The Transimperial Emergence of Pest Control Research: Economic Entomology between Europe and the Tropical World, c. 1890–1930

Tomás Bartoletti

ABSTRACTS

The spread of hazardous chemicals, such as pesticides like DDT, has been the topic of much research in recent decades. Yet the scientific formation of economic entomology – the branch of study of insects interrelated with profit-oriented land management – since the late nineteenth century remains unexplored. As this paper shows, the transimperial emergence of pest control research was the human response to the unexpected ways in which insects spread across plantations and ecological niches without respecting political borders, thereby endangering capitalist profit and food security. The science of pesticides depended on the colonial and private interests associated with the expansion of commodity frontiers in the tropical world. By focusing on German and Italian practices of institutionalizing entomological research in colonial spaces, this paper contributes to diversifying Anglo-centric narratives and to highlighting the interlocking of entomology in processes of global territorialization and imperial capitalism.

Die Verbreitung gefährlicher Chemikalien wie etwa des Pestizids DDT hat im Laufe der letzten Jahrzehnte viel wissenschaftliche Aufmerksamkeit erhalten. Hingegen ist die Entstehung der wirtschaftlichen Entomologie – jener Bereich der Insektenkunde, der sich mit gewinnorientierter Landnutzung beschäftigt – seit dem späten neunzehnten Jahrhundert bislang unerforscht geblieben. Wie dieser Beitrag zeigt, war die transimperiale Entstehung der Schädlingsbekämpfung die menschliche Antwort auf die unvorhersagbare Ausbreitung von Insekten in Plantagen und ökologischen Nischen über politische Grenzen hinweg, was eine Bedrohung für kapitalis-

* I would like to thank Corinna Unger for the careful reading and suggestions of previous versions of this article. I am also grateful to Sabine Clarke, Eric Vanhaute, Nils Güttler, Deirdre Moore, Simone Müller, Rohan D´Souza, Frank Uekötter and Iva Pesa for the helpful critiques during the presentations of this paper in Leipzig, Geneva and Florence.

Comparativ | Zeitschrift für Globalgeschichte und vergleichende Gesellschaftsforschung 32 (2022) Heft 6, S. 704–725.
DOI: 10.26014/j.comp.2022.06.03

tische Gewinne und Nahrungssicherheit darstellte. Die Pestizidforschung hing von kolonialen und privaten Interessen ab, die eng mit der Expansion der „commodity frontiers" in tropischen Regionen verknüpft waren. Indem der Beitrag die deutsche und italienische Institutionalisierung entomologischer Forschung in den Kolonien untersucht, trägt er dazu bei, anglozentrische Narrative zu ergänzen und die Verzahnung dieser Forschung mit Prozessen der globalen Territorialisierung und des imperialen Kapitalismus hervorzuheben.

1. Introduction

Over the past two decades, historians have shown an increasing and stimulating interest in the study of insects. By integrating political, social and global factors in the analysis they highlight the role of insects in the making of the modern world.[1] In this specific field, historical scholarship on pesticides during the DDT boom and on tropical medicine is comprehensive.[2] The history of economic entomology, however, the branch of the scientific study of insects interrelated with profit-oriented land management, still remains to be written, according to historian of technology and agriculture John Harwood.[3] Considering the significance of pest controls in plantation economies ca. 1880–1930, for instance, related "insect histories" have not yet been sufficiently explored. With this paper, I intend to reassess the global emergence of economic entomology and its significant role in shaping a particular conception of nature based on anxieties around control and profit-driven land use during the Age of Empire.[4]

By focusing on the emergence of pest control research in Germany and Italy and their colonial spaces, this paper aims to diversify Anglo-centric narratives about economic entomology and its global institutionalisation. The German and Italian cases reveal a more extensive circulation of pest control research beyond the much examined American and British experiences. While certain specific rhetorical uses had an ideological background in the later context of Nazi and Fascist regimes, the extermination of insects considered

1 J. Clark, Bugs and the Victorians, London 2009; R. Deb Roy, Malarial Subjects: Empire, Medicine and Nonhumans in British India, 1820–1909, Cambridge 2017; J. McNeill, Mosquito Empires: Ecology and War in the Greater Caribbean, 1620–1914, Cambridge 2010; E. Melillo, The Butterfly Effect: Insects and the Making of the Modern World, New York 2020.

2 Recent historical scholarship on pesticides during the DDT boom includes F. Davis, Banned: A History of Pesticides and the Science of Toxicology, New Haven, CT 2014; T. Dunlap (ed.), DDT, Silent Spring, and the Rise of Environmentalism, Seattle 2008; D. Kinkela, DDT and the American Century: Global Health, Environmental Politics, and the Pesticide That Changed the World, Chapel Hill 2011; C. Simon, DDT: Kulturgeschichte einer chemischen Verbindung, Basel 1999. Historical scholarship on tropical medicine includes C. Chakanetsa, The Mobile Workshop: The Tsetse Fly and African Knowledge Production, Cambridge, MA 2018; Deb Roy, Malarial Subjects; D. J. Neill, Networks in Tropical Medicine. Internationalism, Colonialism, and the Rise of a Medical Specialty, 1890–1930, Stanford 2012.

3 J. Harwood, Technology's Dilemma: Agricultural Colleges between Science and Practice in Germany, 1860–1934, New York 2005, p. 27.

4 J. Beattie/E. Melillo/E. O'Gorman (eds.), Eco-Cultural Networks and the British Empire: New Views on Environmental History, London 2015; U. Kirchberger/B. Bennett (eds.), Environments of Empire, Networks and Agents of Ecological Change, Chapel Hill 2020; F. Uekötter, Im Strudel. Eine Umweltgeschichte der modernen Welt, Frankfurt am Main 2020.

"pests" to assure food security and commodity materials started to gain extended consensus beyond national flags from the late nineteenth century.[5] I argue that the so-called war on nature, which was strongly related to the global emergence of economic entomology as a scientific field, depended considerably on the colonial and private interests associated with the expansion of commodity frontiers in the tropical world.[6]

European overseas expansion and its exploitation of natural resources meant knowledge about pest control and plant diseases was crucial for the transimperial settings of commodity chains.[7] During the period under survey, economic entomology was intensively applied to improve yields in several plantation based economic systems, becoming a prominent field of global scientific research.[8] Large extensions of monoculture land required innovative methods to provide sufficient certainties about the management of tropical raw materials.[9] This article analyses the decades between ca. 1880 and 1930 as a turning point when new trends in ecological biology and scientific experimental practices in the field spread in several colonial, quasi-colonial and state spaces, creating the global conditions that later allowed DDT's boom and the Green revolution that followed.[10] Furthermore, the period has been described as the age of "high" imperialism

5 See S. Jansen, "Schädlinge": Geschichte eines wissenschaftlichen und politischen Konstrukts, 1840–1920, Frankfurt am Main 2003; M. Szöllosi-Janze, Pesticides and War: the Case of Fritz Haber, in: European Review. Interdisciplinary Journal of the Academia Europaea 9 (2001) 1, pp. 97–108.

6 J. Buhs, The Fire Ant Wars. Nature, Science, and Public Policy in Twentieth-Century America, Chicago 2004; J. McWilliams, American Pests: The Losing War on Insects from Colonial Times to DDT, New York 2008; E. Russell, War and Nature: Fighting Humans and Insects with Chemicals from World War I to Silent Spring, Cambridge 2001.

7 Notably, the notion of a "transimperial space" has been approached prominently by C. L. Blaser/M. Ligtenberg/J. Selander, Introduction: Transimperial Webs of Knowledge at the Margins of Imperial Europe, in: Comparativ 31 (2022) 5–6, pp. 527–539; M. Brescius, German Science in the Age of Empire: Enterprise, Opportunity and the Schlagintweit Brothers, Cambridge 2019; M. Brescius/C. Dejung, The Plantation Gaze: Imperial Careering and Agronomic Knowledge between Europe and the Tropics, in: Comparativ 31 (2022) 5–6, pp. 572–590; S. Conway, Britannia's Auxiliaries: Continental Europeans and the British Empire, 1740–1800, Oxford 2017; D. Hedinger/N. Heé, Transimperial History – Connectivity, Cooperation and Competition, in: Journal of Modern European History 16 (2018) 4, pp. 429–452; N. Heé, Transimperial Opportunities? Transcending the Nation in Imperial Formations, in: Comparativ 31 (2022) 5–6, pp. 631–639; B. C. Schär, Introduction: The Dutch East Indies and Europe, ca. 1800–1930. An Empire of Demands and Opportunities, in: BMGN – Low Countries Historical Review 134 (2019) 3, pp. 4–20.

8 K. Brown, Political Entomology: The Insectile Challenge to Agricultural Development in the Cape Colony, 1895–1910, in: Journal of Southern African Studies 29 (2003) 2, pp. 529–549; P. Das/V. Giri, Locust Infestations and Marginalized Communities in Colonial Western India in the Nineteenth Century, in: Environment & Society Portal, Arcadia (Spring 2021) 12, Rachel Carson Center for Environment and Society, doi:10.5282/rcc/9262; Jansen, "Schädlinge"; E. Melillo, Global Entomologies: Insects, Empires, and the "Synthetic Age" in World History, in: Past & Present 223 (2014) 1, pp. 233–270; P. W. Riegert, From Arsenic to DDT: A History of Entomology in Western Canada, Toronto 1980; Russell, War and Nature; L. Straumann, Nützliche Schädlinge: angewandte Entomologie, chemische Industrie und Landwirtschaftspolitik in der Schweiz 1874–1952, Zurich 2005; P. Triantafillou, Governing Agricultural Progress: A Genealogy of the Politics of Pest Control in Malaysia, in: Comparative Studies in Society and History, 43 (2001) 1, pp. 193–221; J. Wang, Plants, Insects, and the Biological Management of American Empire: Tropical Agriculture in Early Twentieth-Century Hawai'i, in: History and Technology 35 (2019) 3, pp. 203–236.

9 Beattie et al. (eds.), Eco-Cultural Networks and the British Empire; C. Ross, Ecology and Power in the Age of Empire: Europe and the Transformation of the Tropical World, Oxford 2017.

10 D. Pimentel, Green Revolution Agriculture and Chemical Hazards, Science of the Total Environment 188 (1996), pp. 86-98.

because of the technological and administrative innovations that increased the military, scientific and economic expansion of European empires.[11] More recently, Sven Beckert, Ulbe Bosma, Mindi Schneider, and Eric Vanhaute indicated the period between the 1850s and the 1970s as a second commodity regime largely characterized by the conjunction of spatial, technological and state-led fixes.[12] The development of economic entomology as a response to ecological frictions generated by the agency of insects or what humans called "pests" played an important role in the industrial commodification of natural resources and interconnected socio-ecological transformations in territories of the tropical world. The period from 1880 to 1930 is thus an apt timeframe in which to explore the interlocking of entomological research in processes of global territorialisation and imperial capitalism.

Invasive species in the coconut plantations of German Samoa, the invention of termite fumigators in South Africa later used to protect rubber cuttings in Ceylon, the study of fruit fly circulation in Mandatory Palestine or the prospective surveys about cotton pests in Italian Somalia illustrate the variety of scenarios included in this paper across which the scientific study of insects spread, ranging from colonial regimes and colonial settlements to transimperial cooperation and state and private attempts at modernisation. The thread that connects the diverse locations is German and Italian entomologists and migrants moving and collaborating between these spaces. While American, British and Dutch actors operating within and across both national borders and overseas territories have received comparably greater historical treatment, the study of professional and amateur insect scientists from Germany and Italy in the tropical world seeks to expand the current understanding of the global condition of economic entomology, ca. 1880–1930.[13] Existing scholarship has concentrated on German and Swiss entomology during the period, focusing mainly on the national institutionalisation of this discipline.[14] The "global" connections these works have underlined are mostly related to the American, British and Dutch influence in the establishment of research institutes and universities in Germany and Switzerland. The Dutch experimental station in Java where German and Swiss entomologists were trained and employed is just one example.[15]

11 C. A. Bayly, The Birth of the Modern World, 1780–1914: Global Connections and Comparisons, Malden, MA 2004; S. Conrad, Rethinking German Colonialism in a Global Age, in: The Journal of Imperial and Commonwealth History 41 (2013) 4, pp. 543–566; J. Osterhammel, Die Verwandlung der Welt. Eine Geschichte des 19. Jahrhunderts, Munich 2009.

12 S. Beckert et al., Commodity Frontiers and the Transformation of the Global Countryside: A Research Agenda, in: Journal of Global History 16 (2021) 3, pp. 435–450.

13 Brown, Political Entomology; Das/Giri, Locust Infestations and Marginalized Communities in Colonial Western India; R. Deb Roy, White Ants, Empire and Entomo-Politics in South Asia, in: The Historical Journal 63 (2020) 2, pp. 411–436; Melillo, Global Entomologies; T. Mitchell, Rule of Experts: Egypt, Techno-Politics, Modernity, Berkeley, CA 2002; P. S. Sutter, Nature's Agents or Agents of Empire? Entomological Workers and Environmental Change During the Construction of the Panama Canal, in: Isis 98 (2007) 4, pp. 724–754; Wang, Plants, Insects, and the Biological Management of American Empire.

14 Jansen, "Schädlinge"; Straumann, Nützliche Schädlinge.

15 W. Schoor, Pure Science and Colonial Agriculture: The Case of the Private Java Sugar Experimental Stations (1885–1940), in: W. Roland/C. Yvon/C. Bonneuil (eds.), Les Sciences hors d'Occident au 20ème siècle, Paris 1996, pp. 13–20; F. Wagner, Inventing Colonial Agronomy: Buitenzorg and the Transition from the Western to the

However, there is a scarcity of studies dedicated to the economic entomology of Germans in the tropical world. The German cases presented here shed light on the circulation of pest control research not only as part of colonial enterprises, but also on the collaborative practices of German entomologists in quasi-colonial settings, such as those of Mandatory Palestine, or even in independent states, such as Brazil and Peru. As is the case with Italian entomology, biased historiographies of a Central European "cutting-edge science" have neglected the internationally recognized research of Italian insect scientists in the Istituto Agricolo Coloniale Italiano in Florence and in the Scuola Superiore di Agricoltura in Portici, Naples.[16] This paper will not only recover these leading hubs of entomological research, but also show how European and American scientists were influenced by the Italian research in its colonial space. Therefore, it will first approach how German and Italian entomologists cooperated in the agricultural modernisation of the tropical world, and second the extent to which these experiences contributed to forging economic entomology as a tool of imperial capitalism.[17]

2. Pest Control Research: From the American Frontier to the German Colonial Space and Beyond

What human societies call pests have existed since the first agricultural revolution or, one might say, biblical times. Human and insect societies have created or destroyed niches of mutual shared living conditions in premeditated but also unexpected ways. Therefore, knowledge of pest control has been around for millennia. Certainly, early modern natural theology brought a new perspective towards God's smallest creatures such as beetles and flies in the European context. The collection of butterflies, the taxonomy of ants and drawings of worms were at the centre of these pre-scientific ideas. These practices of collection, classification and representation have accelerated the creation of many European museums since then and served to establish the field of "entomology".[18] Indeed, nineteenth-century museums saw an increasing amount of collected specimens

Eastern Model of Colonial Agriculture, 1880s–1930s, in: Kirchberger/Bennett (eds.), Environments of Empire, pp. 103–128; R.-J. Wille, The Co-Production of Station Morphology and Agricultural Management in the Tropics. Transformations in Botany at the Botanical Garden at Buitenzorg, Java 1880–1904, in: D. Phillips/S. Kingsland (eds.), New Perspectives on the History of Life Sciences and Agriculture, New York 2015, pp. 253–275; A. Zangger, Koloniale Schweiz. Ein Stück Globalgeschichte zwischen Europa und Südostasien (1860–1930), Bielefeld 2011.

16 F. Cardini et al. (eds.), L'Istituto Agronomico per l'Oltremare: la sua storia, Florence 2007; A. Santini/S. Mazzoleni/F. De Stefano (eds.), La Scuola agraria di Portici e la modernizzazione dell'agricoltura 1872–2012, Naples 2015.

17 Brescius/Dejung, The Plantation Gaze; K. Manjapra, The Semi-Peripheral Hand, in: C. Dejung/D. Motadel/J. Osterhammel (eds.) The Global Bourgeoisie. The Rise of the Middle Classes in the Age of Empire, Princeton 2019, pp. 184–204; C. Ross, The Plantation Paradigm: Colonial Agronomy, African Farmers, and the Global Cocoa Boom, 1870s–1940s, in: Journal of Global History, 9 (2014) 1, pp. 49–71; Wagner, Inventing Colonial Agronomy.

18 D. Hünniger, Inveterate Travellers and Travelling Invertebrates – Human and Animal on the Move in Enlightenment Entomology, in: S. Cockram/A. Wells (eds.), Interspecies Interaction. Animals and Humans Between the Middle Ages and Modernity, London 2017, pp. 171–189; B. W. Ogilvie, *Maxima in minimis animalibus*: Insects in Natural Theology and Physico-theology, in: A. Iair/K. von Greyerz (eds.), Physico-theology: Religion and Science in Europe, 1650–1750, Baltimore 2020, pp. 171–182.

from all over the world, which made entomology a globally connected discipline.[19] With colonial European expansion and the transformation of the global countryside by plantation economies, insects also started to be perceived differently. They became enemies, threatening human health by transmitting tropical diseases, and provoking capital losses by destroying crops of different kinds. Paradoxically, these monocultural niches formed by plantation economies generated beneficial ecological conditions that allowed certain insects to thrive. The capitalist settings of plantations then generated the problem they later needed to prevent.

This brief, albeit teleological account, has a milestone in the United States, a milestone closely related to profit-oriented land management and the expansion of the "American frontier." In 1894, the federal government founded the Bureau of Entomology as part of the US Department of Agriculture, one of the first institutions exclusively dedicated to improving entomological research for protecting crops at a national level. However, as early as the 1850s pioneering research was being done by Charles Riley and his successor Leland Howard, who later became director of the same Bureau of Entomology.[20] Riley and Howard not only studied pests in the California citrus industry and the plague of grasshoppers in the Western States, but also safeguarded American lands from "invasive species." The history of entomology in the USA and Canada was particularly connected with both the (self-)interests of professional careers and several capitalist stakeholders, such as chemical companies and the military complex.[21] Pest control research was suffused with discourses about civilizationism and a "war on nature" from the beginning, all to attain sufficient financial and human resources from the national states. Entomologists around the globe were at the ecological frontiers of this "inter-species" war, and yet entomologists would join forces without considering nationalist ambitions, even during and after the Great War. Indeed, the American institutionalisation of economic entomology served to inspire European scientists who recognised a potential for more state and private resources for their own institutes and careers while promising reliable solutions against insect enemies.

Arguably, pest control methods existed on both sides of the North Atlantic context during the nineteenth century and earlier, but only at a local and provincial level and mostly in relation to agricultural associations or forest management. This was so in the case of wine and olive producers in the Mediterranean, for example.[22] In Central Europe, forest sciences were concerned with different kinds of pests in order to protect wood stocks.[23] Pest control methods then were part of the daily in-situ skills of producers, distant from

19 D. Margócsy, Commercial Visions: Science, Trade and Visual Culture in the Dutch Golden Age, Chicago 2014; K. Pannhorst, Zirkulieren. Hans Sauter und der Wert von Insekten, in: I. Heumann/N. Güttler (eds.), Sammlungsökonomien, Berlin 2016, pp. 71–93.

20 L. Howard, A History of Applied Entomology (Somewhat Anecdotal), Washington, D.C. 1930.

21 P. Palladino, Entomology, Ecology, and Agriculture: The Making of Scientific Careers in North America, 1885–1985, London 1996; Riegert, From Arsenic to DDT; Russell, War and Nature.

22 J. Pan-Montojo, Viñas, bodegas y mercados. El cambio técnico en la vitivinicultura española, 1850–1936, Zaragoza 2001.

23 Jansen, "Schädlinge"; Straumann, Nützliche Schädlinge.

the universalist, taxonomist knowledge of the urban universities, and usually not considered to be "scientific." That is, entomologists working in the field (and not in museums) became important once they proved to be key players in several commodification processes in the inner frontiers and in overseas business ventures. This is how the discipline was coined as "applied entomology" to distinguish it from "systematic entomology," which was primarily concerned with classification and not the ecological behaviour of insects. Therefore, the US Bureau of Entomology established in 1894 can be considered a turning point in the interactions between human and insect societies that deeply influenced this discipline in other national and colonial settings.

While American entomologists were mostly concerned with the expansion of the inner agricultural frontier, Europeans were influenced by colonial perspectives. The most prominent colonial counterpart of the American Bureau of Entomology was the British Entomological Research Committee for Tropical Africa created in 1910, which became in 1913 the Imperial Bureau of Entomology, covering two branches of the discipline, Agricultural and Medical/Veterinary Entomology, and forging a very extensive network of collaborators across the British Empire. In 1930, the Imperial Bureau of Entomology (IBE) became the Imperial Institute of Entomology (IIE), and in 1947 British entomologists were part of the Commonwealth Institute of Entomology.[24] These histories, which indicate a certain American and British pre-eminence in the field of entomology, intersect with the exceptional career of the most famous acridologist (the sub-discipline that studies the behaviour of grasshoppers and locusts), the Russian Boris Uvarov. While usually neglected, the history of pest control research was equally developed in the Russian Empire and the Soviet Union.[25] After his biological studies at Saint Petersburg State University and field work on the *Locusta migratoria* in the plantations of the Murgab Crown Cotton Estate, personal circumstances led Uvarov to move to London, where he joined the Imperial Bureau of Entomology. His knowledge about locust pests was in high demand due to British interests in East Africa after the Great War, and Uvarov became the leading scientist in the field.[26]

German entomological research underwent a similar institutionalisation process, as Sarah Jansen has explained in depth.[27] She reconstructs, for example, the travels of Karl Escherich, the "father" of German applied entomology, in Eritrea, Ceylon and the United States as foundational circumstances. Calling for the "reform" of the hegemony of German systematic entomology in museums and universities, in 1913 Escherich published the work *Die angewandte Entomologie in den Vereinigten Staaten. Eine Einführung in die biologische Bekämpfungsmethode,* a propagandist account of the advanced institutionalisation of this discipline in the USA with pictures of many researchers and research

24 Deb Roy, White Ants; M. Worboys, Imperial Entomology: Boris P. Uvarov and Locusts, c. 1920–c. 1950, in: The British Journal for the History of Science 55 (2022) 1, pp. 27–51.

25 E. Forestier-Peyrat, Fighting Locusts Together: Pest Control and the Birth of Soviet Development Aid, 1920–1939, Global Environment 7 (2014) 2, pp. 536–571.

26 Worboys, Imperial Entomology.

27 Jansen, "Schädlinge".

infrastructure.[28] This German entomological evangelism was not limited to national borders. Georg Aulmann, assistant at the Zoologisches Museum in Berlin between 1908 and 1914, studied the most important pests for German commodities in their colonial space, among them rubber, cotton, cocoa, and coffee.[29] He even published a historical account of economic entomology in the German colonies to promote the potential of more pest control research in the colonial plantations.[30] He did so from his Berlin office summarizing more recent publications and collected specimens but without travelling into the field, which is telling of the precarity of German economic entomology in the colonies. Both Aulmann and Escherich complained in this publication and others about the lack of pest control research in the German colonies. The sole exception was the period when the Biological Agricultural Institute in Amani, German East Africa, was directed by entomologist Julius Vosseler between 1903 and 1908.[31] The rest of the colonial space – Togo, Cameroon, German South West Africa, New Guinea, and Samoa – was mostly under the inspection of botanists or, in Escherich's terminology, "zoologenfrei" ("free of zoologists"). As the case of German Samoa suggests, expertise on insects and pests was very specific, requiring the most advanced understanding in ecological biology and biogeography.

Escherich's American journeys and Aulmann's "colonial" entomology are evidence of the wide and mimetic formation of this discipline in the German context. However, while usually addressing the global relevance of pest control research and its related colonial gaze, Escherich and Aulmann's aim was oriented to gain state recognition towards the national institutionalisation of economic entomology. I argue that the number of German entomologists in non-European territories was much larger and their impact broader, as they founded agricultural stations and research institutes in the Global South. The following examples illustrate the German contribution to the global emergence of economic entomology. These cases show the extent of German "colonial" science beyond formal colonies and, as recently proposed, the transimperial production of knowledge connected to the expansion of commodity frontiers. These cases cover disparate regions and a variety of commodity chains and are focused on three distinct biographies of German entomologists. A fourth example looks at the biographies of artefacts, like the "Universal Ant Exterminator" and the "Termitensucher", which enlarged the circulation of pest control research beyond imperial borders.

28 K. Escherich, Die angewandte Entomologie in den Vereinigten Staaten. Eine Einführung in die biologische Bekämpfungsmethode, Berlin 1913.

29 G. Aulmann, Die Schädlinge der Kautschukpflanzen, hrsg. mit Unterstützung des Reichs-Kolonialamtes vom Zoologischen Museum in Berlin (= Die Fauna der deutschen Kolonien, Reihe 5: Die Schädlinge der Kulturpflanzen, H. 6), Berlin 1913.

30 G. Aulmann, Die angewandte Entomologie in den deutschen Kolonien, in: Zeitschrift für Angewandte Entomologie 1 (1914), pp. 95–136.

31 D. Bald/G. Bald, Das Forschungsinstitut Amani: Wirtschaft und Wissenschaft in der Deutschen Kolonialpolitik Ostafrikas 1900–1918, Munich 1972; B. Gollasch, Franz Ludwig Stuhlmann und die kolonialen Reformbestrebungen in Deutsch-Ostafrika vor 1906, Hamburg 2021.

As a consequence of the locust outbreak in Syria in 1915, which caused a famine resulting in thousands of deaths, a call for more "rational" land uses spread in the Middle East.[32] In this context, a group of Jewish German scientists led by Otto Warburg, a prominent "colonial" botanist and initiator of the Kolonialwirtschaftliches Komitee, founded several research institutes and experimental stations in Tel Aviv, Haifa, and Jerusalem.[33] Moreover, religious overtones inflated pest control research as part of the strategies German Zionist movements promoted to support Yishuv people in Mandatory Palestine.[34] Profit-oriented land use of citrus and olive plantations became crucial for territorial claims in Mandatory Palestine and economic entomology was a key tool for this purpose. From 1922 on, German entomologist Fritz Bodenheimer and colonial settlers developed methods for pest control in that territory. Inspired by Escherich's work, Bodenheimer was trained in entomology in Bonn and later at the agricultural entomology station in the aforementioned Scuola Superiore di Agricoltura in Portici, Naples, where experts like Filippo Silvestri and his predecessor, Antonio Berlese, researched the Mediterranean fruit fly. Bodenheimer made several scientific expeditions in collaboration with British officials, German Zionists and settlers in Mandatory Palestine, making him a leading figure in applied entomology during this period.[35] He also expanded his research to Australia, South Africa, the USA, Turkey, and Iraq from the 1930s, achieving international renown. This case sheds light on the transimperial scope of economic entomology in the Mediterranean and Middle East regions and cooperation between German, Italian and British scientists there. Entomologists like Bodenheimer deeply influenced discourses of "modern" agricultural management vis-à-vis colonial settlements and territorial claims not only in Mandatory Palestine but generally in the Middle East during this period.

A second example refers to the "invasion" of 1909, when the Indian rhinoceros beetle (*Oryctes rhinoceros*) was taken unnoticed from Ceylon to Upolu, German Samoa, in *Hevea* cuttings. This species found such favourable conditions there that it multiplied exponentially, killing thousands of palm trees and threatening the entire coconut crop.[36] In order to avoid the loss of coconut plantations, the German colonial regime, under pressure from the Deutsche Handels- und Plantagengesellschaft, took different measures. In the first instance, with extra-funding provided by the colonial administrator

32 R. El-Eini, British Agricultural-Educational Institutions in Mandate Palestine and Their Impress on the Rural Landscape, in: Middle Eastern Studies 35 (1999) 1, pp. 98–114; Z. Foster, The 1915 Locust Attack in Syria and Palestine and Its Role in the Famine During the First World War, in: Middle Eastern Studies 51 (2015) 3, pp. 370–394; H. Kalisman, The Next Generation of Cultivators: Teaching Agriculture in Iraq, Palestine and Transjordan (1920–1960), in: Histoire de l'éducation 148 (2017), pp. 143-164.

33 D. Suffrin, Pflanzen für Palästina. Otto Warburg und die Naturwissenschaften im Jischuw, Tübingen 2019.

34 J. Norris, Land of Progress: Palestine in the Age of Colonial Development, 1905–1948, Oxford 2013; E. Yankelevitch, Creating a National Identity Through Agricultural Education in Mandatory Palestine, in: Polish Political Science Yearbook 47 (2018) 2, pp. 346–354.

35 F. Leimkugel, Botanischer Zionismus: Otto Warburg (1859–1938) und die Anfänge institutionalisierter Naturwissenschaften in Erez Israel, in: Englera 26 (2005), pp. 1–351.

36 K. Friedrichs, Studien über Nashornkäfer als Schädlinge der Kokospalme. Bericht an das Reichs-Kolonialamt über eine 1913/14 im Auftrage ausgeführte Studienreise, Berlin 1919.

Erich Schultz, planters redirected local labour to collect beetles and their larvae. Given that this first approach was not successful, and under pressure from the indigenous people who saw how their food security was also at risk from the beetle pest, the colonial administration brought in the entomologist Karl Friedrichs to develop methods to control the plague.[37] After a scientific tour of South Asia and East Africa, Friedrichs found a biological enemy, the insect fungus *Metarhizium anisopliae*, and introduced it to Samoa. This, with the additional labour of the indigenous people, was partially successful. Friederichs later studied pest control in coffee plantations in Java (1921–1924), was a researcher at the Istituto Internazionale di Agricoltura in Rome (1927) and was a visiting professor at the University of Minnesota (1928–1929.) As a result of his global trajectory, Friedrichs published important works on ecological theory during his academic positions in Rostock and Posen.[38] The "success" against the rhinoceros beetle in German Samoa shows the intermingled scientific, private and imperial interests directed against the loss of economic profit and the cooperation between the German colonial spaces linking agricultural stations in Africa and South Pacific territories, and beyond imperial boundaries, such as stations in Ceylon and Madagascar.[39] Moreover, the global trajectory of Friederichs demonstrates how productive this knowledge was in different plantation economies and colonial settings and in the transnational institutionalisation of pest control research between Germany, Italy and United States.

A third case illustrates how pest control research was developed in South America and the pre-eminence of former German scientific networks connected to earlier migration in the institutionalisation of this discipline. Johannes Eduard Wille studied zoology in Jena. After his participation in World War I he held assistant positions in the pharmacological-zoological department of the Kaiser Wilhelm Institute for Physical Chemistry and Electrochemistry in Berlin-Dahlem and subsequently in the Laboratory for Physiological Zoology of the Biological Imperial Institute for Agriculture and Forestry in Berlin-Dahlem.[40] During this time, he researched the German cockroach (*Blatella Germanica*) and in 1920 he published his first work on pests on the same species.[41] Through connections to German colonists in the region of Rio Grande do Soul, Brazil, he was offered a full position as head of the Entomological Department of the Borges de Medeiros Institute in Porto Alegre. The expansion of orange and coffee frontiers in this

37 H. Droessler, Copra World: Coconuts, Plantations and Cooperatives in German Samoa, in: The Journal of Pacific History 53 (2018) 4, pp. 417–435; S. Firth, German Firms in the Western Pacific Islands, 1857–1914, in: The Journal of Pacific History 8 (1973) 1, pp. 10–28; H. Hiery (ed.), Die deutsche Südsee 1884–1914: Ein Handbuch, Paderborn 2002; Y. Péhaut, L'implantation allemande des mers du Sud avant 1914, Talence 1990.

38 K. Friedrichs, Ökologie als Wissenschaft von der Natur oder biologische Raumforschung, Leipzig 1937.

39 Bald/Bald, Das Forschungsinstitut Amani.

40 For a biographical account of Wille, see H. Sachtleben, Entomologische Chronik, in: Beiträge zur Entomologie 10 (1960) 1–2, pp. 217–219; G. Lamas M., Johannes E. Wille (1892–1959), in: Revista Peruana De Entolomogía, 25 (1982) 1, pp. 87–94. On the emergence of Peruvian economic entomology, see G. Lamas M./C. Lamas M., Introducción a la Historia de la Entomología en el Perú. III. Albores de la Entomología Económica, in: Revista Peruana De Entolomogía, 23 (1980) 1, pp. 32–37.

41 J. E. Wille, Biologie und Bekämpfung der deutschen Schabe (Phyllodromia germanica L.), Berlin 1920.

region needed specific knowledge to fight local pests. Between 1921 and 1926, Wille collaborated intensively with the German colonist community in their plantations but particularly with apiculturists, like Emil Schenck and Maximiliano von Parseval, both of them Brazilians of German descent, who were pioneers in introducing the bee species of *Apis mellifera*.[42] After a short return to Germany between 1927 and 1929, where Wille was a researcher at the Biological Imperial Institute in Aschersleben, he became head of the entomological department of the Estación Experimental Agrícola de la Molina in Lima, Peru, a post he held until his death. This station was part of the National University of San Marcos and it was connected to the Ministry of Agriculture.

Over two decades, Wille investigated insect pests affecting all kinds of Peruvian commodities, covering the different climate zones and regions where they were produced: from coca in the Andes and cotton in Chincha and Piura, to wheat on the coastal side and olive in the Yauca and Chanchamayo Valleys.[43] While he belonged to the most innovative generation of German economic entomologists, his years in Brazil and Peru allowed him to collaborate with American entomologists, with whom he surveyed fruit fly pests in Ecuador under contract with the US Department of Agriculture, and to introduce the most recent pest control methods of the time: Gargoyle Spraying Oil and, already in 1945, DDT and Gammexane.[44] Wille's biography connects a diversity of scenarios across Germany, Brazil, Peru, Ecuador, and America where economic entomology became a crucial tool to improve profit certainties in the commodification of several raw materials. The foundation of experimental stations in Brazil and Peru shed light on a process of globalization of pest control research that went beyond formal colonial spaces. In colonial settings, European migrants were also intermediaries providing territorial reconnaissance and, in some cases, labour to implement studies on pest control. They even adopted or improved pesticide methods and artefacts, like the story of the "Universal Ant Exterminator" (see fig. 1a, 1b) developed by a family company of colonial settlers, P. Henwood, Soutter & Co., in what was the Colony of Natal, South Africa. And it is a story that involved both the British and German colonial spaces for different reasons.

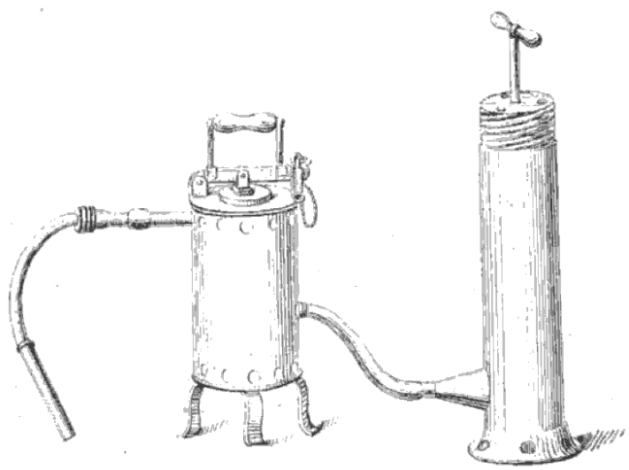
42 J. E. Wille, Die Feinde der Orangekultur und ihre Bekämpfung, in: Der Landwirt 5 (1921), pp. 1–2 and 8 (1921), pp. 1–3; idem, Os principaes insectos nocivos das laranjeiras e limoeiros, in: Correio do Povo (1921); idem, Zur Frage der Bienenkrankheit in Rio Grande do Sul, in: Der Landwirt 12 (1922), pp. 1–2; idem, Programma de organização da defesa agricola (Defesa contra as doenças e pragas que atacam as plantas), in: Egatea 8 (1923) 1, pp. 32–37 and 2 (1923), pp. 92–96; idem, Conorbinus-(Tridtoma) spec., urn novo inimigo das abelhas, in: Egatea 8 (1923) 2, pp. 116–121.

43 J. E. Wille, Los insectos dañinos a la coca en el Perú, in: Vida agricola 14 (1937) 169, pp. 1003–1009; idem, Fruitflies in the Republic of Ecuador. United States Department of Agriculture Bureau of Entomology and Plant Quarantine Services 130 (1937), pp. 25–26; idem, Los insectos del algodonero, in: Agronomía 5 (1940) 23, pp. 27–53. For a general overview of Wille's publications, see Lamas, Johannes E. Wille.

44 J. E. Wille, Visita de los entomologos norteamericanos, in: Boletin de la Dirección de Agricultura y Ganadería 1 (1932) 2, pp. 314–316, idem, Los insectos dañinos a la coca en el Perú; idem, Fruitflies in the Republic of Ecuador; idem, Experimentos con los nuevos insecticidas DDT y Gammexane ejecutados en la Estacion Experimental Agricola de La Molina hasta fines de mayo de 1946, in: Boletin Estacion experimental agricola de La Molina 29 (1946), pp. 1–33; idem, Informe final sobre la aplicación industrial del insecticida "DDT" contra la mosca de la fruta en la huerta de la Estación Experimental Agrícola de La Molina en la temporada 1946–47, in: Informe, Estación experimental agrícola de La Molina 67 (1947), pp. 1–7.

Despite the name, "white ants" were the target of this artefact; that is, termites, the study of which was one of the most prominent sub-fields of pest control research because of their threat to sugarcane and the booming rubber plantations.[45] The global life of the "Universal Ant Exterminator" illustrates the coupling of scientific research and companies of insecticide artefacts in the colonial space of the period. Basically, the mechanism consisted of an air pump connected by a short length of rubber hose to a furnace. Using charcoal or burning cow dung to heat the pipe, the poison was inserted into the termites' nest and the smoke pumped in. Fumigation with sulphur and arsenic, such as that provided by the "Universal Ant Exterminator," was an innovative method of the time, but this one was invented far from the scientific centres of the North, probably as a response to specific local demands. During his position as "government entomologist" in Natal, the Australian-born Claude Fuller carried out several experiments in fruit plantations with this fumigator, although his original official mission was the fight against the locust plague.[46]

Figure 1a, 1b: First illustration of the "Universal Ant Exterminator" and a picture of entomologists Green, Petch, and Uzel using it in Ceylon[47]



45 Deb Roy, White Ants.

46 Brown, Political Entomology; C. P. Lounsbury, The Pioneer Period of Economic Entomology in South Africa, JESSA 3 (1940), pp. 1–29.

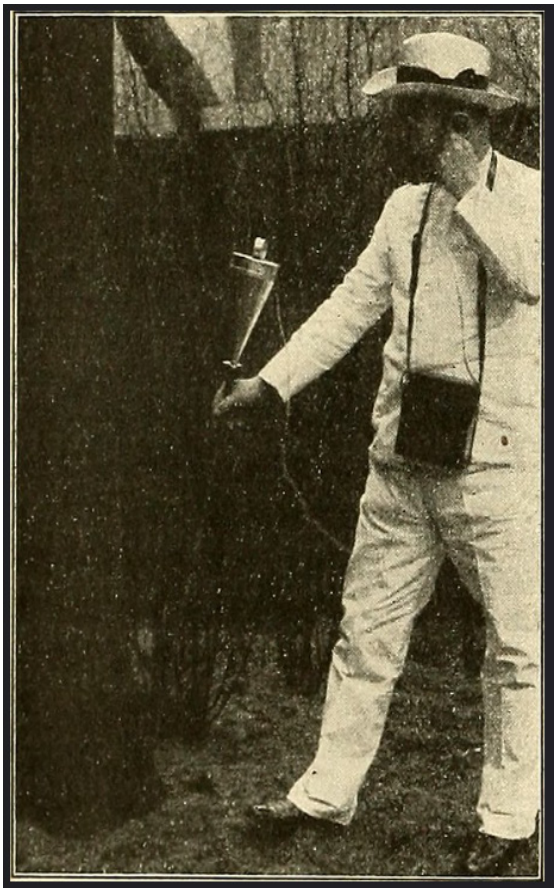
47 K. Escherich, Termitenleben auf Ceylon. Neue Studien zur Soziologie der Tiere; zugleich ein Kapitel kolonialer Forstentomologie, Jena 1911, p. 178.

The impressive results of the application of the Ant Exterminator – and the well-connected network of British colonial scientists – led the artefacts manufactured by P. Henwood, Soutter & Co. to reach the Royal Botanical Gardens in Peradeniya, Ceylon.[48] There, another "government entomologist," Edward Green, born in Colombo to a wealthy British family, owners of coffee and tea plantations, also applied this fumigator to control termite pests in rubber plantations, spreading its uses widely into the Commonwealth space.[49] Thanks to his utilitarian research about pests, Green later served as president of the Royal Entomological Society of London in 1923–1924.[50] The German Escherich met Green on his research journeys across Italian Eritrea and Ceylon to study "white ants." He observed termites in the field and scouted possible pest control methods that would be of interest to German colonial profits, particularly the Deutsche Handels- und Plantagengesellschaft. In the same vein of praise to American economic entomology, Escherich detailed both the biological conditions of so-called "white ants" and the experiments of "government entomologists" in his scientific report *Termitenleben auf Ceylon. Neue Studien zur Soziologie der Tiere, zugleich ein Kapitel kolonialer Forstentomologie* (1911). Among the many methods described, he referred to the "Universal Ant Exterminator." Apparently during this time, he added, the firm Friedrich Suck in Hamburg was creating a similar fumigator, among other artefacts, such as a detector of termites ("Termitensucher") in wood stocks that worked through sound-sensing and in-

48 C. Fuller, A White Ant Exterminator, in: Natal Agricultural Journal 9 (1906) 7, pp. 709–710.
49 E. Green, White Ants, in: Circulars and Agricultural Journal of the Royal Botanic Gardens 4 (1908), pp. 75–86.
50 F. Laing, Obituary – Edward Ernest Green, in: Entomologist's Monthly Magazine 85 (1949), pp. 215–216.

cluded headphones. As published in *Tropenpflanzer*, the innovative machines developed by Friedrich Suck Co. served German colonial interests, since termites are not native species in German (European) territories (see fig. 2).[51] Even in Brazil, the German-language newspaper for colonial settlers *Der Kompass* announced the same products coming from Hamburg.[52] Pest control research was then not only a scientific affair, but situated at the intersection of private stakeholders and expertise of different kinds, relocating cutting-edge knowledge production in the field. Most importantly, it offered the opportunity for non-scientific entomologists and settlers to become part of the "war on nature" across plantations in the tropical world.

Fig. 2. "Termitensucher". Friedrich Suck Co., Hamburg



51 F. Suck, Zur Termitenbekämpfung, in: Der Tropenpflanzer 8 (1909), pp. 290–291.
52 "Vertilgung von Termiten", in: Der Kompass, 17 July 1909, Inland, p. 2.

The various journals founded since the late nineteenth century in colonial agronomy and related fields, such as the German *Der Tropenpflanzer* or the much more specialised American *Journal of Economic Entomology* (which first appeared in 1908), the British *Bulletin of Entomological Research* (1910) or the German equivalent *Zeitschrift für Angewandte Entomologie* (1914) are an appropriate basis on which to analyse interactions between scientists, colonial settlers and private entrepreneurs. These journals were really "centres of calculation" with an impressive range of publications covering reports from all over the world. They were also organs of civilizationist discourses about the modernisation of agricultural production and plantation economies in the tropical world. In these contexts, entrepreneurs promoted their own industrial achievements or even called for more private-scientific partnerships, like Horace L. Frost's propagandistic article "The Economic Entomologist in Business," published in 1909 in the *Journal of Economic Entomology.* He asked for more "commercial economic entomologists" and more "trained labourers" in the field, which offered "unlimited opportunities to the present generation".[53] The invention of artefacts like the detector of termites and the "Universal Ant Exterminator" explains another kind of circulation of economic entomology in the tropical world, which indeed represented an opportunity for the social mobility of colonial settlers.

As in South Africa, the Pacific Islands, Mandatory Palestine and Peru, comparable developments in pest control research occurred during the same period from Spain and Portuguese East Africa to the Western Indies and Italian Eritrea, to name just a few examples. The simultaneous mushrooming of agricultural stations and entomological institutes across the globe, as Howard and Escherich predicted, certainly involved scientific entomologists as main players, and usually as solitary figures. Yet it also required the collaboration of entrepreneurs to produce artefacts such as fumigators or termite detectors, and colonial settlers with the necessary local knowledge to expand commodity frontiers in the plantation economies. As the cases of Brazil and Peru show, pest control was not only a matter of colonial anxieties, but of anxieties surrounding capitalist profit generally. German economic entomology was deeply influenced by both the American and the Italian institutionalisation process. However, it lacked uncontested support to spread and create new infrastructure in the colonial space, with only a few exceptions, among them the case of German Samoa, where the response was urgent. Interestingly, migrant and scientific networks dating back decades in Latin America offered new opportunities for the careering of German entomologists. These experiences are evidence of the global institutionalisation of economic entomology connected with a "rational" exploitation of raw materials beyond imperial contexts. Or maybe it should be posed in other terms: economic entomology by means of protecting crops intended to provide profit certainties to private undertakings while erasing national and imperial borders. The "interspecies" war led by entomologists of different nationalities operated as a human crusade

53 H. L. Frost, The Economic Entomologist in Business, in: Journal of Economic Entomology 1 (1908) 6, p. 351.

against insects, although the primary benefits served the interests of capitalist ventures, whether from olive production in Mandatory Palestine to cotton plantations in Peru and Italian Somalia.

3. From Napoli to the World: The Neglected History of Italian Economic Entomology

A history of Italian pest control research can also broaden the trajectory of economic entomology, commonly seen as an Anglo-American or Central European cutting-edge science, by recentring the entire Mediterranean space, including North Africa and the Middle East. The several pests in Mediterranean plantations, mostly citrus and olive plantations, occupied the two leading hubs of economic entomology, Naples and Florence. I have already referred to the Scuola Superiore di Agricoltura in Portici, Naples, (founded in 1872); together with the Istituto Agricolo Coloniale Italiano in Florence (founded in 1904, in 1959 renamed Istituto Agronomico per l'Oltremare), these represent paradigmatic cases of the transition from a local and regional response to certain plagues dating back centuries to the later transnationalization of economic entomology as a result of the Italian colonial occupation of African territories.[54] In a similar vein to the rhetoric of Howard and Escherich surrounding the concept of "global" entomology, Silvestri delivered a programmatic paper entitled "Importanza dell' Entomologia nell' Economia Mondiale" at the 7th International Entomological Congress in Berlin (1938). Differing from the disciplinary disputes about "systematic" and "applied" entomology among his German and American colleagues, he called for greater collaboration in all branches of entomology and agricultural sciences alike and for transnational cooperation. More entomological stations could be created in every corner and every region of the world, given the enormous biodiversity of insects and the expansion of all the commodity frontiers that transformed the environments in the tropical world. Silvestri foresaw a multi-local network of pest control research, putting human sustainability on a safe path. Thanks to Silvestri, Italian entomology, and in particular Naples, became a reference for scientists from the United States and Australia to Portugal, Spain, and Mandatory Palestine.

Antonio Berlese was a pioneering figure in the first developments in pest control research in the Italian Peninsula; he acted as Silvestri's mentor, among many other prominent entomologists, when he was professor at the Scuola Superiore di Agricoltura in Portici between 1890 and 1903.[55] Founder of journals like the *Rivista di patologia vegetale* (1892) and *Redia. Giornale di Entomologia* (1904) and a prolific author since the late nineteenth century, Berlese is author of the most comprehensive work of Italian invertebrate fauna:

54 See Santini et al. (eds.), La Scuola agraria di Portici; Cardini et al. (eds.), L'Istituto Agronomico per l'Oltremare.

55 For a biographical note on Berlese, see G. Paoli, Antonio Berlese, in: Memorie della Società Entomologica Italiana 6 (1927), pp. 55–65. For a brief account of this scientific contribution, see R. Heymons, Über die angewandte Entomologie in Italien, in: Zeitschrift für Angewandte Entomologie 1 (1914), pp. 68–83.

Gli Insetti, *loro organizzazione*, *sviluppo*, *abitudini e rapporti con l'uomo*, published between 1909 and 1925 in two volumes that included his own drawings. He studied Zoology in Padua and Florence with a focus on acarology. While in Florence, he worked at the Stazione di Entomologia Agraria, oriented primarily towards the support of local farm production. This institute, directed by Adolfo Targioni Tozzetti, was founded by the Royal Ministry of Agriculture, Industry and Commerce in 1875, probably the first of its kind in the European context, and almost twenty years before the creation of the American Bureau of Entomology referred to in the previous section.[56] He made advances in the study of biological control and, in contrast to other travelling entomologists, his global outlook was shaped by the increasing circulation of non-European insects in Italy, like the *Diaspis pentagona* and *Icerya Purchasi,* which affected fruit and nut trees. He was also a designer of innovative artefacts and methods for entomological research. An apparatus used to extract living organisms, particularly arthropods, from samples of soil is known by his name: the "Berlese trap" (*imbuto*). Particularly directed towards pest control in olive plantations, he introduced a system of bowls containing a mix of molasses and arsenic hanging in the trees (see fig. 3.). Berlese covered the necessary range of skills for an economic entomologist: proficient knowledge of local and foreign insect species, their relevance for agricultural production and methods to control their damage, whether biological control or mechanical and chemical devices. Moreover, he published widely and created platforms for more information about pests in the Italian language. Lastly, as a professor both in Naples and later back in Florence, he was a forerunner for a generation of Italian entomologists that decades later expanded economic entomology to the colonial space and collaborated intensively with American, German and British scientists.

Figure 3. "Berlese trap"[57]

56 For a historical account of the experimental station in Florence, see A. Targionni Tozzetti, Nuove Relazioni Intorno al Lavori della R. Stazione di Entomologia Agraria di Firenze, Florence 1899.

57 Heymons, Über die angewandte Entomologie in Italien, p. 79.

While Silvestri followed Berlese's traces, publishing and directing the Scuola Superiore di Agricoltura in Portici, he gained international recognition for his research on fruit flies and termites, which led him from Japan and South Africa to Australia and Hawaii (see fig. 4).[58] More than his global journeys, his fame encouraged many entomologists to travel to Naples from different regions, particularly Americans. His two volumes *Compendio di entomologia applicata: agraria, forestale, medica, veterinaria* (1939–1943) are still considered a standard work for the study of Italian invertebrates. He was also commissioned to study and classify the insects collected during the expedition of Luigi Amadeo de Savoia, duca degli Abruzzi, to the African peak of Ruwenzori. In honour of his influential work, his name is given to the insect collections housed in the *Museo Entomologico Filippo Silvestri* in Portici, which inherited his insect collections compiled from around the world. Silvestri carried out his studies in zoology and anatomy in Palermo and Rome. In contrast to other entomologists of the time, who usually gained their experience in the tropical world, Silvestri started his global career in Southern America, in Argentina, between 1898 and 1900, where he changed from being a traditional naturalist to an applied scientist.[59] Through scientific migrant networks dating back decades, he was offered a position at the National History Museum; later the Ministry of Agriculture contracted his expertise to assess pests in cotton, sugarcane, tobacco and citrus plantations in Salta, Tucumán, Misiones, and Cordoba. After Argentina, Silvestri moved to Portici as an assistant to Berlese, who, as indicated before, left for Florence in 1903. Silvestri occupied Berlese's position and developed further the pest control research of olive plantations. For these reasons, he received contracts from the Greek (1905) and American (1908) governments. The first "big" project, indeed, was commissioned by the Hawaiian administration to study the Mediterranean fruit fly (*Ceratitis capitata*), a pest affecting the trade of commodities from the islands. Silvestri travelled from West and South Africa to Australia, Hawaii and the United States, following the dissemination of this species through commercial shipping.[60] On his return to Italy, the Ministry of Agriculture ordered him to research the parasites of olive flies in Italian Eritrea, the same flies that were affecting the Italian Peninsula.[61]

By 1913, Silvestri was an established figure of economic entomology, and Portici one of the most important locations to study economic entomology with a focus on Mediterranean plantations. This is the case of Fritz Bodenheimer mentioned before, who came to Naples before settling in Mandatory Palestine. Another German, the ecologist and entomologist Richard Heymons (1914), visited Italian experimental stations and universities and offered a detailed eulogy to his Italian peers, particularly the Scuola Superiore di Agricoltura. Like Escherich in the United States, Heymons went to Italy to examine the

58 For a biographical and scientific account of Silvestri, see G. Jannone, Vita di scienziato: biografia di Filippo Silvestri, Pisa 1950. His 750-page autobiography was published posthumously in 1959.

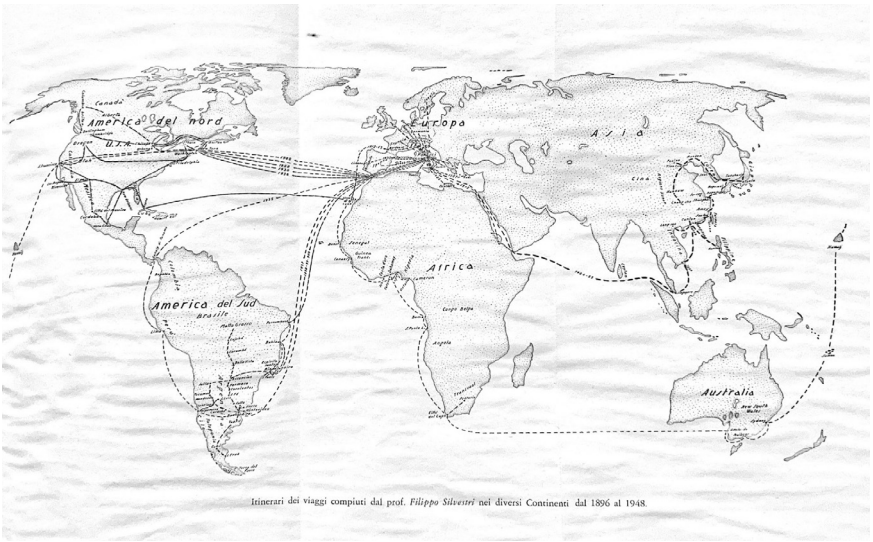
59 Previously, he travelled through Tunisia for a month.

60 F. Silvestri, Viaggio in Africa per cercare parassiti di mosche dei frutti, Portici 1913. For a detailed explanation of the Hawaiian side of this case, see Wang, Plants, Insects, and the Biological Management of American Empire.

61 F. Silvestri, Viaggio in Eritrea per cercare parassiti della mosca delle olive, Portici 1914.

more advanced biology and methods of pest control, but also to report on the academic conditions, finances and infrastructure that allowed Italian scientists to become leading scholars in this scientific field. And like Aulmann, the topic of a "colonial" economic entomology also appeared in Heymons' comparison with the Italian institutions. He even quoted Silvestri complaining about the lack of entomologists in the German colonies. Evidently, Italian pest control research was some steps in front of German research.

Figure 4. Map of Silvestri's global journeys as published in his autobiography[62]



The aspiration for more industrious management of the Italian colonies in Africa pushed the regime and the scientific community to collaborate in improving territorial reconnaissance and the colonised natural resources. The prospecting of Eritrean and Somalian lands and their transformation into cotton plantations led engineers and scientists to carry out several geological, hydrological and biodiversity surveys, which serves as a good example. This was so in the case of the entomologists Guido Paoli and Alfonso Chiaromonte, other disciples of Berlese at the Istituto Agricolo Coloniale Italiano in Florence, who received a commission from the Italo-Somalian Agricultural Society to research pests affecting all kinds of plants, from rice and cereals to sugarcane and cotton. The entomological expedition began in 1925 and was extended to Eritrea, covering the whole of Italian "East Africa" (see fig. 5).[63] They even visited British plantations in near-

62 F. Silvestri, Ricordi e itinerari scientifici, Naples 1959, p. 778.

63 See A. Chiaromonte, Le grandi opere di valorizzazione agraria nell'Africa orientale italiana: comunicazione fatta al 13 Congresso internazionale di agricoltura di Roma, Florence 1927; idem, Attraverso l'Africa orientale italiana in

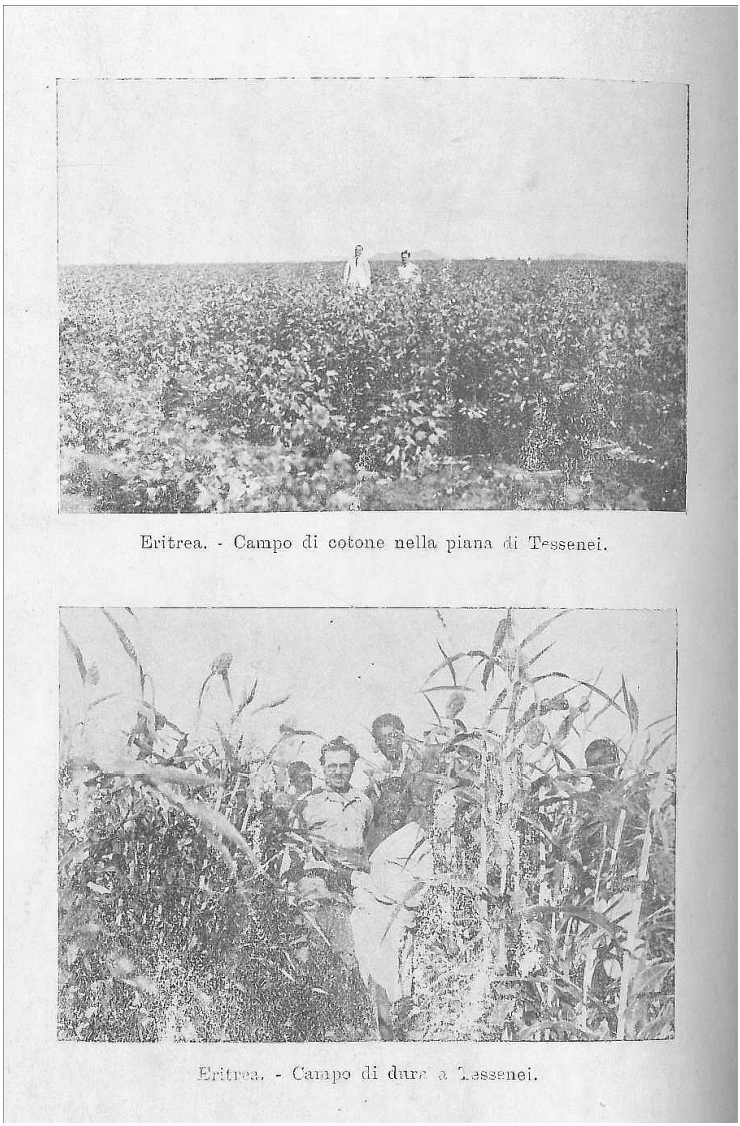
by regions, like the Kassala Cotton Company in Sudan. This study, entitled *Prodromo di Entomologia Agraria della Somalia Italiana* (1931), resulted in a systematic mapping of all insect species of economic importance and was collated with British peers of the Imperial Bureau of Entomology in London. In contrast to other colonial entomological experiences, it revealed the legitimacy economic entomology already had for Italian colonial interests by anticipating future loss. That is, Italian economic entomology in the colonies emerged more as a preventive measure than as a reactive response. Yet, Paoli and Chiaromonte did not limit themselves to describing insect species. They published and offered lectures about Italian African colonisation generally, entangling economic and cultural perspectives with nationalist and racist overtones. Entomologists like Paoli and Chiaromonte, but also Boddenheimer in Mandatory Palestine used their "pest" expertise to conflate myriad discourses about natural resources, population, economic profit and territorial legitimacy under their scientific authority. The agricultural modernisation during their time in Africa, the Middle East, or elsewhere meant entomologists operated in two distinct fields – agricultural sciences and economics –, while responding to the imperial need for producing certainties in the various commodity chains. In the Italian case, economic entomology served Fascist agricultural ambitions both in the Peninsula and the African colonial space. In Chiaromonte's words:

> *Famine, starvation, epidemics, are known in so much of this African continent by the people of colour and must be feared as terrible spectres because of the consequences that may result from them, by the colonizing countries themselves, for whom, not the least for the sake of prestige and do what is possible to keep them away.* […] *This digression, unnecessary, has served to bring into sharper focus the very important action of insects in our colonies; to them, directly or indirectly, civilized nations and regions newly opened to colonization have paid and are paying, largely, albeit too much, tributes of lives and goods*.[64]

un anno di studio (Conferenza detta il 24 marzo 1928 all'Istituto Agricolo Coloniale Italiano di Firenze), Florence 1928; idem, La inutilità della disinfestione al calore del seme di cotone, prodotto in luogo, come mezzo di lotta preventiva contro la Platyedra (Platyedra gossypiella, Saund.) nella Somalia italiana, Firenze 1931; idem, Aspetti entomologici della coltura del cotone nella colonia eritrea, Florence 1933; idem, Considerazioni entomologiche sulle principali colture della Somalia italiana, Florence 1933, pp. 495–514; idem, Note intorno alla biologia degli insetti più importanti per la coltivazione delle principali piante economiche (escluso il cotone) nella Somalia italiana: ricerche, raccolte, allevamenti, osservazioni di un anno di lavoro, Florence 1936.

64 A. Chiaromonte, Servizio fitopatologico e questioni entomologiche nelle nostre Colonie, Florence 1935, p. 31.

Fig. 5. Chiaromonte in Eritrean Cotton Plantations (1927)[65]


Eritrea. - Campo di cotone nella piana di Tessenei.

Eritrea. - Campo di dura a Tessenei.

65 Chiaromonte, Le grandi opere di valorizzazione agraria nell'Africa orientale italiana, p. 4.

4. Conclusion

The different but convergent trends in economic entomology in the German and Italian spaces, both national and colonial, analysed in this paper have recovered two important cases in the global institutionalization of pest control research between ca. 1890 and 1930. Instead of understanding the emergence of this scientific field in teleological terms as a purely disciplinary development, I have argued that these entomologists were on the ecological frontiers of the expanding capitalist settings of several commodity chains around the tropical world. These experts responded to the profit aspirations of colonial and private enterprises while transforming the socio-ecological conditions of many disparate regions. And they were doing so in a collaborative spirit without taking into account imperial or national boundaries. Pests endangered capitalist profit and food security without respecting political borders, shaping economic entomology as a transimperial science. In fact, the uncertainty of insect behaviours – from an anthropocentric point of view – and what humans tended to call pests triggered reactions that reflect the interlockings of political territorialization, capitalist reconfiguration, transimperial collaboration and knowledge production during this period. Anxieties of capital loss in Samoan coconut plantations provoked by a beetle or the threat of fruit flies travelling around the globe from Naples to Hawaii via South Africa because of more dynamic shipping of raw materials are evidence of the unexpected ways human societies have dealt with other non-human actors. Many scholars in recent debates about climate change, the Anthropocene and the like are calling for the more critical approaches required to understand the agency of these minimal actors.[66] Particularly for the cases studied here, we need a more nuanced perspective on the agency of insects in mobilising or limiting human actions, and thus imperial and economic undertakings, which might shed light on methodological frameworks for more "multispecies" histories of global capitalism. This is imperative if we are to overcome the potential biases in our current understandings of the environmental crisis; an analytical task that I am committed to exploring further in future works.

66 See K. Gillespie, An Unthinkable Politics for Multispecies Flourishing Within and Beyond Colonial-Capitalist Ruins, in: Annals of the American Association of Geographers 112 (2022) 4, pp. 1108–1122; S. E. Kirksey/S. Helmreich, The Emergence of Multispecies Ethnography, in: Cultural Anthropology 25 (2010), pp. 545–576; T. LeCain, The Matter of History: How Things Create the Past, Cambridge 2017; J. Thomas, History and Biology in the Anthropocene: Problems of Scale, Problems of Value, in: The American Historical Review 119 (2014) 5, pp. 1587–1607; A. Tsing, Friction: An Ethnography of Global Connection, Princeton 2004; idem, The Mushroom at the End of the World: On the Possibility of Life in Capitalist Ruins, Princeton 2015.