recognition of Italian economic rights in Western Ethiopia in return.

Italians' perception was that a great scheme was being planned behind their back to exclude them from the future economic and political hegemony in the region, even if London had a limited actual control of the construction projects at Lake Tana. In his communication to the Italian embassies in London and Addis Ababa, Mussolini remarked that the matter of Lake Tana has shaped British political and diplomatic interests in Ethiopia for thirty years and had intensified in recent years. "Between 1925 and 1930 British policy in Ethiopia has been increasingly oriented toward its major goal in that country: the realization of the concession for the exploitation of Lake Tana […]. The matter is for us particularly interesting from the political and economic point of view," Mussolini wrote. These negotiations were crucial economically, because this was Italy's last chance to gain at least informal control of Western Ethiopia and make the possession of the poor coastal Eritrea and Somalia any kind of economic sense despite the environmental challenges of the colonization, as I have demonstrated in the previous section. Deprived of economic links with northern and western Ethiopia, Eritrea and Somalia were useless.

The negotiations were also politically crucial, because, at the same time, Mussolini began military projects in order to outdo his British competitors. The British ambassador in Rome was confidentially told in 1934 that "Tana was about the most important political question in Africa."[691] As Rochat has documented, Mussolini's inquiries about military preparation with his generals and the Minister of the Colonies, De Bono, dated to spring 1934. Still in September 1934, the Foreign Office was reluctant to disappoint Mussolini's requests to honor the 1925 Agreement despite receiving information by Sir Sidney Barton, British representative in Addis Ababa, that Britain lacked pretexts to delay the dam project any further and that Haile Salassiè was disappointed by British delays as he clearly conceived of the dam as a strategy to involve foreign interests and gain support against the Italians.[692] In September, Italians pressured the British ambassador to come to an agreement among the great powers concerning Lake Tana in Rome, while they also neutralized France with the preparation for the Laval-Mussolini Pact.[693] In November 1934, military clashes at the border between Ethiopia and Somalia gave Mussolini's pretext to begin the war almost a year later. Since he could not compete with the British Empire on the same level of the liberal technopolitics of economic flows, hydraulic projects, and financial bargains, Mussolini started thinking about switching to the fascist techno-politics of military aggression—although not in those terms.

Despite Mussolini's insistence, Italy was not included in the commission for the study of the projects for the construction of the dam. It was even more insulting that Egyptian and

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[691] Tvedt, *The River Nile*, 166.
[692] *Ibid*.
[693] *Ibid*., 167. Signed on January 4, 1935, the Laval-Mussolini was essentially seen as the French blank check for Mussolini's invasion of Ethiopia. Laval intended to appease Mussolini as an ally against Hitler.

Sudanese interests were represented by British engineers. In a letter from the embassy in Addis Ababa dated April 14, 1934 and titled "British Activities in Western Ethiopia," Vinci (the Italian representative in Addis Ababa) explained: "It is my conviction that through the concession to the White Corporation for the construction of hydraulic works at Lake Tana, England is preparing a vast and important network of penetration in Western Ethiopia, namely in the same regions around Lake Tana, that must seriously alarm us."[694] Vinci complained that this was the usual British strategy to gain hegemony or control over new territories, by attracting interests and creating economic ties in their favor.

In order to dispel the specter of any imperialist game, win Ethiopians over and conclude the project, the British were eventually willing to sacrifice the 1925 deal with Italy. Ethiopians would have seen a committee with Italian representatives as part of an imperialist plan. Without Italy, it could pass for a technical board of experts. In short, Italians perceived that the British were plotting with the Ethiopians to exclude them from the region.

Moreover, Italians rejected entirely the notion that the Lake Tana project was a technical and scientific problem. Seen from Rome, the issue of Lake Tana was overtly political. In a communication from the Ministry of Foreign Affairs rebuking the scientific office Ufficio Studi of the Ministry of the Colonies for getting involved in the issue of Lake Tana, it was pointed out that "the question of Lake Tana—which includes, among other things, British projects for the improvement of the Sudan—is already the topic of correspondence and negotiation between the General Direction of the Ministry of the Colonies and the Ministry of Foreign Affairs" and there should not be any confusion of jurisdiction. The goal of the Ufficio Studi was only "to do research, collect and process data and information, and provide them to the General Directorship of the Ministry for what concerns foreign colonies […]. The question of Lake Tana is doubtlessly too peculiar to be confused by different jurisdictions. Indeed […] it is necessary to remember that such matter does not involve a foreign colony, but a sovereign state, Ethiopia. Moreover, everyone knows that there has been a lively competition among European states, and among them Italy is not the least involved, for its economic penetration and political conquest. And England aims at exploiting the hydrological resources of Lake Tana to achieve this plot, along with the development of Sudan. Thus, the question […] cannot be the subject of simple theoretical 'research' [studi]. It is essentially and totally political."[695]

In short, it was no mystery that Italian and British interests were at odds in the region and Lake Tana was the price for the competition.

As the activities of the American engineer L. B. Roberts in Ethiopia for the study of the dam and highway ended in 1934, the Italian embassy in Addis Ababa asked that the results of the commission be examined by Italian experts, in order to understand the technical and political implications of the construction of the dam and the road. The Italian engineer M. Zambon in Addis Ababa suggested sending the reports about the construction of the dam to the Italian National Research Council (Consiglio Nazionale delle Ricerche or C.N.R.) and criticized the British tendency to prioritize their economic interests over their loyalty—a critique based on

[694] A.S.M.A.E, Lago Tana, Pos. 54/15 (1914-1935).
[695] A.S.M.A.E., Pos. 54/15 (1914-1935). Lago Tana. Ministero delle Colonie. Direzione Generale Africa Orientale, Ufficio I, n. 4953 S.D. [1922].

Italians' resentment at how the British had treated them in 1919 and in 1926 with the concession of the Jubaland.[696]

The Italian Government consulted the engineer Guido Lori, Superior Inspector of the Genio Civile (the corps of civilian engineers), who rejected the project as a disguise of British interests based on documents (including the White Report which somehow was appropriated and is still at the Italian archive of the Ministry of Foreign Affairs) rather than fieldwork. He argued that a dam on Lake Tana would not benefit British interests in Sudan, because the reservoir was too far from it. The water would easily get dispersed during the way from Ethiopia to the Sudanese border. Moreover, the financial costs were out of proportion with the actual economic benefits, which entailed that such was a political move.

By the end of 1934, actual preparation for the war against Ethiopia was well under way, as Mussolini's military plans were finalized between December 30, 1934 and March 8, 1935.[697] On a famous note to the Chief of Staff Pietro Badoglio, he commented: "The problem of the relationship between Italy and Abyssinia has lately shifted to a different level: from a diplomatic problem it has become a problem of strength [un problema di forza]; it is a 'historical' problem that we need to solve with the only means to solve such problems: with the use of violence [con l'uso dell'armi]."[698]

After a series of delays, doubtless due to political negotiations, the White Corporation plan was approved on September 10, 1935 after Egypt and Sudan agreed on the amount of water they would claim rights to, a "decision accelerated after specific instructions by the British consul" according to Italian sources.[699] Meanwhile, the Italian explorer Vittorio Tedesco-Zammarano launched a series of attacks against the British project on Lake Tana from the first page of *Il Popolo d'Italia*, Mussolini's newspaper, largely summarizing the conclusion of the engineer Lori (without mentioning him), a move certainly orchestrated by the totally regimented press of the regime.[700] Excluded by the commission for the study of the project, probably furious for the British betrayal of the Mussolini-Graham deal, and unable to secure Italy's hegemony in the Horn of Africa through the traditional liberal techno-politics of economic penetration, hydraulic engineering, and international diplomacy of environmental management, Mussolini ordered the invasion of Ethiopia on October 3, 1935.

Fascist imperialism differed dramatically from liberal imperialism in terms of its economic scope, the organization of consensus, and its techno-political approach to solving the infrastructural problem of the conquest of Ethiopia. First, the proof that a fascist war was different from colonial wars waged by liberal colonial powers like England and France was that

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[696] Zambon suggested sending the documents produced by American and British scientific experts to three members of the C.N.R.: Senatore Luigi Cozza (Comitato di Ingegneria); Alessandro Martelli (Comitato di Ingegneria); Prof. Amedeo Giannini (Comitato di Geografia). It is still unclear whether they were actually consulted.
[697] Nicola Labanca, *Una guerra per l'impero. Memorie della campagna d'Etiopia* (Bologna: Il Mulino, 2005), 28.
[698] Promemoria di Mussolini per Badoglio, Capo di Stato Maggiore Generale, Roma, 30 December 1934, in Giorgio Rochat, *Militari e politici*, 376.
[699] A.S.M.A.E., 54/15: Lago Tana, Communication of the Ministry of Foreign Affairs to the Embassies in London, Addis Ababa and Washington, September 10, 1935.
[700] Vittorio Tedesco-Zammarano, "Parliamo un po' del Lago Tana," *Il Popolo d'Italia*, June 18, 1935; "Ancora il Lago Tana," July 10, 1935.

Mussolini organized an expensive national war with vast deployment of European troops and technological means, in particular airplanes and mechanized vehicles whose modernity was greatly emphasized in the propaganda of the time. Unlike any colonial war previously waged by liberal imperial powers, the 1935 aggression to Ethiopia had an open budget without any limits to its costs.

Second, demographic and racial goals were as paramount as economic concerns. While Italian liberal imperialism in the late nineteenth century had tried to use Ethiopians' collaboration whenever possible, failing to force Menelik's to accept Italy's protectorate in 1887, Mussolini's final goal of affirming Italians' superior racial status and vindicating Adwa dictated the rejection of any alliance with the indigenous population. Despite the use of indigenous troops, Mussolini sent a great deal of Italian troops and fascist militias.[701] This policy of oppression of Ethiopians and rejecting any notion of "indirect rule" marked the beginning of the end of Italy's empire due to a very strong resistance.

Third, the propaganda of the regime managed to turn the war in Ethiopia into a major success thanks to a timely and coordinated organization of the press and all sources of information. Unlike the controversies of the late nineteenth century described in chapter 1, no controversy was possible about the war of the regime and the expansion of the Italian colonial empire. Compared to the doubts, protests and polemics of the first clash with Ethiopia at the end of the nineteenth century, and even at the time of the invasion of Libya in 1911, the conquest of Ethiopia was turned from a controversial topic to a dogma of the regime.

Last and most important point, the 1935 Italo-Ethiopian conflict was an infrastructural war. As Labanca has shown, the true success of the Ethiopian campaign was based on the development of massive logistics rather than military bravery in combat, considering the imbalance between Italy's modern army and Ethiopia's traditional forces.[702] In particular, the Italian army had to fight across extremely mountainous regions without any available roads. Moreover, they had to crush the Ethiopian army and reach the capital Addis Ababa before the arrival of the summer *Kremt* rains that forced the interruption of any form of travel and communication for several months of the year. Fascism's techno-political regime professed the modernist conquest of nature by technological means.

[701] For example, Badoglio delayed the entrance of indigenous troops in Addis Ababa in 1936 for three days, in order to wait for the arrival of slowlier Italian troops.
[702] Nicola Labanca, *La guerra d'Etiopia: 1935-1941* (Bologna: Il Mulino, 2015).

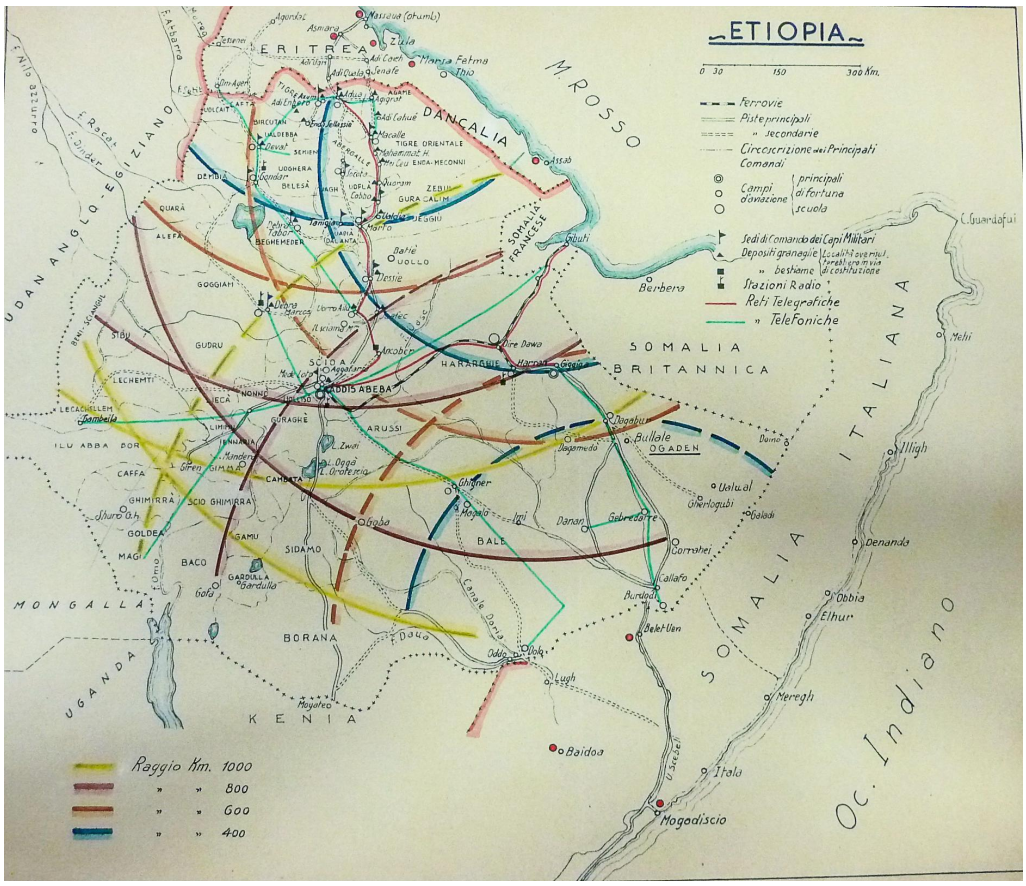

Fig. 4.3: The attack to Ethiopia as infrastructural war. The map shows the infrastructure of airfields, railroads, telegraph lines, radio stations, and especially the range airplanes from Eritrea and Somalia into Ethiopia.[703]

The use of aviation was the critical factor that allowed Italians to win against the Ethiopian army in seven months. Mussolini was in a hurry to win the war quickly for diplomatic, economic, and environmental reasons. Diplomatically, he needed to beat the international community and present the League of Nations with the fait accompli of the conquest of Ethiopia. Economically, a war planned like a national European conflict in Africa was so expensive that it would not have been sustainable longer than a few months. Last and most important, the arrival of the rainfall season would have stalled military operations and blocked Italians in the mud. Ethiopians relied on the rugged nature of the terrain and their geographical knowledge of their homeland. Despite all technological advances, war in the Horn was still a seasonal affair limited by the arrival of the rainfall season. But because Ethiopians did not have an efficient aviation, Italians' complete control of the sky was a crucial advantage.

The development of a network of airfields was planned from the start as an infrastructural system alternative to the difficult movement through land transportation.[704] As early as May 25,

[703] U.S.M.A., Italian Ministry of Defense.

1934, a military report for the preparation of the conflict made clear that roads in Eritrea were absolutely insufficient to bring soldiers and materials to the front, and the situation across the border in Ethiopia was even worse. Thus, the project for "a tight network of airports and airfields of first and second class would allow more freedom in the deployment of aviation that would be very useful for both exploration and bombardment."[705] In January 1935, Giuseppe Valle, the secretary of aeronautics, listed the lack of roads to provide refueling materials, the local climate, and the competition for the supply chain with other armed forces on the ground as the main challenges for the use of airplanes. Therefore, he recommended creating a series of airfields independent from the constraints of terrestrial transportation, connected by radio-telegraphic stations, and capable of moving materials and personnel necessary for the activity of aeronautics. Valle declared that "Only with such organization will it be possible to break free from the terrain, create rapidly a solid infrastructure on the ground, and attack with the most rational and decisive strategy."[706] Airplanes were necessary not only in combat operations, but to make up for the almost complete lack of roads and infrastructure crossing the Ethiopian highlands.

The preparation for the war forced Italians to revolutionize aerial transportation in Africa in order to fly airplanes from Italy to East Africa through Libya, Egypt, and Sudan rather than shipping dismantled aircrafts by boat and assemble them in Eritrea. This method was considered too slow as early as March 1935, before the war even started, when General Badoglio asked Mussolini to make a deal with the British to create an invisible aeronautical and meteorological bridge between Italy and its colonies.[707] In the same way they did not oppose the passage of Italian troops through the Suez Canal, the British and Egypt agreed on a deal to share meteorological bulletins and allow the passage of Italian airplanes for civilian purposes across Egypt and the Sudan.

Italians needed a meteorological network as well as invisible infrastructure for the deployment of airplanes. The Ministry of Aeronautics established a complete meteorological office in Asmara that produced synoptic weather maps, like a European meteorological office. A first group of geophysicists and cartographers arrived on September 11, 1935.[708] Their first goal

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[704] About the deployment of aviation in the Italo-Ethiopian war, see: Carlo Lucchini and Giorgio Apostolo, ed., *Ali italiane in Africa orientale: 1935-1940* (Parma: Albertelli, 1997); Roberto Gentilli, *Guerra aerea sull'Etiopia: 1935-1939* (Florence: EDAI, 1992); Ferdinando Pedriali, *Guerra etiopica 1935-36* (Rome: Stato maggiore aeronautica, 1997).

[705] Colonnello Visconti Prasca, *Ricognizione sull'Organizzazione militare Eritrea* (Aprile-Maggio 1934), Rome, May 25, 1934, in Rochat, 327.

[706] Valle, Sottosegretario all'Aeronautica to Badoglio, Capo di Stato Maggiore, Rome, January 12, 1935. In Rochat, 381. Valle insisted in a second letter to Badoglio on January 22, 1934 that "it is not enough to 'be confident' that our scarce aeronautic forces currently present in the region will be enough. We need to prepare the infrastructure that we have studied starting immediately and take action for the realization of the intense program presented in the previous report." In Rochat, 390.

[707] See Badoglio to Mussolini, Rome, March 12, 1935, "Direttive Strategiche per l'AO," in Rochat, 411: "We need to begin negotiations with the British and Egypt to fly over, land and refuel in their airfields in Egypt and Sudan." The negotiations were carried out with Egypt and the British Foreign Office; see UK National Archive, F.O. 371/19534 and F.O. 141/564/8.

[708] They were the head geophysicist (*geofisico principale*) Domenico Montanari, the geophysicist Salvatore Maietta and the engineer Ferdinando Lazzarini, the cartographers Vittorio Aprea, Salvatore di Paola, and Giorgio Berardelli, with the clockmaker Zigno. Domenico Montanari (Lugo, December 16, 1902 - Rome, October 4,1992) graduated in

was to organize meteorological bulletins for Eritrea (Asmara, Assab, Agordat and Schafè) called Meteo Eritrea and for Somalia (Mogadiscio, Galati, and Belet Uen), called Meteo Somalia. The meteorological service was also in charge of the organization and control of the forthcoming aeronautical meteorological network in East Africa, the meteorological assistance to airplanes, and creation of meteorological instruments.

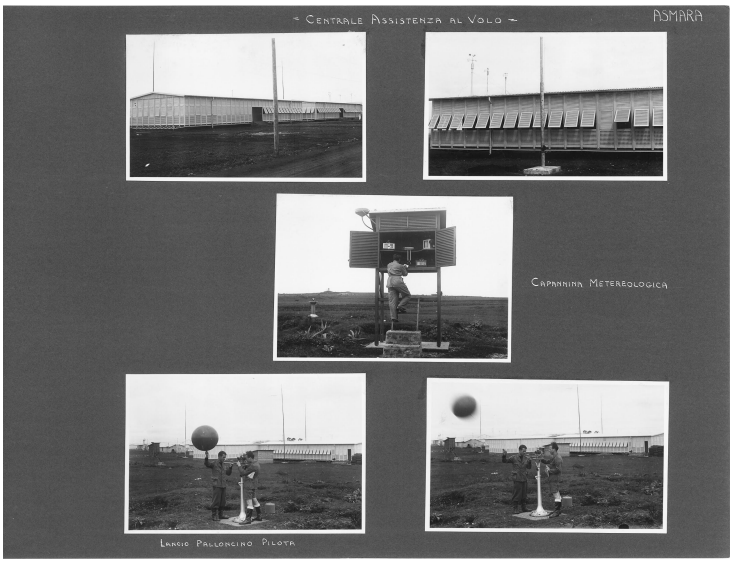

Fig. 4.4: Photographs of the Meteorological Service in Asmara for the assistance to aviators and synoptic weather forecasting.[709]

On January 10, 1936, the service was reorganized and expanded as Asmara issued a radio-bulletin for the entire East Africa called Meteo Africa Orientale. The novelty that characterized this meteorological service, compared to any previous meteorological network in East Africa, was that its role was not limited to collecting climate data. Rather, it was specifically for weather forecasting and synoptic meteorology at equatorial latitudes.[710] "The activities of

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physics at the University of Bologna. He joined the meteorological and aerological service of civil aviation and air traffic (Ufficio Presagi, Aviazione Civile e Traffico Aereo). When the service was militarized as part of the corp of aeronautical engineers (Genio Aeronautico) he was appointed Captain. After organizing the regional meteorological center of Milan, he went to Asmara to organize the aeronautical meteorological service in East Africa. In 1940, he was in service on the British Channel and in Tripoli in 1941. In 1942, he became director of the experimental and scientific observatory in Vigna di Valle and its school of geophysics. He continued to work for the Ministry of aeronautics in the postwar period and taught at the university of Parma and Rome. See Franco Gabici and Fabio Toscano, *Scienziati di Romagna* (Milan: Sironi Editore, 2006), 335-336.

[709] Ufficio Storico del Ministero dell'Aeronautica, Italian Ministry of Defense.

[710] In 1936, the service included as first class stations Asmara, Agordat, Senafè, Assab, and Mogadiscio; as secondary stations, it included Tessenei, Barentù Gura, Macallè, Adi Ugri, Axum, Otumlo and Zula (Eritrean sector) and Lugh-Ferrandi, Belet-Uen, Gorrahei, Neghelli, and Rocca Littorio (Somali sector). On April 30 Dr. Nardo Morsellino replaced Montanari as director. See Filippo Affronti and Giacomo Petta, "Il Servizio Meteorologico dell'Aeronautica negli anni dal 1934 al 1937," in Servizio Meteorologico, *Origini ed evoluzione*, 189-193.

scientific research during the year 1936 were essentially directed to the study of the climate of our African colonies."[711]

Controlling the sky was crucial for military and cartographic operations. Historians have denounced the massive use of chemical weapons that Italian airplanes used to bomb Ethiopian troops, terrorize the population, and poison rivers and wells.[712] Italian airplanes dropped the bomb C.500T that contained iprite (nitrogen mustard gas). The bomb contaminated the regions where it was dropped for several days, depending on the temperature and density of irroration, and was used both on the Eritrean and the Somali front.[713] Without rain and the local temperature at about 25°C, a density of 200 grams of chemical for each square meter of terrain ensured that the area of the bombing would be poisoned for at least two days. This environmental factor might partially explain the vanishing effect of the gas and the claim by deniers of the use of chemical weapons in Ethiopia that Italian troops did not see the use of poison gas on the ground by the time of their arrival, in addition to the undeniable cover-up of the events by the regime.[714]

The C.500T bomb contained 1.5 kg of explosive and 212 kg of chemical material that vaporized at the moment of the explosion in the form of droplets that Ethiopian sources described as a "deadly smelling rain" killing anything and anyone it touched, immediately or due to ensuing wounds. In order to drop a bomb, pilots needed to calculate the direction of the wind on the ground by throwing a special smoke bomb.[715] As in World War I, meteorology was crucial to use chemical weapons, in addition to providing the invisible infrastructure to fly airplanes.

The use of airplanes turned out to be essential even for cartographic purposes. Before the war, Italian maps of Ethiopia beyond the border were still at an extremely wide scale that made them useless for military operations. In 1933 the Director of the Military Geographical Institute ordered a new geodetic campaign in Ethiopia whose data were still stuck at those collected between 1888 and 1902.[716] The best available map had been produced in 1906 and stopped at the

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[711] *Ibid*., 193.

[712] See Del Boca, ed., *I gas di Mussolini: il fascismo e la guerra d'Etiopia* (Roma: Editori riuniti, 1996); Simone Belladonna and Del Boca, eds., *Gas in Etiopia: i crimini rimossi dell'Italia coloniale* (Vicenza: Neri Pozza, 2015); Rochat, "L'impiego dei gas nella guerra d'Etiopia. 1935-36," *Rivista di storia contemporanea* 17, no. 1 (1988): 74-109.

[713] Rochat writes that "the protagonist of Italy's chemical war was doubtlessly the aeronautics," see Rochat, "L'Impiego dei gas nella guerra d'Etiopia 1935-1936," in Del Boca, ed., *I gas di Mussolini*, 63.

[714] In particular, the journalist Indro Montanelli, who had been in Ethiopia in his youth, embarked in a famous controversy with Del Boca in the 1990s when he denied that he had ever seen the use of chemical weapons. After Del Boca's publication of Mussolini's telegrams to Generals Badoglio and Graziani (on the Eritrean and Somali front respectively), Montanelli was proved wrong and conceded by arguing that "truth in Italy is always multifaceted, and it is easy to be wrong about some of them." Montanelli, "Gas in Etiopia. I documenti mi danno torto," *Corriere della Sera*, February 13, 1996, quoted in Belladonna and Del Boca, eds., *Gas in Etiopia*, 178.

[715] Ferdinando Pedriali, "Le armi chimiche in Africa Orientale: storia, tecnica, obiettivi, efficacia," in Del Boca, ed., *I gas di Mussolini*, p. 95.

[716] The project was triggered by requests coming from the Ministry of the Colonies and the Ministry of War as Mussolini started inquiring in a military option in Ethiopia. Topographer Gastone Petrolini and captain of artillery Alessandro Latini travelled under cover to Ethiopia in March 1934 to study the itineraries from the border into Ethiopia, write reports about the logistics for roads and water in the region, and provide political and military intelligence.

12th parallel, just north of the Ethiopian city of Dessiè (see fig. 5).[717] Because the goal of such work had to remain secret, Italian agents could rely only on a compass, a small sextant, and an aneroid barometer and they focused on the region at the border with Eritrea.[718] Their knowledge of the rest of Ethiopia was very superficial.

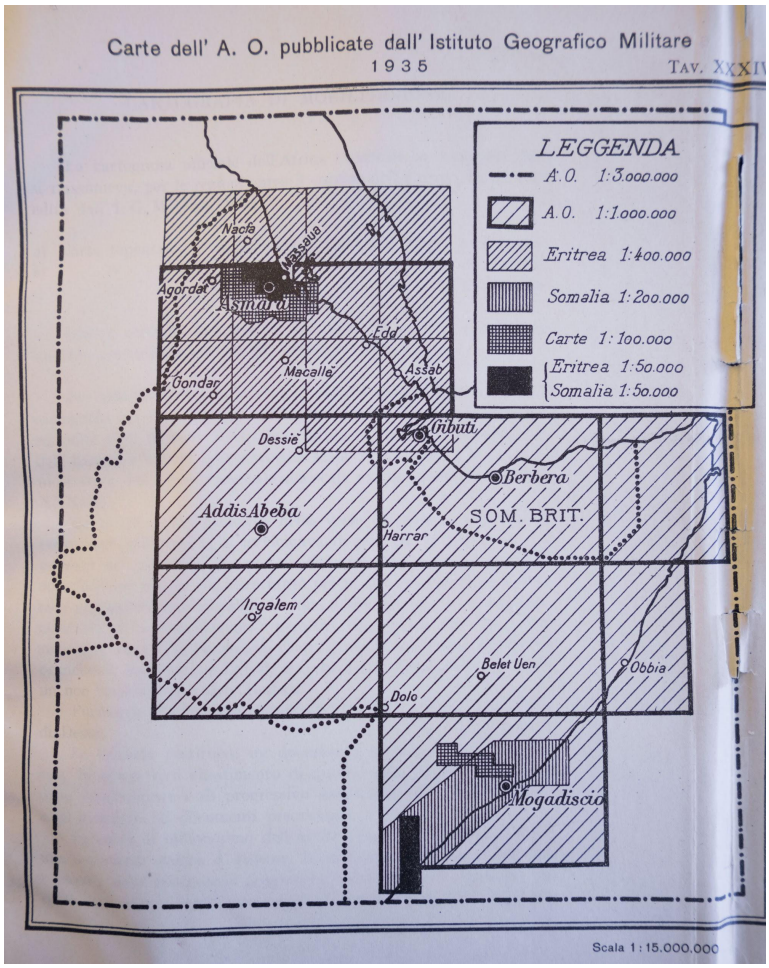

Fig. 4.5: The state of Italian cartography is Eastern Africa in 1935. As it is clearly visible, Italian maps were more detailed in very small section of Eritrea and Somalia, whereas the scale of general map of the region was too wide to be useful for military operations.[719]

As the campaign gained momentum, the Military Geographic Institute established a fully equipped department in Asmara, the 7th topo-cartographic section of East Africa (*7a sezione topocartografica Africa Orientale*) whose goal was to chart all the regions where the fighting

[717] Istituto Geografico Militare, ed., *L'Istituto Geografico Militare in Africa Orientale, 1885-1937* (Florence: Istituto Geografico Militare, 1939), 111.
[718] *Ibid*., 83.
[719] *Ibid*., plate 34.

could possibly take place as the army advanced and distribute maps to the troops as military operations developed. The 7th section had at its disposal an aircraft Caproni 101 (later a Caproni 131) and created a special camera, the Santoni photo-camera, to record and map the area in front of the army.

The Santoni photo-camera embodied the characteristics of fascist technopolitics.[720] It was a futuristic technological device developed in the face of the new colonial environment that allowed Italian cartographers to produce maps quickly, privileging expedited execution over the accuracy of the liberal techno-political period, in the early twentieth century. The photo-camera Santoni consisted of four cameras rotating at different angles and mounted on the wings of Caproni airplanes. When the images were assembled together, they allowed the representation of wide areas and the variation of elevation and reliefs, a crucial factor in the mountainous Ethiopia. This technique of aerial photography was developed to face the challenges of the new colonial environment: "Creating maps, even quickly, of vast regions where we could not travel, in particular those beyond the most advanced frontlines, was very much challenging. The evolution of our technical means, and in particular airplanes and the photo-camera Santoni for wide landscapes contributed to give the topo-cartographical service in East Africa a feature and style that were completely new."[721] Additionally, the photo-camera allowed Italians to make significant progress without relying on indigenous knowledge.

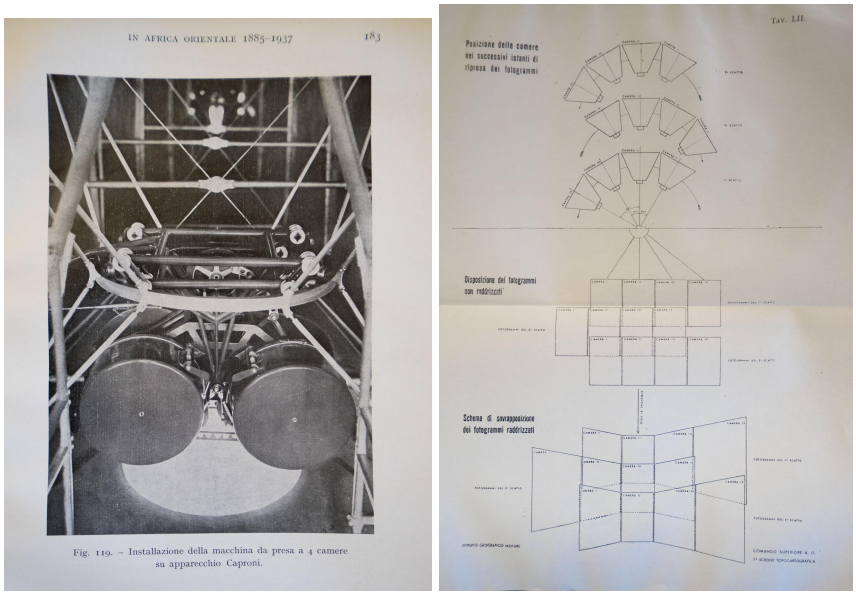

Fig. 4.6: The photocamera Santoni mounted on the wings of the airplane Caproni on the left. On the right, graph of the moving mechanism of the four cameras that allowed Italians to map the terrain beyond the frontlines.[722]

[720] About the relationship between society and technology, see Wiebe E. Bijker, Thomas Parke Hughes, and Trevor Pinch, eds., *The Social Construction of Technological Systems: New Directions in the Sociology and History of Technology* (Cambridge: MIT Press, 1989).
[721] *L'Istituto Geografico Militare in Africa Orientale*, 121.
[722] *Ibid*., 183 and plate 52.

Thanks to the Santoni photocamera, the Military Geographical Institute managed to chart in seven months an area as wide as Central Italy, one fifth of the national territory, and to bring Italian columns to successfully conquer Addis Ababa. However, Italians had mapped only the corridors leading to Addis Ababa, Gondar and Harar by the time of the official termination of the campaign in 1936, as shown in the map in fig. 7. Moreover, such hasty maps were considered widely inaccurate by troops on the ground. They often did not report any toponyms - or if they did, they were often incorrect - for local mountains and villages, as they had been produced without indigenous information and intelligence. The very device that made fascist techno-politics successful in the conquest of Ethiopia produced Italians' ignorance and paved the way for their downfall.

By relying so much on airplanes for military intelligence and chemical warfare, Italians had "conquered" an immense country of which they were entirely ignorant. The reason of their success was the same of their eventual downfall with the beginning of Ethiopian resistance, especially as their crucial advantage—namely the deployment of aviation as infrastructure for transportation, warfare, and cartographic intelligence—put them at the mercy of the weather. They could rely on airplanes for only a few months of the year, between the two seasons of the *Kremt* and the *Belg* rains.

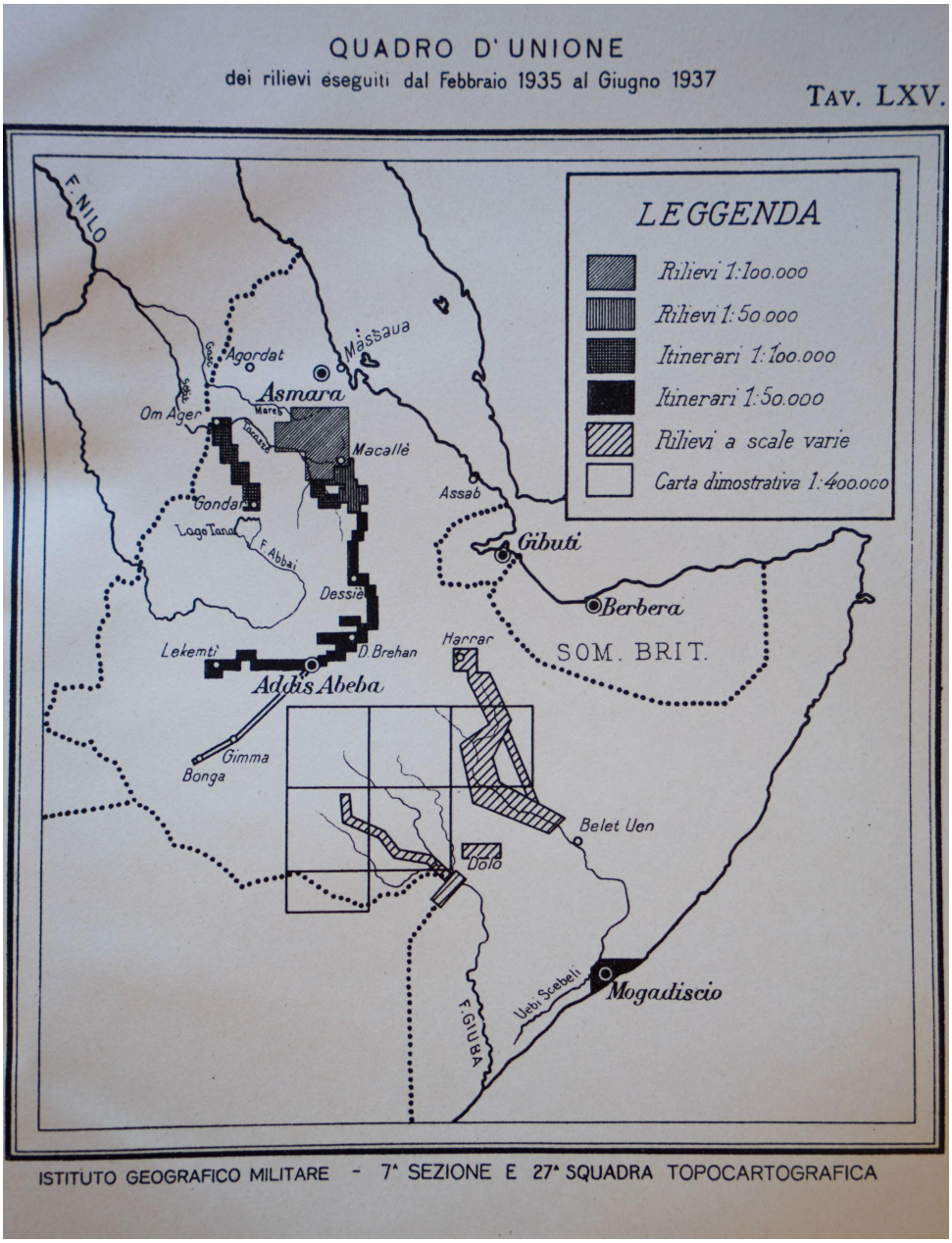

Fig. 4.7: The use of air photography thanks to the photo-camera Santoni explains the rise and fall of the Italian colonial empire in Ethiopia. The Military Geographic Institute mapped only the corridors used by Italian troops to reach Addis Ababa, Gondar and Harrar. Even if this method led them to successfully defeat the army of the Negus in seven months, by the arrival of the rainfall season Italians controlled a very small section of the country and new even less of it. Of course, the cartographic method employed during the campaign was useless during the rainfall season, producing knowledge and ignorance at once.[723]

[723] *Ibid*., plate 65.

When Badoglio's troops entered Addis Ababa on May 5, 1936, witnesses report that the rain had just started. When Mussolini announced that the conquest of Ethiopia was a "mission accomplished" and proclaimed "the empire" on May 9, a new war was just beginning, as Italians were trapped in the capital of an immense country that they ignored, surrounded by guerrilla fighters from the army of the fleeing Negus, and unable to receive supplies, reinforcements or maps as the rainfall season paralyzed airplanes to the ground and made Italians cartographically blind.

The first troops to encounter the challenges of the arrival of the rain were those commanded by General Graziani coming from the southern Somali front, as the big rains move northerly from the Indian Ocean. The atmosphere of this tragic period is still perceivable through memoirs of the time. As Nicola Labanca has pointed out, reading fascist accounts between the lines of fascist rhetoric and propaganda is actually an extremely valuable source, to the environmental as much as to the military historian.[724] In order to highlight the importance of meteorology and knowledge of the weather in this period, I will focus on the memoir *L'Africa non fa paura* ("Africa does not scare us") by the doctor Giuseppe Barbèra.[725] Of course, what this text actually reveals is the opposite of such a brave, virile and fascist title, namely that, in fact, Africa is a scary place.

Barbèra traveled with the divisions of fascist militias Tevere and Vittorio Veneto with General Graziani from the Southern Somali front. After the arrival of the rains, he described the road "as if it were covered with soap:"

> Recent rainfalls have turned the trail into a slippery, deceitful surface. For hundreds of kilometers we have cursed bumps in the road… now it seems to walk on soap. For drivers, keeping the balance of their vehicles is very difficult. In front of me there is a big truck, loaded with equipment and people on top of it. Suddenly it starts waving awkwardly. It swings on one side, then on the other, it almost tilts on the left side, but finally chooses the right one… Here it is an even bigger truck, heavier than the previous one, swinging like the previous one, but with more excitement. This time it falls down in a ravine! The people on top of it are safe by jumping on some bushes, but they come out with a lot of scratches.[726]

After the conquest of Addis Ababa, Italians found themselves surrounded by guerrilla fighters and without communication, as phone lines were cut and radio instruments were unusable due to the bad weather: "Only one radio, a small R.2 can still communicate every once in a while with other radios, when weather conditions are good enough, in order to inform them

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[724] Nicola Labanca, *Una guerra per l'impero: memorie della campagna d'Etiopia 1935-1936* (Bologna: Il Mulino, 2005).
[725] Giuseppe Barbèra, *L'Africa non fa paura* (Rome: Unione editoriale d'Italia, 1937).
[726] *Ibid.,* 34-35.

of our situation and our needs."[727] As soon as weather conditions improve, airplanes fly out and throw messages to ask troops on the ground to create an arrow with pieces of cloth in order to know the direction where the rebels were hiding. Barbèra reports an imaginary dialogue with the aviators that echoes more the cold and muddy memoirs of the Great War than the futuristic propaganda of the regime:

> [Aviator:] Do you need anything?
> [Barbèra:] We would need so many things! There is a group of soldiers in Assas that has just one blanket, only one tent. Soldiers shiver in the cold rain at night, they freeze in their cold and wet clothes.[728]

And Barbera continues:

> Our situation was gloomy more than ever. The news was imprecise and often contradictory. New facts made worse the already difficult situation of that rainy period of the first rainfall season that precipitated on us, grey and sad, right after Italians' triumphal occupation [of Addis Ababa]. The road between Dessiè and Addis Ababa was interrupted by the water. Some columns of soldiers were blocked in the mountains, imprisoned by the mud, by the harsh season and by the boldness of the Abyssinians… The lives of white men, supplies, communications, everything was paralyzed by the rainfalls, by the mud that made it impossible to cross any terrain. The mud of the *Shewa*! Neither horses nor mules managed to stand in that slippery soil! And people sank up to their knees, taking every step with incredible pain, with their heavy shoes full of sticky and slippery mud. If anyone adventured outside for a bit, deluded by a moment of sunlight, he could remain blocked for a long time, prisoners of his useless and fool bravery, due to sudden showers, those showers so frequent and unforeseen in the mountains.[729]

The same "mud" flowing downstream to Egypt, Sudan, Eritrea and Somalia and constituting the hydrographic problem of Ethiopia now kept Italian soldiers as wet and hungry prisoners. Barbèra also reports that aviators were forced to stay in during the entire season, with the exception of a few short military flights—"short because they were possible for a few hours when sunshine was sure. For a few briefs and untrustworthy hours airfields were barely

[727] *Ibid.,* 83.
[728] *Ibid.,* 84.
[729] *Ibid.,* 112-113.

usable."[730] Even the airport of Addis Ababa, built at the bottom of a valley, had quickly become a big pond. Only the Ascari, indigenous soldiers fighting with the Italians, were able to ride the territory and often terrorized the population, as they were left completely free from Italian oversight. As soon as the rainfall season ended, the air force was employed in the so-called "great operations of colonial police" against the rebels that would continue until World War II.[731]

4.4 Autarchy and *Colonialismo Integrale*: The Reorganization of Science Under Fascism

Mussolini micromanaged military operations for the conquest of Ethiopia as much as he overlooked making any concrete plan for the study and development of the colony in the "postwar" period.[732] Behind the rhetoric of a totalitarian, autarkic, and corporatist colonialism, it was hard to conceal the chaos that ensued the proclamation of the empire. The improvisation of scientific colonization plans is a further proof that fascist techno-politics of military aggression intended to thwart British and Ethiopian liberal techno-political projects in the Nile basin, grab space and resources preventively, but did not offer a constructive vision of Ethiopia as the core of an Italian colonial empire in East Africa.

In this section, I will examine how Italian scientific experts scrambled to study the long-coveted Ethiopian highlands, only to discover how ignorant they were of this huge country. Understanding rainfalls, hydrography and possible water uses was clearly one of the priorities in order to solve the infrastructural problems of the empire and to control the great price of the Italian campaign, the Blue Nile waters of Lake Tana. I argue that their efforts and the totalitarian pressure of the regime reshaped Italian sciences even back in Italy on the eve of World War II.

Italians' efforts to control the weather, collect data and study the meteorology of the region were not signs of their imperial strength, but a frantic effort to cope with the challenges of their empire. Their plans for the production of weather data were spurred by their weaknesses as colonial conquerors and the urgency of dominating natural elements. They had won the first part of the Ethiopian war thanks to the control of the sky, but this was a control that they could not master for the entire year. The very reason of their success had put them at the mercy of Ethiopian weather at the same time and would ultimately cause their downfall.

The need of a "totalitarian" approach to colonization was a recurring theme of Italian colonialism that should have made it different from British and French colonialism. It was based on the centralizing power of the state and the experience with practices of land reclamation of the *bonifica integrale* (total reclamation) that the regime had pioneered in Italy with the land reclamation of the Agro Pontino. The *bonifica integrale* intended to transform natural environments radically, in every aspect, in the totalitarian interest of the nation rather than private businesses. A clear example was the use of water. The government set up studies and engineering projects for both agriculture and hydroelectric power plants, as Ethiopia did not have

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[730] *Ibid*., 114.

[731] See Matteo Dominioni, *Lo sfascio dell'impero: gli italiani in Etiopia, 1936-1941* (Rome: Laterza, 2008); Alberto Sbacchi, *Ethiopia under Mussolini: Fascism and the Colonial Experience* (London: Zed, 1985).

[732] There are two significant exceptions. He decided to forbid any sexual interaction between Italians and Ethiopians "for the preservation of the race" and he ordered the rejection of any form of indirect rule, thus fueling even more the strong anti-Italian guerrilla already on the ground.

any oil for the production of energy. At odds with one another in a capitalist system, Italians thought that state intervention and top-down planning would regulate these competing environmental interests for the use of hydrological resources.
Nevertheless, behind the rhetoric of such a totalitarian approach to colonization, there was the lack of trained and specialized personnel, so that decisions were *integrali* ("integrated") and centralized in a few hands more out of necessity than out of choice. For example, the projects of the empire meteorological and hydrographic services were drafted by the same person, Amilcare Fantoli (protagonist of the third chapter of this dissertation), previously director of the meteorological service in Libya—despite the fact that the two services would have been assigned to different ministries (Colonies and Public Works). Even Fantoli had to deal with the mud of Ethiopia, as he survived a car accident during his mission in 1937.[733]

During the preparation for the invasion, Fantoli traveled to Eritrea and Somalia to restore the meteorological services of the two colonies.[734] This mission was the realization of a project he had already envisioned in 1927, when he proposed the unification of all colonial meteorological services, but made possible only with the new mobilization of resources triggered by the war.[735] In 1936, Fantoli drafted the project for a meteorological service of the newly conquered empire that stressed the need of a centralized network for the study of the climate and hydrology of Ethiopia.[736] Unlike the aeronautical meteorological stations used for weather forecasting during the conflict for the use of airplanes and which were mostly located at airports, Fantoli proposed an alternative infrastructure of stations whose goal was to determine Ethiopia's climatological regions for human settlement, agriculture, and the study of rainfalls.

Centralization and discipline were the key elements of Fantoli's project for a meteorological service. Fully aware of the chaotic competition for the hegemony of meteorology in Italy between different ministries, Fantoli recommended the creation of a centralized institution under the supervision of the Ministry of the Colonies in Addis Ababa with peripheral branches in each new governorship of the empire. Such centralized institution would also be in charge of training Italian personnel, assign instruments, and collect the data of Italian territories and neighboring foreign colonies, notably the Physical Department of the Ministry of Public Works in Egypt, the Governor of Kenya, and British Somaliland.

As a very skilled empire builder, Fantoli built on his experience in Libya as a successful example of meteorological network and warned against the initial excitement of expanding meteorological stations without the certainty of their long-term maintenance, a problem that had plagued efforts to create a meteorological service in Eritrea. He also stressed that the production of new climatological studies and their publication would dispel misinformation about Ethiopia's climate, as its regional climates varied dramatically from one another, a clear echo of the debates

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[733] Amilcare Fantoli, *Una recente missione in AOI* (Rome: Società geografica italiana, 1939).
[734] In 1934 Fantoli went on a mission to Eritrea and Somalia, but the conflict with Ethiopia in 1935-1936 absorbed all the personnel instructed for the collection of data without replacing it. Despite the effort of doctor Pavirani in Somalia, the data in Eritrea for the year 1935 were the worst to record.
[735] Fantoli, "Sulla necessità di coordinare il servizio meteorologico nelle colonie italiane," in Atti Del Decimo Congresso Geografico Italiano, Milan, 1927.
[736] Fantoli, "Progetto per l'Organizzazione di un servizio meteorologico in Etiopia," 1936, in Archivio Istituto Agronomico per l'Oltremare, f. 1989.

about Ethiopia's climate that had hampered Italian efforts in the late nineteenth century in Ethiopia (see chapter 1). Based on the same experience, he recommended the collection of historical weather data about Ethiopia, as they were previously scattered in multiple archives and journals that were difficult to find—again, an archival problem that made the production of climate knowledge particularly difficult, as we have seen in chapter 1. In short, Italians had learned their lessons from their previous colonial failures.

In March 1937, Fantoli travelled again to Ethiopia to implement his plan.[737] He travelled for six months across 13,000 km, building the core of Ethiopia's meteorological network, with a meteorological office in Addis Ababa, five sections at all regional capitals, 25 meteorological stations and about 50 rainfall stations. While already in his mission in Africa, he was also assigned the task of drafting the project of the hydrological service, a clear example of how Italy's "integrated" colonization was often due to the availability of skilled experts on the ground rather than efficient planning. The meteorological and hydrological services of Ethiopia were crafted by the same scientist, the only truly skilled and adventurous colonial expert of meteorology and hydrology in the entire colonial empire.

[737] Fantoli, *Una recente missione in A.O.I.*

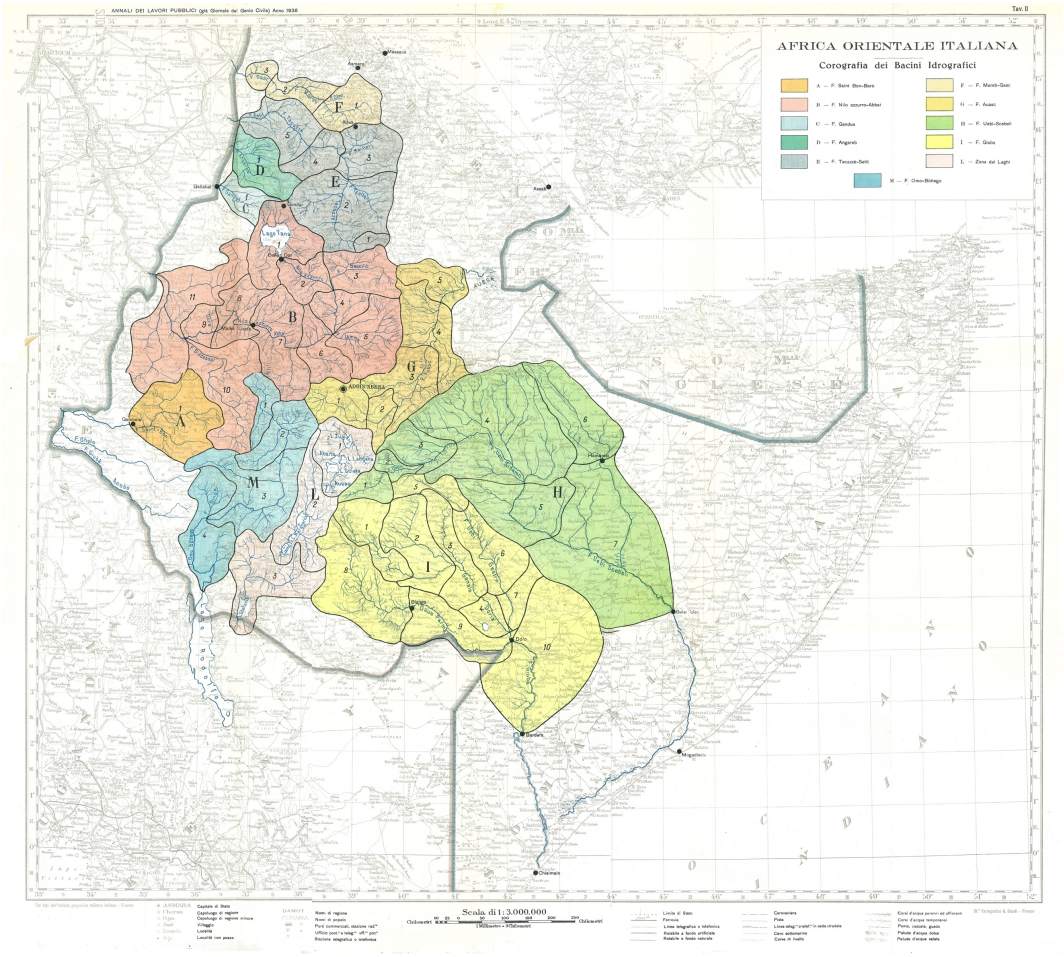

Fig. 4.8: Hydrographic basins of the Horn of Africa studied by the Italian Ministry of Public Works immediately after the invasion of Ethiopia.[738]

The hydrographic service of the Ministry of Public Works immediately tried to collect all available data about Ethiopian rivers in 1936.[739] The Italian National Research Council (C.N.R.) called for the institution of a hydrological service in Ethiopia right after the official ending of the war. On May 23, 1936, the vice president of the C.N.R. Giannini wrote to the Ministry of the Colonies and the Ministry of Public Works soliciting the study of the hydrography of Ethiopia as one of the most urgent issues to tackle: "The recent superb victory and the creation of the Empire raised attention of the C.N.R. on all scientific and technical problems that we need to solve, in order to make Italian work fertilize the conquered territories, for the prosperity of the fatherland. Among the initiatives that we need to discipline immediately, water use and its control have paramount importance, because the chances of development of a civilized life are connected with

[738] Ministero dei Lavori Pubblici. Servizio Idrografico, Notizie Idrografiche sull'Africa Orientale Italiana, Memoria del Prof. Ing. Marco Visentini (Rome: Istituto Politgrafico dello Stato, 1936), Table 2.
[739] Ministero dei Lavori Pubblici, Servizio Tecnico Centrale, ed., *Notizie idrografiche sull' Africa Orientale Italiana (Memoria del Prof. Ing. Marco Visentini)* (Rome: Istituto Poligrafico dello Stato, 1936).

the use of water, and this precious element is even more precious in Ethiopia." Giannini reported that Italians did not have an organic knowledge of the hydrography of the region, but only "sporadic measurements taken from foreigners meant for specific goals and concerning particular goals in small areas of the empire, where there were foreign interests." Clearly, Giannini was referring to British interests on the Blue Nile and the need of a more complete approach, as Italians could finally study the hydrographic problem of Ethiopia by themselves.[740] The Ministry of the Colonies approved the suggestion of the C.N.R. for a hydrographic office in Africa but nothing happened for almost a year, when they asked Fantoli during his meteorological mission to draft a project for the hydrographic service in order to know the regimen of the main rivers of the empire.[741] Fantoli ordered immediately the purchase of hydrographic instruments and focused on the Blue Nile, in order to ensure continuity with British measurements at Bahrdar Georghis for the study of Lake Tana, and the Awash river "since these rivers [could] be used best immediately for hydroelectric power plants." On July 14, 1937, Fantoli drafted an even more detailed plan of the location for the instruments necessary for the hydrographic study of the region.[742] In his final report, he commented: "The importance of hydrographic research and all the operations concerning the development of a complete program for the knowledge of hydrographic resources in the empire constitute a task of such magnitude that a specific office must be put in charge of it, with specialized personnel."[743] Fantoli proposed the creation of a central hydrographic office with six regional branches (one for each region of the empire), coordinated with the meteorological service in East Africa. In short, the project of an integrated system was spurred by Fantoli's presence on the ground rather than a project drafted in Rome. Despite claiming that they would organize water use rationally for irrigation, hydroelectric projects and aqueducts—all goals at odds with one another in a capitalist system—thanks to a totalitarian, integral, and corporatist mode of government, it is hard to individuate any actual comprehensive plan for the empire's water resources from the documents of the Ministry of the Colonies.

[740] A few days later, the C.N.R. wrote directly to Mussolini himself in order to create a committee for the production of better maps of Ethiopia, but disagreements among disparate ministries stalled the project for months regardless of what was happening on the ground. In particular, see the letter from Marconi to Mussolini, May 29, 1936 in Dominioni, 38-42. The C.N.R.'s opinion was similarly disregarded when it came to geological and mining studies.
[741] At first, the Ministry of the Colonies asked advice from the Ministry of Public Works. Fantoli agreed to draft projects for both the meteorological and the hydrographic service while he was already in Addis. See ACS, Ministero Africa Italiana, B. 107, f. 21: "Servizio Idrografico A.O." In particular, Ministry of the Colonies to Fantoli, March 10, 1937; Fantoli, May 1, 1937 da Addis Ababa: "Promemoria per S.E. il Vice Governatore Generale A.O.I." Addis Ababa, July 14, 1937.
[742] At a second time, Fantoli suggested creating three hydro-meteo-graphic stations on the upper course of the Omo, Dinder, and Shebelle River, for a total expense 80,000 lire just for instruments.
[743] Fantoli, Tripoli to Ministero A. I., October 19, 1938.

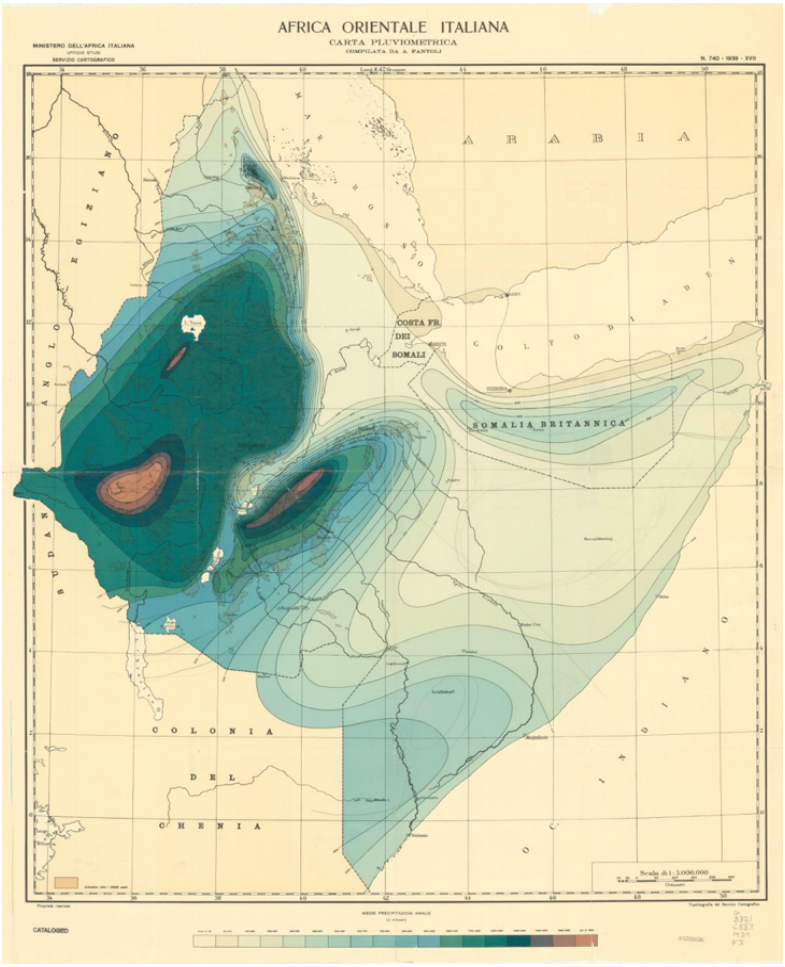

Fig. 4.9: Fantoli, Ministero dell'Africa italiana, Servizio Cartografico, "Africa Orientale Italiana, carte pluviometrica," 1939.

Fantoli was able to chart the average rainfall distribution of the entire Horn of Africa for the first time in 1939.[744] Rainfall charts were extremely useful in order to plan aqueducts for the emerging new cities of the empire, the damming of rivers for the production of hydroelectric power, and agriculture. Yet the meteorological service in East Africa was never perfectly functional, unlike the meteorological network in Libya.

Fantoli had created a structure for the collection of data for each governorship of Libya, Amara, Eritrea, Galla and Sidama, Harar, Shewa, and Somalia. However, the only data regularly flowing to Rome were those from Libya.

[744] Fantoli, Letter to the Central Meteorological Office, "Carta Pluviometrica dell'Etiopia Compilata da A. Fantoli," October 1939. C.R.A.-C.M.A. For the results of Fantoli's work, see Fantoli, *Contributo alla climatologia dell'Etiopia. Riassunto dei risultati e tabelle meteorologiche e pluviometriche* (Rome: Ministero degli Affari Esteri, 1965).

There were three reasons for the malfunctioning of Ethiopia's colonial service. First, the region was never fully under Italian control. Second, producing good meteorological data required a stable society of settlers and Mussolini never managed to turn Ethiopia into Italy's settlement colony. Italians focused on cash-crops plantations of cotton and coffee, rather than settlements for Italian peasants as in Libya, or those envisioned by Franchetti in the late nineteenth century (see chapter 1). Finally, regional hydrographic and meteorological services never worked effectively due to the lack of personnel and actual control on the territory of the empire.[745]

Italians had conquered Ethiopia in theory. In practice, Mussolini's "empire" was actually a violent, dark, thirsty, and hungry place. The arrival of a far higher number of people than those that the Italian colonies of Eritrea and Somalia had ever sustained strained their poor infrastructure, especially when it came to food and water supplies. In Ethiopia, such infrastructure did not exist, and often there was not enough food to feed all the troops involved in the occupation of a huge country still fighting against the Ethiopian guerrilla. Italian agronomists started frantically studying all the grains and types of wheat of the Ethiopian highlands in order to address these problems.[746] A number of aqueducts were planned to sustain the future growth of the cities of the empire.

Italians saw hydroelectric power as the best solution to address the need for energy, especially for massive land reclamation works and the reconstruction of the capital Addis Ababa. The General Director of Civilian Affairs asked for Fantoli's rainfall charts in October 1938 because they were useful to the colonial government and the Company C.O.N.I.E.L. (Compagnia Nazionale Imprese Elettriche), in charge of providing electricity to Addis Ababa in the future by building hydroelectric power plants on the Awash river. The plan was that the Public Works office would collect weather data along with the Meteorological Office and the data that the C.O.N.I.E.L. was collecting on its own in order to know the hydrometric and pluviometric regime of these regions. The Italian Association of Electric Companies (U.N.I.F.I.E.L.) rejoiced at the possibilities of development of hydroelectric power in the empire, in particular as they prospected the development of Lake Tana.[747]

Lake Tana was the most obvious point of intersection between scientific and political interests, as the origin of the hydrographic problem of Ethiopia, and probably the trigger for the war itself. During the war, a special motorized column led by the Secretary of the fascist party, Starace, occupied Gondar and the Lake Tana region for political more than military reasons, and

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[745] For example, the Governor of Harrar asked urgently on December 16, 1938 to send specialized personnel, explaining as follows: "we need increasingly abundant and precise knowledge for the solution of the problems of nutrition and irrigation, thus the creation of the Hydrographic Service has become urgent and cannot be further delayed." Governo dell' Harrar a Min. Africa Italiana, Direzione Generale Affari Civili, December 16, 1938, "Servizio Idrografico."

[746] Raffaele Ciferri, Guido Renzo Giglioli, Isaia Baldrati, and Mario Garavini, eds., *I Cereali del'Africa Italiana* (Florence: Regio Istituto Agronomico per l'Africa Italiana, 1939).

[747] Maiocchi mentions Ettore Cesari and Angelo Testa as engineers of the Ufficio Studi ("Research Office") of the U.N.I.F.I.E.L.E. See A. Testa and E. Cesari, "Notizie sulle possibilità di utilizzazioni idroelettriche nell'AOI" *Energia elettrica* (1936): 725-810.

in particular to take over the region of British interest as quickly as possible.[748] Throughout the conflict, London's official policy was to protest against Italian aggression without actually taking any concrete action, in order to avoid enraging Mussolini further and eventually getting a piece of the "Tana pie:" "as long as Mussolini would accept London's rights and interests in the Lake Tana area, the British would do nothing, or stop at rhetoric."[749]

In retrospect, London's assumption that Mussolini would respect British interests in Lake Tana after the war, based on Italy's past alliances with the British, looks entirely delusional, as in general the policy of appeasement that the British government followed with Italy on the eve of World War II. Reading the reports of Italian engineers rejoicing about the conquered lake expose the British Foreign Office as entirely naïve when it came to understanding Italians' new attitude.

As fascist techno-politics had finally solved the hydrographic problem of Ethiopia, the issue of Lake Tana looked completely different from the Italian point of view. Mussolini commissioned a detailed report about the Nile to the engineer Lello Pontecorvo. Pontecorvo denied outright the legitimacy of British claims to water rights at Lake Tana and prospected the use of the basin for both agricultural and hydroelectric purposes.[750]

The war had changed dramatically power relations in the region. Pontecorvo argued that "with the conquest of Ethiopia matters of fact have radically changed […]. Italy became in May 1936 a Nilotic power of primary importance. The potential wealth coming from the Nile is immense." He recommended the creation of fluvial ports to expand trade with Central Africa and establish diplomatic benefits with the British by organizing the river as an international river. In general, he advised the Ufficio Studi ("Research Office") of the Ministry of the Colonies that after the war, the point of view of English studies of the river could be reframed according to projects that were far more favorable to Italy.[751]

While Italians were still fighting against Ethiopian guerrillas throughout the Horn of Africa, in Rome Italian scientists and politicians alike were hectically scrambling to affirm respectively their piece of glory over the results of the campaign and their authority for the future study of the long-coveted empire, especially Lake Tana. The first scientific expedition organized by the National Research Council was, of course, to the lake and the sources of the Blue Nile. The scientist in charge of the exploration was Giotto Dainelli, one of the first professional scientists that had taken part at the first Colonial Congress of Asmara (see chapter 2) in 1905 under Governor Martini and that had become one of the most prominent geographers in fascist Italy.[752] The regimen of the lake, its fauna, and chemical characteristics were the subject of

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[748] Military historians agree that Starace's offensive towards Gondar and Lake Tana was useless from the military point view or it was even detrimental, as it diverted 3,348 men, 500 vehicles of food and ammunition, and 6 artillery pieces without meeting any military resistance. See Del Boca, 609-613.

[749] Tvedt, *The River Nile*, 174.

[750] See A.S.M.A.E., 54/16, "Accordi Italo Inglesi." A special issue of the report was prepared for Mussolini in person by Pontecorvo after instructions from the Minister of Public Works, Luigi Razza, and later Lessona, the Minister of the Colonies. An excerpt was published in *Annali dell'Africa italiana*, Vol. I, with the title "L'A.O.I. ed il Nilo di L. Pontecorvo." Pontecorvo had been advisor for twenty years of the Egyptian Government in hydraulics.

[751] A.S.M.A.E., "A.O.I. Varie (1936-1938)," 181/59, f. 297 "Lago Tana." Pontecorvo Report to the Ministry of the Colonies, Rome, March 10, 1938.

[752] Giotto Dainelli, Accademia d'Italia, Centro di studi per l'Africa orientale italiana, *Missione di studio al Lago Tana, promossa dal Centro studi per l'Africa orientale italiana, Conferenza tenuta alla Reale Accademia d'Italia il*

several pieces of research. They were examined at the 25th meeting of the Italian Society for the Advancement of Science in 1937.[753] In the following years, Italians produced a number of studies about Lake Tana, a further sign that they knew that the main priority for the successful colonization of the Horn was the control of water.[754]

Fascist propaganda even spurred the creation of songs and music dedicated to Lake Tana as well as poems about the Blue Nile.[755] The lake still gives the name to a street in Rome in the "African district" created by the regime (Via Lago Tana). Increasingly concerned, the British Government led by Chamberlain managed to convince Mussolini to sign a new agreement recognizing British interests in the lake in exchange for the official recognition of Italian sovereignty over Ethiopia, only to discover a few months later that Italians insisted on building a dam themselves and charge a heavy price for the water. Fascist Italy had no intentions of going back to the old way of British liberal techno-politics.[756]

Italians' planning fever reoriented dramatically the research interests of the entire Italian scientific community. Scientific experts from all institutions and disciplines scrambled to comply with the new techno-political regime that ordered to focus on the empire and its autarkic exploitation. In 1935, the fascist regime established the *Centro Studi AOI* (Eastern Africa Study Center) under the direction of the *Accademia d'Italia*.[757] The first meeting of the Italian Association for the Advancement of Science (namely the *Società Italiana per il Progresso delle Scienze* - S.I.P.S.) met in Tripoli on November 1-7, 1936 pledging with the choice of the location to increasingly focus on colonial issues. Thanks to their huge effort for the construction of the meteorological network during military operations in East Africa, the Ministry of Aeronautics sent as its representatives the meteorologists Filippo Eredia and G.B. Rizzo.[758] Like most Italians, Italian scientists were totally aligned with the success of the regime.

After the conquest of Ethiopia, the invitation to the program of the third Congress of Colonial Studies (held in Florence between April 12 and 17, 1937) proclaimed: "For the first time, bad memories and the anxious longing for that place in the world granted by the genius of our *Duce* will not veil the serenity of research. Unbound by the ties that delayed it, only today [our] scientific thought can turn to the study of the questions regarding the prosperity of the

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29 maggio 1938-XVI (Rome: Reale Accademia d'Italia, 1938). Dainelli, *Le pianure attorno al Tana* (Rome, 1937); Dainelli, *La regione del lago Tana; con 174 illustrazioni inediti e una carta geografica* (Milano: Mondadori, 1939). Dainelli promoted also the first massive study of Ethiopia's geology in three volumes that built on previous efforts from Italian geologists in the region: *Geologia dell'Africa Orientale: opera pubblicata col concorso del Consiglio Nazionale delle Ricerche* (Rome: Reale Accademia d'Italia, Centro Studi per l'Africa Orientale Italiana, 1943). In particular, see Stefanini, *Saggio di una carta geologica dell'Eritrea, della Somalia e dell'Etiopia alla scala di 1:2.000.000* (Florence: Istituto geografico militare, 1933).

[753] Ruggiero Ruggieri, *Gli studi idrografici del Lago Tana esaminati nei rapporti della valorizzazione terrier* (Rome: Società italiana per il progresso delle scienze, 1937).

[754] Ferruccio Antongini, *Etiopia: la eegione del Lago Tana* (Milano: Alfieri- Lacroix, 1936).

[755] They were written by Umberto Nicoletti with music by Eldo Di Lazzaro.

[756] The deal was signed on April 16, 1938, see Tvedt, *The River Nile*, 175-176.

[757] Del Boca, *Gli italiani*, vol. 2, 23.

[758] Eredia, "Il Clima e in particolare le correnti aeree della Libia," and Rizzo, "L'Organizzazione del servizio geofisico e meteorologico nelle Colonie Italiane."

empire, with freedom and serenity."[759] In the same conference, the meteorologist Filippo Eredia discussed the current state of knowledge of the climate in Eastern Africa, and Fantoli presented a paper about the environmental features of colonization regions in Ethiopia.[760] Italians scientists were at the very beginning of producing a general understanding of Ethiopian environments.

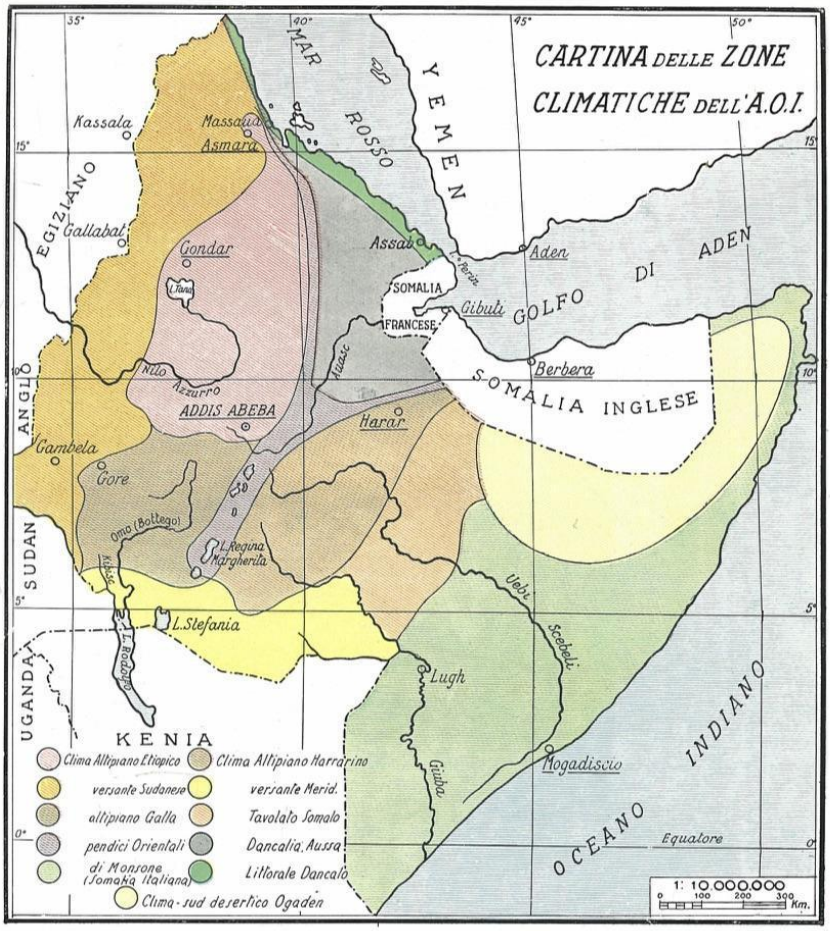

Fig. 4.10: Climatological regions of Ethiopia.[761]

[759] Centro di Studi Coloniali and Istituto Coloniale Fascista, "Terzo Congresso di Studi Coloniali," Florence, April 12-17, 1937, 3.
[760] *Ibid*., 23.
[761] Guido Sala and Filippo Eredia, eds., *Clima dell'Etiopia e confronti col clima dell'Eritrea e della Somalia* (Bergamo: S.E.S.A, 1938).

Yet when Italian scientists set themselves to actually study the empire, they discovered a new enemy: their own ignorance of the vast regions of the empire. Italian scientists frankly admitted that they did not know much about Ethiopia and literally mapped their own ignorance. For decades, they had focused on the formal empire of Somalia, Eritrea, and Libya. At the previous meeting in 1934, Dainelli had complained that about a hundred communications and papers dealt with Libya, about thirty to Somalia, about twenty to Eritrea and neighboring regions, twenty about the three colonies in general, and fewer than ten to the Dodecanese islands. "Only about ten considered colonial problems specifically concerning territories not under Italian rule," a clear reference to Ethiopia.[762] Because Italian expeditions into Ethiopia had often been carried out by military personnel and because Ethiopians did their best to control foreigners' trips to the highlands, Italian colonial science had been stuck within the limits of the formal empire for decades.

In a lecture to the entire congress titled "The Current State of Geographical Conditions of Italian Eastern Africa," Attilio Mori pointed out explicitly the lack of information and the need to expand the data about the colony. "We are very far from having enough elements for its complete geographical knowledge, even at the level of the simplest cartographic representation. With the exception of Eritrea and Southern Somalia data about altimetry and astronomic observations of the itineraries through the region are a patchy and inorganic complex that is difficult to use even for a piece of synthetic work."[763] His comments were echoed by Giuseppe Stefanini, commenting on the current state of geological knowledge of Ethiopia: "It is very difficult, if not impossible, to shortly synthesize the geological knowledge that we have so far about such a vast region like Ethiopia, even if such knowledge is incomplete for the most part (as it is exactly the case). Maybe it would be easier to say that the geology of the AOI is largely unknown and for some parts only imperfectly known […]. The cause of so many gaps, in addition to the obstacles systematically imposed by Abyssinian authorities to any explorer that intend to visit those territories with any instruments, are the lack of any reliable topographic map and the rudimental conditions of infrastructures and communications."[764] Of course, these scientists were all keen to propose new research for the study of the region.

Yet the war in Ethiopia dramatically changed Italian science, affecting even scientists and disciplines beyond the scope of colonial studies. As historian Roberto Maiocchi has pointed out, there was "a seamless public union between the keywords of autarky on one side, and the reason of science and technology."[765] This point emerges in particular by looking at the C.N.R. and the impact of the war on the institutional organization of meteorology.

Mussolini turned the C.N.R. into a scientific body whose goal, in his mind, was to advise the government and promote scientific research in areas considered useful to the country, despite its original mission to promote national coordination with international scientific research. In

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[762] Dainelli, in *Atti del secondo Congresso di studi coloniali, indetto dal Centro di studi coloniali sotto gli auspici della Società africana d'Italia. Napoli 1-5 ottobre 1934-VII* (Firenze: Olschki, 1935), 60.
[763] Dainelli in *Atti del terzo Congresso di studi coloniali, Firenze-Roma. 12-17 aprile 1937-XV* vol. V, IV Sezione Naturalistico-Geografica (Firenze, 1937), 214-215.
[764] Stefanini: "Stato attuale delle conoscenze sulla geologia e la morfologia dell'AOI," 166-167.
[765] Roberto Maiocchi, "Gli scienziati italiani e la guerra d'Etiopia," *FOEDUS* 32 (2012): 32–49.

short, rather than promoting scientific internationalism, the C.N.R. had to promote Italian imperialism by collaborating with the Government's autarchic targets.[766]

First, a new charter of the C.N.R. was adopted on June 25, 1937 that tightened the Government's grip on Italian scientific research. The new document placed the C.N.R. under Mussolini's direct control in order to "promote, coordinate and discipline scientific research for the advancement of scientific progress in the country."[767] Just a few months before, the Gran Consiglio del Fascismo, the supreme organ of the fascist party, approved on March 1, 1937 an "invitation to Italian scientists and experts to collaborate in order to achieve the greatest possible autarchy." A great deal of activity of the C.N.R. dealt with the development of the colonies after 1935 and the discovery of alternative ways to process raw materials to replace imported goods.[768] As Maiocchi pointed out, "there was the widespread impression that [1937] was a turning moment in the life of the C.N.R., because the goal of autarchy would require a stronger orientation of scientific research toward applicable goals."[769]

Second, on November 20, 1937, Mussolini appointed as President of the C.N.R. General Pietro Badoglio, the conqueror of Addis Ababa and previous governor of Libya.[770] For a few years, the offices of the Chief of Staff were actually hosted in the building of the C.N.R. The position had always been previously occupied by a scientist, not a politician or a member of the military.[771] Despite Mussolini's intention to regiment Italian scientists as if they were soldiers, Badoglio's great ability as military planner did not translate into his new role as scientific manager, as he interpreted his role as a form of ceremonial surveillance of the activities of the C.N.R. to underscore that autarky was the main goal of the institution. He simply announced: "The C.N.R. was called by the Duce to be at the forefront in the battle for autarchy."[772]

Third, Mussolini flooded the C.N.R. with funding between 1936 and 1939, convinced that the economic resources funneled in applied research would immediately produce economic returns for autarky or contribute to Italy's war effort while guerrilla fighting ravaged Ethiopia and the specter of war loomed on Europe in the second half of the 1930s. Economic resources went from about 7.7 millions lire in 1935 to 11,926,963 in 1936 and continued to skyrocket until 1939.[773] Research funding was administered by scientific committees that effectively kept a tight

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[766] Maiocchi, *Gli scienziati del Duce. Il ruolo dei ricercatori e del C.N.R. nella politica autarchica del fascismo* (Rome: Carocci, 2003).
[767] *Ibid*., 480.
[768] See Raffaella Simili, "La Presidenza Marconi" in Simili and Paoloni, eds., *Per una storia del Consiglio Nazionale delle Ricerche* (Bari: Laterza, 2001), 162.
[769] Maiocchi, "Il C.N.R. da Badoglio a Giordani" in Simili and Paoloni, 175.
[770] Rochat, *Pietro Badoglio* (Milan: Mondadori, 2002), 473-483.
[771] Until his death in July 1937, Guglielmo Marconi served as president. Before him, Vito Volterra, had been removed for his opposition to the fascist regime in 1924. Badoglio did not have specific preparation for the job, with the exception of a few previous contacts with Marconi, the Committee for Economic Independence and the Committee for Raw Materials. See Simili and Paoloni, 166.
[772] Rochat, *Pietro Badoglio*, 482.
[773] Maiocchi, "Il C.N.R. da Badoglio a Giordani," in Simili and Paoloni, 182.

rein on research, did not allow much intellectual freedom, and did not empower scientists' initiatives from below.[774]

Paradoxically, the military looked down on the C.N.R. and its scientific research. Despite Mussolini's appointment of General Badoglio as President of the C.N.R. to build a bridge between the military and the Italian scientific community, "the military and several ministries were not willing to collaborate with the C.N.R., which was left directionless. The only direction was 'autarchy,' but it was way too generic […]. The only criteria coming from the principles of autarchy was to privilege activities promising immediate application while depressing theoretical research." A clear example of the military's disdain of collaboration with civilian scientists is offered by the missing unification of Italy's meteorological services in 1939.

There is still a great deal of work to do to understand how the war in Ethiopia transformed Italian scientific disciplines. In the field of meteorology, it is fair to say that the war severely affected the development of the discipline at a crucial time of its international transformation. In particular, the resources and prestige gained by the Ministry of Aeronautics thanks to the conflict allowed the rise of a militarized meteorology at complete service of aeronautical needs. In short, after the war militarized meteorologists started to believe that they could do without civilian meteorologists.

A comparison between two projects for the reorganization of the meteorological service before and after the war, in 1934 and 1939 respectively, shows that the war catalyzed hidden tensions between military and civilian scientists. Between 1932 and 1934, all ministries involved in the study of the weather (Aeronautics, Agriculture, Colonies, Public Works, Education) drafted a project for the creation of a new unified institute of meteorology. What unified all ministries was the intent to replace the liberal Central Meteorological Office founded in the nineteenth century that was deemed inadequate to the current needs of the discipline.[775] The proposal arrived at Mussolini's desk at the most inopportune time in 1934, while Italian financial efforts were entirely turned toward the preparation for the war in Ethiopia. Despite being sponsored by Guglielmo Marconi himself, the proposal was discarded by the Ministry of the Treasury for lack of funding and Italy missed the chance of creating a modern central institute of meteorology in 1934.[776]

Even before the war in East Africa started, its preparation strengthened the position of the aeronautical meteorological service in Libya. In order to send airplanes to Ethiopia, the Ministry of Aeronautics required an efficient infrastructure of radio-meteorological bulletins connecting Italy with the Horn through Libya, Egypt and the Sudan (see fig 10). Despite the fact that the

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[774] Projects developed from below without the support of the C.N.R. struggled to find funding. For example, Edoardo Zavattari—a zoologist with excellent fascist credentials and one of the signatories of the Manifesto of Racial Scientists in 1938—failed to get funding from Mussolini for his project of an institute of colonial biology at the University of Rome, despite the formal support of the Ministries of Education and Colonies. See ACS, P.C.M. (1937-1939), b. 5.1.780.

[775] Foresta Martin and Geppi Calcara, *Per una storia della geofisica italiana: la nascita dell'Istituto Nazionale di Geofisica (1936) e la figura di Antonino Lo Surdo* (Milan: Springer, 2010).

[776] See ACS, P.C.M. (1931-1933), 1. 1.2 6033: "Coordinamento dei Servizi Meteorologici Esistenti presso diversi Ministeri." See also M.P.I., D. G. Istruzione Superiore Div. IV, Serie Leggi e Regolamenti, 1928-1948, b. 144; PCM (1934-1936): 5.1. 453 "Istituto Centrale di Meteorologia, Geodesia e Geofisica."

meteorological service of Libya, organized by Amilcare Fantoli, had been designed from the start to satisfy the needs or agriculture, artillery and aviation (see chapter 3), the Ministry of Aeronautics managed to create its own aeronautical meteorological service and split from the meteorological service of the Ministry of the Colonies, still directed by Fantoli himself.[777] This choice clearly damaged the Ministry of the Colonies and must have been approved by Italo Balbo, Governor of Libya, prestigious fascist leader and aviator himself.

[777] On May 9, 1935, the Superior Colonial Council approved the partition of a meteorological service in Libya for aeronautics separated by the Meteorological Office of Libya. Even if the Meteorological Service of Libya was known for being very efficient with a vast number of stations, the argument used by the Ministry of Aeronautics was that "the meteorological office in Tripoli cannot issue a daily weather map and does not have any personnel that is able to draw them and use them for weather forecasting, because its work is limited to the statistical and climatological study of the colony." (Paper n. 45: 15.5.35 Schema di R.D. concernente il riordinamento del Servizio Meteorologico della Libia). The new aeronautical-meteorological service was located at the outskirts of Tripoli, first on the western side of the harbor and later at the airport of Castel Benito, one of the settlements created by the Italian Government. Its goal was to organize flight assistance in Libya and for the routes heading to East Africa. See Archivio Ministero degli Esteri, ASMAI, Consiglio Coloniale, Pacco 19 (1935). Servizio, 266-267. The Director of the Regional Meteorological Center was Raffaele Di Maio, with the assistant geophysicists Lucio Melis and Luciano Biondo. Di Maio was known for being a friend of the Governor of Libya Italo Balbo.

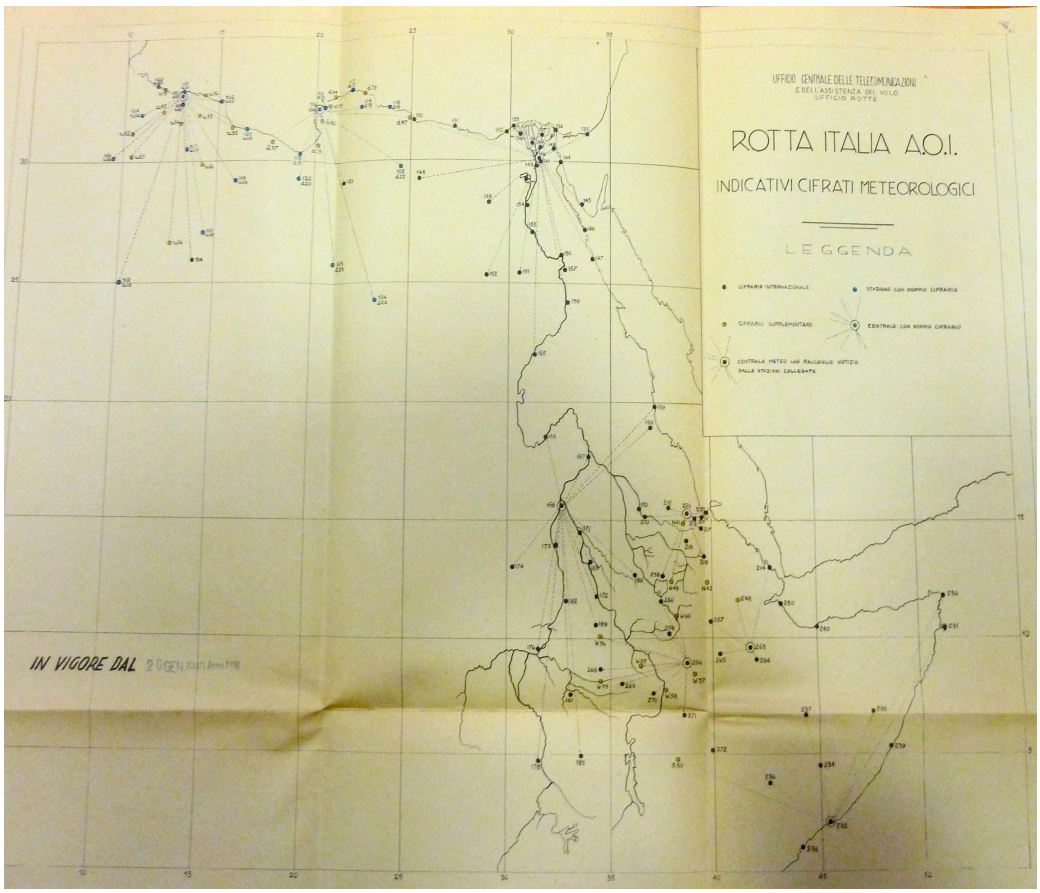

Fig. 4.11: The invisible network of radio meteorological signals connecting Italian East Africa and Libya showing the strength gained by the Ministry of Aeronautics and its meteorological service. Interestingly, the map is on a white background, erasing geographical and climatological features in favor of meteorological bulletins.[778]

Meanwhile, the war strengthened the infrastructure of the Ministry of Aeronautics with the creation of a meteorological network in the Horn of Africa for synoptic meteorology and promoted its international standing. At the seventh conference of the directors of meteorological service of the International Meteorological Organization in Warsaw in 1935, the Italian Ministry of Aeronautics was assigned the task of controlling and expanding meteorological networks in central and eastern Mediterranean region. Moreover, the meteorological service of the Ministry of Aeronautics took part in the meeting of the International Commission for the Study of African climate with their British and French colleagues in Lusaka in 1936, rather than the

[778] U.S.M.A.

meteorological service of the colonies.[779] Italians were assigned the study of the entire East African sector, including French and British Somaliland.

The impressive postwar growth of the aeronautical meteorological office—in terms of structure, organization, funding, international recognition, and proficiency in the scientific research at the time—resulted in the transformation of the aeronautical meteorological service into the Ufficio Centrale delle Telecomunicazioni e dell'Assistenza al Volo (Central Office of Telecommunication and Flight Assistance). This bureau unified in a single organization all meteorological services with telecommunication and logistical services for aeronautics. The new name highlighted that the science of meteorology had to be useful for aviation, above all, and calling the new institution "central" was an explicit challenge to the existing—yet seriously struggling—Central Meteorological Office that had existed since the liberal period.[780] By 1939 the Aeronautical Meteorological Service was so hegemonic and confident in its capacity that it aimed to control Italian meteorology altogether.[781]

The Ministry of Aeronautics also launched its own independent scientific journal titled *Aeronautical Meteorology*, clearly a choice to disregard the existing journal of the Italian Meteorological Society. A great deal of issues of the journal reported the data collected in Ethiopia by the aeronautical meteorological service in the Horn of Africa.

With the confidence gained from their colonial successes, the Ministry of Aeronautics proposed to centralize all meteorological services in Italy under its control, in apparent disregard of the previous consensual effort in 1934. In short, the Ministry of aeronautics tried to outdo its competitors by appealing directly to the Duce: "We are firmly convinced of the absolute need to unify meteorological services under disparate administrations […]. Considering the quality and quantity of the network of existing and prospected meteorological stations of the Ministry of Aeronautics in the territory of the metropole and the empire, as well as its absolute primacy above any other network […] we would achieve a more rational organization by unifying all meteorological services under the meteorological service of aeronautics."[782] This was a unilateral action from the Ministry of Aeronautics, without consultation with the other institutions involved in meteorology, and behind their back.

Of course, all other ministries rose up as soon as they were informed about the attempted hegemonic bid of the Ministry of Aeronautics. They all suggested that a coordination—rather than unification—of meteorological services under the supervision of the C.N.R. would have been preferable. The Ministry of the Colonies in particular argued that the constant expansion of meteorological stations in the Empire, the needs of experimental agricultural stations and the creation of the new hydrographic services in Ethiopia entailed the expansion of the network of

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[779] Secretariat de l'Organisation Meteorologique Internationale, Regional Commission N. 1 (Africa), "Minutes of the First Meeting Held at Lusaka, the Capital of Northern Rhodesia August 17th to 26th, 1936" (Utrecht: Imprimerie Broekhoff N.V., 1937).

[780] Areonautica militare, ed., *Origini ed evoluzione del Servizio Meteorologico dell'Aeronautica Militare*, vol. 1, 195.

[781] *Ibid*., p. 254.

[782] A.C.S., P.C.M. (1937-1939), b. 12.2.7161, f. 1, March 30, 1939 from the Ministry of Aeronautics to the Prime Minister.

the Ministry of the Colonies from 250 current stations to 2000 in the future.[783] Weather data and meteorological networks became elements of the power struggles within the fascist regime.

The attitude of the Ministry of Aeronautics reveals that power mattered more than the organization of the discipline. After critiquing the C.N.R. as "bureaucratic" and potentially detrimental to flight assistance, the ministry refused the offer of collaboration, so that Italy entered World War II without a modern and unified meteorological service.[784] It was this combination of fascist overconfidence and internal divisions between different branches of the regime, along with the exhaustion of the country after years of colonial warfare, that brought Italy to defeat in World War II. In the middle of war, when the empire was lost and American troops already occupied Sicily, the Ministry of Aeronautics finally accepted the need for more coordination with other civilian meteorological institutions. "It would not be a matter of constituting a bureaucratic institution, but an institution for the collection of data, observations, news, research concerning meteorological science, with practical intents."[785] This time, the Ministry of Aeronautics agreed. The first meeting was a brainstorming at the Ministry of Public Works in July 1943. On July 13 of the same year, meteorologists were asked to "accelerate the exchange of ideas" with the Ministry of Aeronautics, but it was too late. On July 25, 1943 Mussolini was removed from power and Italian fascist techno-politics came to a halt with the regime that had created them. Yet their legacy is still present today, as only the Meteorological Service of Aeronautics is still the most important Italian weather service since the 1935 invasion of Ethiopia.

4.5 Conclusions

When Italy joined World War II in 1940, Italian East Africa was doomed from the start, surrounded as it was by British colonies. Finally, the British decided to join forces with the Ethiopian resistance and help Haile Selassie take his kingdom back. In 1941, the last group of Italian troops surrendered around Gondar, near Lake Tana. Mussolini's empire, conquered in seven months, collapsed after about five years characterized by grandiose colonization projects, unprecedented violence, and a great deal of rhetoric that contrasted sharply with the reality of Ethiopia.

Despite its meteoric trajectory and Italians' desire to forget their deeds and misdeeds in Africa, fascist imperialism had a huge impact on modern Italian history. In the post-war period, Italians did their best to forget—and more importantly, to let their new British and American allies forget—their war crimes in Ethiopia and Libya, such as the use of poison gas. After unsuccessfully trying to take back part of their colonial possessions, the new republican government received only Somalia as a ten-years mandate of the United Nations until 1960; Libya was granted independence and Ethiopia was silenced with the annexation of Eritrea. The memory of Italy's colonial past was sabotaged in order to avoid any request of war reparations from Ethiopia and Libya. The history of Italian post-colonial amnesia began.

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[783] *Ibid*., Ministero dell'Africa Italiana to PCM, May 23, 1939.
[784] *Ibid*., Ministero dell'Aeronautica al PCM e C.N.R., September 4, 1939.
[785] Ministero dell'Aeronautica a C.N.R., April 29,1943.

Italian scientific experts were crucial to promoting an image of Italian colonialism contaminated with elements of post-war theories of development. While maintaining control of the archive of the Ministry of Italian Africa, experts published a history of Italian colonialism illustrating Italy's modernizing efforts, such as the construction of roads, cities, agricultural plantations, and promotion of a modern economy in Africa. In short, they tried to recast their previous enterprises in the new mold of an Italian civilizing mission in Africa that actually never was.

Italians did not colonize Africa to bring modernization and progress and they never even used the liberal techno-political rhetoric of "the improvement of the world" like the British or the French.[786] They invested the bare minimum necessary for the production of practical colonial knowledge and provided even less for the education of their colonial subjects. Their ex-colonies shared a situation of skyrocketing illiteracy and the absence of an educated upper class that could be able to take control of an independent government.[787] Italians had no intentions to modernize Africans—instead, their goal was to become modern themselves by exploiting the natural resources of foreign countries and peoples. If anything, they relentlessly complained about the fact that those natural resources were never enough from the colonial projects that they envisioned—whether peasant communities in the nineteenth century, capitalist plantations in the liberal period, or state-directed colonization under fascism.

Dosing quite carefully memories and omissions, Italian scientists were pivotal in promoting two long-lasting ideas about Italian colonialism. First, they nostalgically remember the efforts of their youth described in section 1 as a noble and ungrateful fight against nature. They complained about the lack of resources and environmental hostility they had encountered in Africa, whether the Libyan desert, the lack of water in Somalia, or the mountainous regions of Eritrea and Somalia. They "forgot" that their studies and efforts had always pointed to the hydrographic problem of the Horn of Africa and that they had been enthusiastic supporters of the invasion of Ethiopia and its colonization plans when they came. In short, they remembered the economic failures and environmental challenges of liberal techno-politics, while at the same time forgetting their transformation into the fascist techno-political regime that they had wholeheartedly supported.

Second, Italian scientific experts were the first to use "ignorance" as a disguise of their previous actual intentions, projects, and goals. This effort was so successful that a contemporary historian has recently called Italian imperialism "a colonialism like any other, just more ignorant and racist."[788] As I have shown, using the making of colonial "ignorance" as much as "colonial knowledge" an object of analysis rather than a damning label explains the mechanisms of liberal and fascist techno-politics, as much as their downfall.

Proclamations of "ignorance" were a recurring theme of the Italian colonial experience. In the liberal techno-political regime, Italians' admission of "ignorance" was a spur to create

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[786] Richard Harry Drayton, *Nature's Government: Science, Imperial Britain, and the "Improvement" of the World* (New Haven: Yale University Press, 2000).

[787] Tekeste Negash, "The Ideology of Colonialism: Educational Policy and Praxis in Eritrea," in *Italian Colonialism*, ed. by Mia Fuller and Ruth Ben-Ghiat (New York: Palgrave Macmillan, 2008), 121–30.

[788] Belladonna, *Gas in Etiopia*, 270. See *Ibidem*, 264-270.

more consensus for the Italian colonial experience after Adwa. In fact, the most influential generation of colonial scientific experts led Italian fascist techno-politics in the 1920s and 1930s had approached Italy's colonial problems in the previous techno-political regime and had tried to solve them by joining fascist imperial efforts. In short, imperialism turned the liberal techno-political regime into the fascist imperial techno-political project.

The continuity of scientific actors between the first experiences of liberal imperialism, the colonization of Libya, and their return to East Africa exemplifies the transformations of Italian colonialism. In many cases, the same personnel that had produced the first studies about Africa in the early twentieth century picked up their research exactly where they had left it. Filippo Eredia, Italy's most important meteorologist that had traveled to Libya and Eritrea in his youth, taught colonial climatology at the University of Naples and collected weather data in the Horn for the Ministry of Aeronautics in the 1930s. The doctor Lincoln Di Castro, the collector of weather data at the Italian embassy in Addis Ababa before World War I (see chapter 2), wrote pamphlets of colonial hygiene for Italian troops after 1935.[789] Isaia Baldrati, the Director of Eritrea's Agricultural Service under Governor Martini in the early twentieth century (see chapter 2), was among the authors of the first massive study of the empire's grains in 1936. The meteorologist of the Libyan meteorological service, Amilcare Fantoli, was promoted to Director of the Meteorological Service of the Ministry of Colonies and put in charge of producing the first map of rainfalls in the empire, thus dominating Italian colonial meteorology between 1919 and 1939 (see chapter 3).[790] Arnaldo Maugini and Nallo Mazzocchi Alemanni—the main architects of Italian colonization in the empire and land reclamation in Italy—began their careers in the early twentieth century in Libya and Somalia respectively. These individual trajectories show that fascist colonialism and the invasion of Ethiopia were in fact the result of projects and frustrations laid out in liberal Italy. The fascist regime fundamentally relied on the same scientific experts working on Italian colonialism for decades that had grown disillusioned with liberal techno-politics.

The lack of generational change is a striking symptom of how little fascist Italy had invested in the study of local natural resources and cultures before the invasion of Ethiopia in 1935, as well as in the training of new colonial experts. "[In 1935] young functionaries were bewildered when they saw that construction projects in Keren still needed to follow the lines drawn thirty years before […] and when they needed to know anything about the Cunama people they still had to rely on the volume by Alberto Pollera [from 1913]. Nobody in twenty years had been able to add a line or correct a piece of judgement."[791] The same can be said about any scientific studies about the climate of Ethiopia. Considering the meteorological bibliography compiled by Fantoli in 1932, the best research and data available were still those collected by the Italian doctor Lincoln di Castro and studied by Eredia and Oddone at the Central Meteorological Office in the early twentieth century, with the only exception of those sponsored by Luigi di

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[789] Lincoln De Castro, *Per star bene nelle colonie: nozioni e consigli* (Tripoli: Cacopardo, 1935); De Castro, *Etiopia: terra, uomini e cose* (Milan: Treves, 1936).

[790] Fantoli, "Africa Orientale Italiana, carte pluviometrica;" Fantoli, *Una recente missione in A.O.I.*

[791] A. Denti di Pirajno, *Incantesimi neri* (Milan: Mondadori, 1959), 185. Quoted in Del Boca, *Gli Italiani in Africa Orientale*, v. 2, 162.

Savoia in the Villaggio Duca degli Abruzzi in Somalia.[792] Fascism claimed to have promoted a "colonial consciousness" in Italy that was based on stereotypes functional to the making of Italians as brutal conquerors, not as interested scientific experts trained to study and understand the colonies. In this respect, fascist imperialism had been successful.

Fascist imperialism did not produce major breakthroughs in colonial knowledge compared to liberal imperialism not just because of its shorter time span, but because it lacked the most important ingredient to produce colonial vernacular knowledge: the collaboration with indigenous population. Italians' ignorance was first and foremost the result of the conflictual nature of the relationship between Italy and Ethiopia. Ethiopians were fully aware of the politics of scientific imperialism as well as the dangers of the politics of development, like the building of the Lake Tana dam and highway, when they got in foreign imperialist hands. In short, the strongest limit of Italian colonial knowledge was the lack of desire to understand local scientific cultures and produce an imperial vernacular knowledge.

Liberal and fascist techno-political regimes drew opposite conclusions from the major defeat of Adwa in 1896. The approach of the liberal techno-political regime was to promote more colonial knowledge to produce more consensus in Italy and prepare future political actions in Africa. Fascist techno-politics reversed the order of knowledge and action. When competing with stronger liberal techno-political regimes like the British empire in Lake Tana or with challenging environments like Somali rivers and Ethiopian mountains, Mussolini preferred to put action, aggression and violence ahead of reflection and knowledge. Consensus was produced by the regime's propaganda-machine, the results would come later.

The fascist techno-political regime favored quick solutions such as the Santoni photocamera and the use of poison gas that produced immediate results even if they were widely inaccurate. The grabbing of natural resources and the destruction of the enemy were more important than the detail-oriented desire for accuracy and precision that characterized liberal techno-politics in the early twentieth century. The most striking reminder of the gaps between the two techno-political regimes were the "maps of ignorance" that Italian scientists produced at the 1937 Congress of Colonial Studies, offering a visual representation of the regions Italians had studied in previous decades and how much they did not know yet. In the post-war period, Italian scientific experts could use their "ignorance" to demonstrate that Italian colonialism had been an external phenomenon that had not contaminated the independent world of "science." Ignorance was functional to restoring their credibility of objective scientists after being so compromised for decades with the bath of rhetoric and imperialist projects of the fascist regime. In short, admissions of "ignorance" were reconfigured to demonstrate that imperialism was Mussolini's choice, whereas scientific experts had just conformed to the circumstances like anyone else.

This perspective, largely inherited by the historiography until today, is deeply misleading and hides the reasons that drove Mussolini into attacking Ethiopia in 1935. Mussolini made a

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[792] Eredia and De Castro, *Sulla climatologia dell'Etiopia* (RomE: Tip. Unione Fd, 1914. De Castro, Lincoln, and Oddone, Emilio. "Risultati delle osservazioni meteorologiche ad Addis Abeba e Addis Alem," *Bollettino Della Società Geografica Italiana* 1 (1906); Eredia, *Lezioni di climatologia coloniale nella facoltà di agraria* (Naples: G.U.F, 1938).

decision based on the scientific and political information offered by engineering projects that Italian experts studied about Lake Tana. Any other reasons offered by military and diplomatic historians (the revenge of Adwa, the 1929 crash of the stock market, the rise of Hitler in Germany, the destabilization of the Versailles Order) had always been there and do not explain Mussolini's decision to attack in 1935, rather than before or later.

The perspective of environmental history and the study of colonial hydro-politics offer a far more convincing explanation of why and when Mussolini decided to attack Ethiopia. In this section, I have argued that Mussolini started considering the conquest of Ethiopia to outdo British competition for the water rights and economic penetration in Ethiopia. I do not intend to replace a teleological explanation of the conflict grounded in political history with a new one based on environmental determinism. Mussolini chose to frame the invasion as an opportunity to complete the colonial project left unfinished by the liberal state at Adwa in 1896 and get Italy's revenge. Understanding the relationship between liberal and fascist techno-political regimes makes his decision less obscure and arbitrary.

Like the liberal state, Mussolini knew that Somalia and Eritrea made economic sense only if connected with the water of the Ethiopian highlands. This awareness came after decades of efforts to make the environments of Eritrea and Somalia productive through agricultural schemes such as Tessenei and the Villaggio Duca degli Abruzzi. As Italy's liberal techno-political regime failed to harness the environmental challenges of the Horn of Africa, it was time to turn to military aggression and fascist techno-politics. As I have argued in this chapter, the notion of Italian colonialism as a "failure" prevents us from understanding Mussolini's actions, those from his scientific collaborators on the ground, and the long-lasting legacy of Italian colonialism in modern Italy, such as the militarization of meteorology today.

CONCLUSIONS

Results of the Ecological History Approach

What can we learn from the ecological history of Italian colonialism? To summarize, I have used the history of meteorology as the infrastructure of knowledge necessary to reconstruct the broader history of Italian imperialism across two techno-political regimes: liberalism and fascism. The history of Italian colonialism is often perceived as a set of "failures" rather than a coherent narrative of imperial expansion, environmental exploitation, or growth in scientific knowledge. Against such assumptions that cast Italian imperialism as a marginal historical process, I have shown that it can shed light on the broader question of the transformation of liberalism into fascism. Indeed, Italian colonialism differs from any other European empire because it was a palimpsest of two colonial projects, socio-technical imaginaries, and techno-political regimes: liberalism and fascism.

Liberal and fascist imperialism emerged as a result of the consequences of the battle of Adwa. They developed different strategies, re-used African resources, and over-wrote their scripts of imperialist myths whenever it was possible. They faced the same environments and cultural problems, but elaborated different strategies to address them. In particular, they were a response to the sense of wounded racial pride and the perceived lack of space and resources.

Before Adwa, Italian colonialism was a magmatic mix of political ambitions for the control of the entire Horn of Africa, vague agricultural economic prospects for a rural country that had not yet developed a capitalist economy, and demographic aspirations for Italian emigrants. In chapter 1, I have shown that Franchetti's socio-technical imaginary envisioning East Africa as a settlement colony was based on a cruel environmental assumption: the ecological unraveling of the Ethiopian Empire, the destruction of indigenous agriculture in Eritrea due to the Gulai cattle plague, and the demographic collapse of Ethiopian population.

Even if not all observers on the ground had the full picture of the ecological disasters triggered by the Italian invasion of the Ethiopian highlands, their "colonial experts" were aware of these events. However, they disagreed on how to exploit them because of their internal, regional divisions. Franchetti's project of settler colonialism imported Italian seeds, animals, and labor in order to replace local ecologies, rather than learning from them. The great Ethiopian famine of the "Cruel Days" was the original sin of Italian imperialism.

When the ecological and political conditions for a settlement colony in Africa dissolved after Adwa, Italians abandoned temporarily the demographic project of a settler colony only to mobilize it again as propaganda for the 1911 invasion of Libya. However, Italian elites could not easily deactivate the demographic myth of Italian colonialism, because the demand for land and the pressure of emigration were real concerns. Nineteenth-century peasants never dreamt about becoming rich in Ethiopia (where to find the capitals?) and were not passionate about colonial politics. In fact, they celebrated Crispi's downfall at Adwa with cheers like "Viva Menelik!" Thus, liberal imperialism aimed at creating a new basis of consensus and a new plan for Italian colonialism in Africa.

In chapter 2, I have shown how Italian colonialism got a new start with the creation of a liberal techno-political regime, under the sponsorship of the Governor of Eritrea Ferdinando Martini. Martini—a witness of the Great Ethiopian famine—scrapped Franchetti's plan that envisioned Africa as a settlement colony, since its ecological socio-technical imaginary had elapsed. Martini focused on the economic development of Eritrea by encouraging agriculture, railroad constructions, and a colonial meteorological service. As a savvy cultural organizer, his first colonial conference in Asmara promoted a new consensus among Italian scientific elites to build an epistemic community working with the state. By the early twentieth century, a cultural infrastructure of institutions, scientific journals, and intellectual networks involved in Italian colonialism was set in place. Science would help Italians restore their prestige lost at Adwa and hopefully make Eritrea and Somalia productive in the long-term.

Martini was an intelligent organizer of colonialist culture as well as a shrewd manipulator of Italian ignorance. He endorsed the narrative that "had Italians known better" indigenous laws, cultures, and environments, the tragedy of Adwa would not have happened. In his liberal techno-political scheme, the lesson from Adwa was to use science and technology in order to revitalize Italians' shattered influence on Ethiopia. Martini's success was limited because Italy was still a fragile economic power that could not compete with the British and French on the same level of liberal techno-politics, as shown by the analysis of British hydro-politics in the Blue-Nile basin and the French construction of the Addis Ababa-Djibouti railroad.

The two decades of warfare spanning between the invasion of Libya, the Great War, and the re-conquest of Libya (1911-1931) marked the crisis of Italian liberal techno-politics, the collapse of the scientific paradigm of liberal international meteorology, and the rise of a militarist techno-political regime. Libya was the laboratory for the transformation of liberal into fascist techno-politics. After resurrecting the myth that Libya could become the much-needed Italian "Fourth Shore" on the Mediterranean, Italian liberal techno-politics proved unable to develop a largely arid country in Tripolitania and control the fertile peninsula of Cyrenaica, ruled by the powerful Senussi Order.

For a decade, Italy's colonialist community had been preparing for a new colonial enterprise and had been setting the expectations too high. Facing the challenge of hostile political and natural environments, Italians used aircrafts in warfare for the first time in world history. While at first convinced that they would be developing an agricultural meteorological network in Libya like in Eritrea, Italian meteorologists saw their scientific paradigm collapse with the start of the Great War.

The war wiped out the scientific paradigm of liberal international meteorology. The meaning of "meteorology" as a science transformed, as weather forecasting became a much more prominent component than agricultural and climatological studies. The international community of European meteorologists worked for years in isolation from one another to produce weather forecasts for the frontlines, rather than pursuing their globalist research for the universal laws of the atmosphere by collecting collaboratively colonial data. By the end of war, multiple methods of weather forecasting circulated in Europe, without a clear hegemony of one method over the other. Fierce debates about the Norwegian "Polar Front Theory" replaced the collaborative international accumulation of weather data alongside colonial expansion that had characterized the age of empires.

The collapse of liberal imperialism was blatant in Libya even before the political rise of fascism. In North Africa, the liberal state changed the gears of Italian techno-politics with the beginning of the re-conquest of Libya in 1919. A new meteorological service was created to serve the needs of artillery, aviation, and agriculture between 1919 and 1931. The liberal state set up this new network as environmental infrastructure for the possible use of poison gas against Arab rebels. This was a disturbing antecedent to the infamous deployment of chemical weapons during the fascist invasion of Ethiopia in 1935, showing the metamorphosis of an exasperated liberal imperialism into the forthcoming fascist techno-political regime. Again, Italians manufactured ignorance by censoring the report that explained the real goals of the Libyan meteorological service. The colonization of Libya under fascism and the settlement of Italian colonists in North Africa after the deportation of Arab population marked the triumph of fascist techno-politics. Fascism could finally claim to have accomplished what the liberal state had failed to do: realize the myth of an Italian migration to Africa against the ecological limits of North-African environments and the traditional political economy of liberal techno-politics.

The transition from liberal to fascist techno-politics in the Horn of Africa was more abrupt than in Libya. At first, Mussolini followed the guidelines of colonial policies designed in the liberal period. Sudden floods from the Ethiopian highlands, beyond Italians' control, disrupted the cotton, sugar, and bananas plantations of Genale, Villaggio Duca degli Abruzzi, and Tessenei. Italian colonial experts tried in vain to regiment the irregular waterfalls of Eritrea and Somalia in irrigation schemes. Meanwhile, the project of a dam at Lake Tana for the management of the Blue Nile threatened Italian interests in Western Ethiopia, in favor of British and American interests. Without access to the water and natural resources of Western Ethiopia as a link between Eritrea and Somalia, Italian colonialism in the Horn risked to become a failure forever. The environmental limits of Italian developmental projects in Eritrea and Somalia and the intensification of the competition with the hydro-politics of the British Empire triggered the invasion of Ethiopia.

Mussolini portrayed the 1935 war against Ethiopia as the ultimate completion of the colonial project abandoned at Adwa by the liberal state. The techno-politics of aggression and the logic of fascist imperialism trumped the organization of the territory developed in a liberal techno-political regime. Mussolini invoked Italy's need of a demographic outlet, but he did not have a clear plan on how to govern the nature and people of Ethiopia. Grabbing resources quickly was a more paramount goal in fascist techno-politics than in liberal techno-politics. Fascist techno-politics subverted the Versailles Order and overrun the liberal logic of slow economic development under the impetus of autarchy and a totalitarian ("integrale") approach to colonialism.
The weak infrastructure of roads and incomplete maps leading to the border with Ethiopia—designed by a cheap imperialism for economic, not military penetration—proved completely insufficient when Mussolini reversed against Ethiopia a massive amount of equipment and military forces, thus turning a colonial adventure into a national war. Aviation, a network of airfields, and a brand new military meteorological service allowed Italians to break free from the environmental challenges of the rugged terrain of the Ethiopian highlands. Aerial photography, bombardments, and chemical weapons proved a crucial advantage over a traditional African army.

The environmental base of the success of fascist techno-politics turned into the reasons of the downfall of Mussolini's empire, as Italians could not use airplanes during the long rainy season. Italians were at the mercy of the weather, without communication, and cartographically blind against the Ethiopian guerrillas stirred by Italian violence and Mussolini's racial policy of apartheid. The war transformed the relationship between science and the state. Fascism enrolled scientists in the battle for autarchy, Mussolini appointed general Badoglio (the conqueror of Addis Ababa) as President of the National Research Council, and the Italian military Meteorological Service of Aeronautics reached the international status previously held by the liberal Central Meteorological Office. Fascism claimed to have succeeded where liberal imperialism had failed. In terms of colonial violence and military conquest, this assertion is certainly true. Yet if we examine Mussolini's empire from the lens of imperial governance, Italian East Africa was the epitome of how *not* to rule an empire. In the post-war period, it was the turn of fascist imperialism to be considered a ruinous failure in Europe itself, since the invasion of Ethiopia had led Italy toward the alliance with Nazi Germany and the disaster of World War II. As a result, Italian imperialism became an unwanted legacy, a palimpsest of two different colonial projects that had developed in continuity—and yet in tension—with one another.

New Research Directions and a Warning for the Future

My research intends to open new directions in the history of science, environment, and empire. I hope that further studies will enrich the structure of the ecological history that I have outlined in this work and will perfection some of its details, but I am also confident that the framework and periodization of liberal and fascist techno-politics will prove useful for other scholars. In this respect, I hope this work will produce a paradigm-shift in the historiography about Italian imperialism as a palimpsest of multiple rationalities and colonial projects in dialogue with African environments and forms of knowledge. There directions of research still deserve further attention.

First, many histories of the entanglement between Italian imperialism and the natural sciences are still to be written. I focused on meteorology because the study of climate and water resources was the fundamental base of any colonization plan. My sources were the voices of agronomists, botanists, doctors, and engineers, but I have collected their voices without examining how their experience transformed their fields. Selecting a scientific discipline like meteorology provided an arbitrary but manageable intellectual boundary to show how colonialism shaped Italian sciences. However, botany, forestry, biology, geology, hydrology, engineering, public health and medicine are still unexploited areas of analysis in the Italian colonial empire.

Second, the production of hybrid forms of knowledge between colonial subjects and Italians remains an uncharted topic in Italian historiography. In this realm, I have only scratched the surface, unfortunately. My research includes Somali weather folklore and I am sure that the director of the meteorological service in Libya developed his studies thanks to patient observations of North African nature and Arab weather proverbs. Yet I have only investigated the tip of an iceberg. Other types of sources would probably be necessary to understand how Arabs, Somalis, Eritreans, and Ethiopians produced natural knowledge and exchanged it with Italian colonists, scientists, and

administrators. Current political instability does not allow to safely carry out field work in Libya, Somalia, and Eritrea. Ethiopia remains the most promising country for further research, despite the short time span of Italian presence there. Considering the scholarship about the hybridity of forms of knowledge in the British and French empires with colonized societies, it is very much plausible that similar cultural transfers took place in the Italian case.

Third, Italian imperialism still needs to finds its place in the broader field of international history. Because I intended to demonstrate how colonial environments shaped Italian climate science, I artificially focused on the relationship between Italy and its colonies. Whenever possible, I have included comparisons and connections with Britain and France, especially when dealing with the competition between European powers in the Horn of Africa. In chapter 3, I drafted the first international history of meteorology in Europe before and after the Great War, in order to explain the demise of the scientific paradigm of liberal international meteorology and the difficult reception of the Norwegian "Polar Front Theory." Yet Italian imperialism did not exist in a vacuum and knowledge production took place across colonial empires. In the future, I am planning on investigating the history of Italian colonialism from the perspective of international history.

Choosing to write an ecological history and the method of Science and Technology Studies allowed me to combine political history, history of science, and environmental history to produce a new account of Italian imperialism.

First, I hope to have re-located Italian colonial history from Europe to Africa. I have written a history of Italian imperialism that emphasizes the agency of actors on the ground, whether unknown soldiers, doctors, or scientific experts, and especially the role of local environments in shaping Italian scientific knowledge. This perspective balances the traditional account—based on the "distorted mirror" of state and military archives—of political history that portrays Italian colonialism as just the result of decisions made in Rome.[793] Instead, I have written a history of Italian sciences from the perspective of the colonial empire, rather than based on decisions made in Rome. Surely Rome's decision to invade Ethiopia was centralized and political. Yet the STS concept of techno-political regimes reveal that the actions of unknown meteorologists, scientists, colonial administrators, and doctors on the ground were as political as Mussolini's determinations in Rome.

Second, the ecological history of Italian colonialism placed the Italian state among other actors of the colonialism, such as Africa environments, colonial subjects and the independent Ethiopian kingdom, Italian civil society, and their dialectical production of scientific knowledge. Paying attention to the geographies of knowledge entails realizing that the Italian state was always behind ecological transformations on the ground, no matter what the biased perspective of state and military archives might be. Like Richard Grove in *Green Imperialism*, I have argued that the colonial experience and African

[793] For example, Labanaca writes: "In the Italian colonial case, since the beginning the weight of the center and politics in particular was always prominent, because economic interests were never relevant enough to lead politics […] because the public opinion counted less than in other countries in the political and electoral system of liberal Italy […] because there were more contrasts […] than consensus between expansionist circles and the military […]. For these and other reasons, the political initiative from the center remained occupied a wide space in the history of Italian colonialism." Labanca, *Oltremare: storia dell'espansione coloniale italiana* (Bologna: il Mulino, 2002), 55.

environments transformed Italy itself, the organization of its environmental sciences, and its techno-political regimes. The colonial encounter transformed Italy as much as the rest of Europe. In fact, every time Italians watch in TV the weather forecasts produced by meteorological service or aeronautics they are assisting to a legacy of the militarization of meteorology, the demise of the civilian Central Meteorological Office, and the 1935 invasion of Ethiopia.

Third, the original angle of ecological history advances produces a new, revisionist account of the military and political history of Italian colonialism. In particular, in chapter 1 I argued that the myth that East Africa could become a settlement colony for Italian peasants was based on the ecological unraveling of Ethiopia that the Italian invasion triggered with the transfer of a cattle plague epidemics. In chapter 4, I provided a new interpretation of Mussolini's invasion of Ethiopia in 1935 as a result of the competition with the British Empire for the control of the Lake Tana region in Western Ethiopia. Including the analysis of water, rainfall, animals and natural environments in the history of colonialism explains the timing and motives behind Mussolini's otherwise utterly arbitrary decision to invade Ethiopia in 1935.

My methodology intends to offer a fresh perspective on the history of Italian colonialism from the perspective of the history of science and environment that complicated and complemented the political, social and military histories produced since the 1960s by historians Angelo Del Boca and Nicola Labanca. Building on their work, I aimed to contribute to the removal of many misconceptions about Italians in Africa by insisting on the relationship between war, environment, and science. It was this scientific and environmental infrastructure that made the use of aerial warfare, poison gas, and chemical weapons first conceivable and later possible. By focusing on the history of water, rainfall, practices of climate data collection and meteorology, I have reconstructed the social fabric of Italian colonialism as well as the techno-political projects of liberal and fascist imperialism.

The most enduring myth of Italian colonialism is that Italians were *brava gente*, better colonizers than the British and the French. Quite to the contrary, this ecological history suggests that Italians were set to become as brutal as any other colonial power had they succeeded in taking advantage of the drought and famine that plagued Ethiopia before Adwa. Only the lack of coordination between scientists and the state as well as the proliferation of competing colonial projects prevented Italians from understanding that the environmental conditions for their success were only temporary. Adwa exposed the improvisation of early Italian colonialism and robbed Italian history of the linear trajectory of accumulation of knowledge and power that we are used to in other colonial empires.

Italian techno-politics escape linear narratives because liberal and fascist techno-political regimes overwrote each other's stories, ideologies, and colonization projects. Mussolini did not invent anything new about Italian imperialism. He was a journalist, the same socialist journalist that had been jailed during protests against the invasion of Libya in 1911. Mussolini simply overwrote, made notes and corrections, and gave a new spin and emphasis on the text of liberal imperialism, creating a new palimpsest of Italian colonialism.

In particular, Mussolini was successful in mobilizing the grievances of the liberal era in an organic program. He gave voice to the discontent for the limits of liberal

imperialism and made colonialism a central concern in fascist ideology. In the case of the war in Ethiopia, he was willing to deploy national resources in Africa on a massive scale. No liberal empire could afford to do that. Del Boca wrote that the liberal state resorted to colonial violence and racism as brutally as fascism, with the exception of the use of chemical weapons.[794] My discovery that the Meteorological Service of Libya was originally created to test chemical weapons in 1919 pushes Del Boca's argument even further. The transformation of one techno-political regime into the other (almost seamless in Libya and more sudden in East Africa) was a structural remodeling of the relationship between Italian science, environment and empire, despite the understandable desire to charge Mussolini with the entire responsibility of Italian atrocities in Africa.

In order the understand the transformation of liberalism into fascism, we have to look beyond the distorting mirror of the dictatorship and the role of the individual, to examine the structural ecological history of Italian colonialism. Both liberal and fascist techno-political regimes were different responses to the same two problems left unsolved at Adwa. First, the sense of racial disorder caused by a debacle against an enemy considered inferior, a shame that deeply affected the perception of racial hierarchy in Italy and made the notion of "race" virtually disappear in Italy until fascism vindicated Adwa, only to be eclipsed again after World War II. Second, the ensuing perception of lack of space, natural resources, and proper standing in a closed world where no indefinite capitalist development is possible, but only a zero-sum game of racial struggle.

Thus, the history of Italian colonialism offers a lesson that is more useful today than ever in history. The transformation of a liberal to a fascist techno-political regime was due to the combination of environmental constraints, a sense of racial defeat, and ill-conceived colonial adventures. The British and French empires faced similar hostile environmental challenges of aridity and unruly colonial environments, but their sense of racial superiority and mastery of nature was never challenged on the scale of Italian colonialism, and never these two factors occurred together. The most similar combination of these factors took place in Nazi Germany, but the loss of the colonial empire unleashed the Nazis' brutality, sense of racial revenge, and conquest of space in Eastern Europe, rather than in Africa.

Nowadays, the world is facing the environmental challenges of climate change, the capitalist exhaustion of natural resources, and the crisis of the myth of an unending frontier promising unlimited space, development and progress. We are at a historic crossroads. Humanity has to decide whether to act on the base of consensual liberal techno-politics like the Paris Climate Agreement, based on climate science, international consensus, and mutual respect among nations, or plunge into a new order where politics trumps science, national and racial competition dictate the rules of international relations, and natural resources are seen as a benefit for the few. This ecological history of Italian colonialism strongly warns against the second option.

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[794] As Del Boca writes: "Even if it despised the laxity and lack of determination of liberal democracy, fascism did not invent anything [new] that the liberal state had not already tried out in the colonies. It was only more efficient thanks to the political means of a dictatorship, to new weapons (legal and illegal), new means of communication and propaganda, and the masses' support for the myth of the place in the sun." Del Boca, *Gli italiani*, vol. 1, 879-880.

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A.C.S.	Archivio Centrale dello Stato
A.S.M.A.E.	Archivio Storico Ministero degli Affari Esteri, Ministero Africa Italiana
b.	busta [envelope]
B.S.A.I.	Bollettino della Società Aeronautica Italiana
B.S.G.I.	Bollettino della Società Geografica Italiana
Bjerknes Papers	Norway National Library, Oslo
C.N.R.	Consiglio Nazionale per le Ricerche
C.R.A. - C.M.A.	Consiglio per la Ricerca in Agricoltura - Climatologia e Meteorologia applicate all'Agricoltura
D.T.M.	Carnegie Institution for Science, Department of Terrestrial Magnetism
Eredia Archive	Private documents by Mirella Petitto-Eredia
f.	fascicolo [folder]
F.O.	United Kingdom, National Archive, Foreign Office
I.A.O.	Istituto Agronomico per l'Oltremare
M.A.I.	Ministero dell'Africa Italiana
M.A.I.C.	Ministero dell'Agricoltura, Industria e Commercio
P.C.M.	Presidenza del Consiglio dei Ministri
pos.	posizione [position]
S.I.P.S.	Società Italiana per il Progresso delle Scienze
U.S.M.A.	Ufficio Storico del Ministero dell'Aeronautica
U.S.S.M.E.	Ufficio Storico dello Stato Maggiore dell'Esercito

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