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Jacques de Coutre has a Scoop on Intersectionality of Diamond Miners in Early 17th Century South India*

by

Johan VERBERCKMOES**

KEYWORDS. — Cultural Diversity; Diamond Mining in India; Border Studies.

SUMMARY. — In 1591 Jacques de Coutre went as a young man from Bruges to Lisbon and from there with his elder brother to Goa, India. He travelled widely across Southeast Asia and India and returned twice to the Iberian Peninsula via Persia and the Middle East. De Coutre was a successful diamond trader and gave the king of Spain (who then was also king of Portugal) sound advice on trading in the East. The present paper will outline how de Coutre performed as a cultural mediator between the Dutch and the Portuguese, but also between Indian rulers and the Portuguese. He dealt in precious stones, but also served as a diplomat. In doing so, he crossed many borders: he spoke several languages; he regularly changed the social register of his language as he spoke to rulers as well as very poor diamond workers in central Indian mines; he explored many different political systems; he compared cultural practices. During his adventurous life he always crossed geographical and state borders which made him a Habsburg world citizen as well as an inhabitant of Goa with a firm knowledge of India and Southeast Asia. This paper will focus on India, as de Coutre's written life story is one of the first extended European reports on the cultural diversity of the Indian subcontinent and the role of cultural mediator that he took up there as a migrant from Europe.

TREFWOORDEN. — Culturele diversiteit; Diamantmijnen in India; Studie van grenzen.

SAMENVATTING. — *Jacques de Coutre heeft een primeur over de intersectionaliteit van diamantmijnwerkers in Zuid-India aan het begin van de 17de eeuw*. — Jacques de Coutre vertrok in 1591 als jongeman vanuit Brugge naar Lissabon en vandaar met zijn broer naar Goa, India. Hij trok lang rond in Zuidoost-Azië en India en keerde twee maal terug naar het Iberische schiereiland via Perzië en het Midden-Oosten. Hij was een succesvol diamanthandelaar en gaf de Spaanse koning (die toen ook koning van Portugal was) adviezen over de handel in het Oosten. In dit artikel analyseer ik hoe de Coutre als cultureel bemiddelaar optrad tussen Nederlanders en Portugezen, maar ook tussen Indische vorsten en de Portugezen. Hij legde zich toe op handel in kostbare gesteenten, maar was ook als diplomaat actief. Op die manier ging hij vele grenzen over: hij gebruikte verschillende talen; hij wisselde geregeld van sociaal register, want hij onderhield zich zowel met vorsten als met steenarme diamantontginners in Indiase mijnen; hij leerde vele politieke systemen kennen; hij vergeleek culturele gebruiken. Tijdens zijn leven heeft hij voortdurend geografische en staatsgrenzen overgestoken die van hem zowel een Habsburgse wereldburger als een inwoner van Goa met een stevige kennis van India en Zuidoost-Azië maken. In deze tekst spits ik mij toe op voorbeelden over India, want zijn uitgeschreven levensverhaal

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is een van de eerste uitgebreide rapporten van een Europeaan over de culturele diversiteit van het Indische subcontinent en de culturele bemiddelaarsrollen die hij als migrant daar opnam.

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Jacques de Coutre was the son of a well-to-do broom maker living in Bruges in Flanders (Stols, 1974). He was born around 1575. Shortly after his father's death, his mother, Anna van Houven, decided to send Jacques abroad, to Spain. He was then around sixteen years of age and at least one of his brothers lived on the Iberian Peninsula. Arriving in Lisbon in October 1591 he met his elder brother Joseph and after some hesitation they both travelled to the East, settling in Goa, in southwest India, in September 1592. But not for long.

> It was against my character to remain in one place because I eagerly wished to see differences in the world (*como era contra mi inclinación el estar quedo en un lugar por el deseo y gusto que tenía de ver variedades del mundo*) (de Coutre, [1700], book 2, chapter 16).

For three decades Jacques de Coutre constantly travelled in South India and Southeast Asia. From September 1593 to March 1603, he acted as a diamond and textile trader and informal agent of the Portuguese governor of Melaka, Francisco de Silva de Meneses. In that capacity de Coutre visited, traded and negotiated in Singapore, Pahang, Siam, Cambodia, Manila, Brunei, Palawan, Mindoro, Patani and Johor (Borschberg, 2014). In May 1603 he returned to Goa and married a Portuguese Old Christian and his sister-in-law Catarina do Couto (whose sister had previously married Jacques' brother, Joseph). For two more decades Jacques continued as a diamond trader in South India, interspersed with two overland visits to Madrid to defend his interests. That was because since 1605 the Portuguese royal legislation had ordered the expulsion of foreigners from its overseas territories, mainly for fear of Dutch and English competition. This included the Flemish, subjects of the Spanish Crown, but not the Portuguese, notwithstanding the Union of the Crowns (1580-1640) at the time.

However, in Goa, the implementation of the law took nearly two decades to materialize. Several gem traders, among whom the brothers de Coutre, fiercely resisted expulsion. In the end, their resistance was in vain. On 1 April 1623 the governor of Goa ordered the arrest of Jacques de Coutre, his son and his brother and their deportation to Portugal along with several others. He spent about five years under house arrest in prisons in Lisbon and Madrid. By royal decree of 29 June 1632, the Council of Portugal in Madrid acquitted the brothers. For his service to the joint Spanish-Portuguese Crown in South Asia Jacques de Coutre ultimately was honoured as a knight in the prestigious Order of Santiago. Jacques de Coutre died in June 1640 in Zaragoza, Spain. A voluminous manuscript of his life story as an ego-document was co-authored by his son Esteban (de Coutre, [1700]; Verberckmoes & Stols, 1988; Stols, Teensma & Verberckmoes, 1991).

Notwithstanding his privileged status as Flemish-Iberian colonial agent, Jacques de Coutre identified intersectionality issues among diamond miners while in South India from 1603 to 1623. He was the first European to do so. De Coutre underlined the interweaving of their extreme poverty, miserable working conditions, spiritual desperation, gender issues, conditional payment and debt bondage to the private owners of the diamond mines on the Deccan plateau.

Overall, he emphasized their intricate marginality in a sector of economic activity in which he prominently participated as a merchant. Intersectionality refers to the aggregation of discrimination factors (Duran & Jones, 2020). Originally referring to the marginality of women (Crenshaw, 1989; Yuval-Davis, 2006), recent assessments on intersectionality point to the structures that accumulate inequalities among vulnerable workers (Bhattacharya, 2017; Bohrer, 2018), particularly in industries expanding in a global world (Mezzadri, 2016). Diamonds were such a global industry and early modern Goa one of its centres in Asia (Cunha, 2001). In that globalizing context Deccan workers extracting diamonds in underground mines faced social downgrading as a result of multiple discriminations (Plank, Rossi & Staritz, 2014).

Two reasons stand out to explain de Coutre's sensitivity to intersectionality. First of all, since his time in Melaka he had become an accomplished international diamond trader with above all expertise in the field of endless negotiations with unwilling local rulers (Bycroft & Dupré, 2019, p. 95). This pushed him to explore the sources of diamond extraction. During his visits to the diamond mines of Ramallakota, south of Kurnool, and the mines around Kollur, de Coutre came into close contact with miners and diggers (Winius, 1988, pp. 20-21). The dire circumstances of the manual labourers and excavators of a hugely promising product (the potential of which these workers were well aware) arguably attracted Jacques de Coutre to intimately explore the accumulating factors of their exploitation and even give evidence of their fight against intersectional discrimination. For they continued to dig nevertheless, just as he persisted in trading gems although gains were highly insecure. In his life story he tells how on more than one occasion he lost everything (de Coutre, [1700], book 1, chapters 2, 12 and 17; book 2, chapter 10; book 3, chapters 2 and 11). However, his social status as a colonial agent was never at risk. So, arguably not a sense of injustice pushed him to investigate the lives of diamond workers, but a sense of high risk and structural social downgrading intimately connected to the volatile gem business (Siebenhüner, 2018; Bycroft & Dupré, 2019). Some exceptions notwithstanding (Hofmeester, 2012, pp. 23-29; Alam, 2001; Mukund, 1991), this aspect of de Coutre's rich descriptions of the diamond mines of Vellore, Bijapur and Golconda has not been properly analysed in its own right. Historians have focused on trade (Disney, 1978; Chaudhuri, 1985; Maloni, 2021), travel (Rubiés, 2000) and religion (Županov, 2005; Barreto Xavier, 2022) as undergoing significant changes as a result of many intercultural exchanges in early modern India (Subrahmanyam, 1990), but hardly on subaltern workers.

Secondly, driven by his curiosity — *por curiosidad* (Winius, 1988, p. 24) — de Coutre was always travelling and thus gained huge experience (Subrahmanyam, 2017, p. 27). His continuous travel among many different cultures in rapidly changing international political circumstances in South India and Southeast Asia consistently affected and undoubtedly altered the views Jacques de Coutre had on the world and its people. This turned him into a cultural broker and a go-between and led him to meet people from all layers of society (Ares Queija & Gruzinski, 1997). That is the zest of his memoirs, written down at the end of his life but never published. Presumably on the basis of his personal notes as well as his memory, Jacques de Coutre told his adventures to his son Esteban and he turned these into a manuscript, or they jointly did. It is labelled *a vida*, a life of Jacques, and told in the first person. In contrast to a traveller from a generation earlier, Jan Huygen van Linschoten from Enkhuizen, who also left home aged sixteen, but on a sober mission of gathering useful information (van Gelder, Parmentier & Roeper, 1998), de Coutre often left the trodden path and eagerly embarked on new horizons. He gained local cultural experience, learned languages and acquired a sensitivity to

human encounters. What gave his life and his travels urgency, however, and tested his go-betweenness, was the historical context, more specifically, the break-up of the Deccan during the early seventeenth century due to Christian — Hindu as well as Muslim — Hindu political and commercial tensions (Alam & Subrahmanyam, 2012, pp. 162-203). While de Coutre was definitely blind-sighted on religious pluralism, he was not on commercial opportunity linked to political upheaval. In striking contrast to the extravagant luxury of the rulers of Bijapur and Golconda, which he documented with clarity, horror and fascination, the diamond extractors and transport workers operating in horribly poor conditions, somehow caught his sympathy.

Privilege and Peril: The Life of Jacques de Coutre

Although often living in perilous conditions Jacques de Coutre enjoyed many privileges of a Flemish citizen participating in Portuguese colonial ventures. However, his life started in uncertainty. In the 1590s Bruges still suffered from constant warfare during the Dutch Revolt (Bauwens, Braekman & Lauret, 1987). Mother van Houven feared her son Jacques was inclined to take service in the army. A future in the Iberian countries seemed more secure. In June 1591 Jacques went aboard the Red Lion in Vlissingen, Zeeland. For three months the ship was sailing and fishing in the North Atlantic and once fought with English ships in view of the Irish coast. On that occasion the ship's captain Gaspar Janssens lost both his legs when a cannon ball hit him and killed him. In October 1591 Jacques finally arrived in Lisbon. He was so shaken by his three months as an ordinary sailor that he collapsed and fell to the ground in the house of Herman Vermeire, the Flemish owner of the Red Lion who lived in Corpo Santo near the waterfront. There Jacques met with his elder brother Joseph, whom he had not seen for five years. Living a life of destitution in the Portuguese capital, Joseph and Jacques soon decided to sail to Asia (de Coutre, [1700], book 1, chapters 1 and 2). Before commenting on his Asian venture, the exact status of de Coutre as a Flemish in the Portuguese-Spanish overseas empires under one Crown needs to be defined.

The most detailed source on de Coutre's life is his autobiography written in the Spanish language (de Coutre, [1700]; Stols *et al.*, 1991). The text was penned between 1623 and 1628 while Jacques de Coutre and his brother Joseph were under investigation from the Crown, first in Lisbon and from 1624 in Madrid. Seven memorials with advice for the Spanish king Philip IV on how to conduct trade in South and Southeast Asia and East Africa complemented the autobiography (Stols *et al.*, 1991, pp. 359-438). Whether the de Coutre brothers acted as willing or unwilling spies for the Dutch East India Company or were loyal citizens of the joint Portuguese-Spanish Crown is still open for discussion (Borschberg, 2014, pp. 21, 33). This was the period when the Portuguese *Estado da India*, its official empire in the East, was in fierce competition with the Dutch United Provinces, the latest newcomer in the highly competitive South and Southeast Asian markets. Since the 1590s the Dutch Republic had been very active in the Indian Ocean and South Chinese Sea, culminating in the fusion of several existing companies into one East India Company (*Verenigde Oostindische Compagnie*, *VOC*) in 1602. Although Jacques de Coutre had occasional contacts with Dutch mariners in Manila and Melaka and evidently spoke their language, most evidence suggests Jacques de Coutre and his brother never actively sought any involvement with the VOC. On the contrary, as Flemish they fully participated in the Portuguese *Estado da India* as their marriages to an Indo-Portuguese family do Couto of Old Christians in Goa and diplomatic interventions on behalf of Portuguese

officials throughout South and Southeast Asia confirmed. Moreover, two centuries of intimate dynastic and commercial connections between Portugal and Flanders (Everaert & Stols, 1991) had paved the way for the Flemish, though subjects of the Spanish Crown, to be considered as also loyal to the Portuguese Crown. On the other hand, early modern imperialism was a mixture of public and private enterprise and distinctions blurred rapidly (Antunes, 2017). The gem business in particular easily transcended cultural, social and legal barriers (Bycroft & Dupré, 2019; Siebenhüner, 2018; Vanneste, 2011). As diamond traders, Jacques and Joseph de Coutre worked for their own pockets as well as for Portuguese officials and local rulers throughout Southeast Asia and India, including Jahangir, fourth Moghul Emperor.

Jacques de Coutre was a fixer, a go-between in empires (Subrahmanyam, 2021) and a merchant mediating between cultures (Ares Queija & Gruzinski, 1997). In 1592 he travelled to Goa on board of a Portuguese ship that consisted of a multinational crew. Although the Crowns of Portugal and Spain from 1580 to 1640 belonged to the same Spanish Habsburg king, colonial institutions of the two countries were not merged nor were their colonial laws, although Madrid had the last word. As Flanders was not subject to the Portuguese Crown, de Coutre was technically a foreigner in Goa. However, to start off his career, he ignored his mother's advice and became a soldier, a *soldado* in service of the Portuguese to obtain the protection of local Portuguese officials in Melaka (Subrahmanyam, 1999, p. 316). This was a rational choice, though, enlisting as a soldier was a legal way for the Flemish to participate in Portuguese ventures. On the other hand, arriving in Melaka in late September 1593, the ageing Venetian gem merchant Sequin Martinela took Jacques de Coutre under his protection (de Coutre, [1700], book 1, chapter 2). Sequin was a second father to Jacques. He learned the young man from Bruges all tricks of the trade in diamonds and other precious stones. As Venice was a crucial link in the diamond trade between Portuguese India and the Habsburg Netherlands (Everaert, 2004), this made much sense also for Sequin Martinela. During his decade of service to the Portuguese in Southeast Asia, Jacques de Coutre undoubtedly raised his status as trustworthy subject (Borschberg, 2014, p. 35).

However, Dutch-Portuguese tensions ran so high that on 18 March 1605 a law was declared in Portugal that ordered all foreigners to be driven out of the Portuguese settlements in the *Estado da India*, as well as the Atlantic islands, Brazil and the African coast (Subrahmanyam, 1999, p. 297). On 28 November 1606 King Philip III of Spain ordered the viceroy in India, Dom Martin Afonso de Castro, to implement this law (Borschberg, 2014, p. 15), as the informal capital of Portuguese Asia, Goa, teemed with strangers — Persians, Armenians, Jews, Germans, French, Italians, and Flemish. Although Habsburg subjects, according to Portuguese colonial law, Flemish were also foreigners. That is why starting in 1606 Jacques de Coutre travelled over land via the Persian and Ottoman empires to Lisbon and Madrid to defend his actions (among other reasons because he had talked in Manila in Dutch to a Dutch ship captain of the VOC) and present the monarch with detailed petitions (de Coutre, [1700], book 2, chapters 5 to 12). For instance, he argued that he was not only loyal to the Portuguese Crown, but had also carried letters by the viceroy of Goa on his overland journey (Borschberg, 2014, p. 15). He then returned to Goa, apparently having satisfied authorities. Finally, it took a very long time before action was taken against gem traders such as de Coutre and the most prestigious and rich among them all, the German Ferdinand Cron from Augsburg (Malekandathil, 1999, pp. 97-111). In the meantime, the de Coutre brothers confirmed their loyalty with donations to churches and hospitals in Goa (Borschberg, 2014, p. 11). In 1620 Jacques de Coutre undertook

a second voyage to the Iberian Peninsula to justify his doings to the Portuguese Crown, but got no further than Aleppo and returned to Goa (de Coutre, [1700], book 3, chapters 9 and 10). Perhaps accusations of collaborating with the Dutch VOC began to weigh. He even planned a third visit to Madrid in 1621, but that did not materialize, as he was taken prisoner by the Portuguese not far from Goa (de Coutre, [1700], book 3, chapters 11 and 12). Clearly, Portuguese patience had run out, as the Dutch and the English became ever more fierce competitors and gem traders Jacques and Joseph de Coutre and Ferdinand Cron were all expelled. Finally, the arrest in and deportation from Goa of Jacques and Joseph de Coutre in the company of Jacques' son Esteban, on 1 April 1623, brought them first to Lisbon and then to Madrid for almost a decade of legal battle (de Coutre, [1700], book 3, chapter 15). In 1632 they were acquitted of any charges of spying for the Dutch and acknowledged as loyal to the Crown.

Although under suspicion as foreigners with a possible double agenda, until 1623 the de Coutre brothers always enjoyed the privilege of working in complete freedom in and from Goa. They earned significant wealth in the gem trade and vouched for others. As economic agents they belonged to a privileged social group of high-end traders working for rich buyers and took every opportunity and risk (Cunha, 2001). In the light of this, the autobiography of Jacques de Coutre gains special significance. It has been suggested that it was written in the style of a picaresque novel (Winius & Chorba, 1998). Humour and ironic self-deprecation, but also fury and indignation at the actions and words of others, fuel the narrative. The manuscript has a title-page drawing with a coat of arms, an I-character telling a story of many adventures with numerous twists and turns and uses a Spanish language fused with Portuguese (Teensma, 1989). This suggests a popular genre (Borschberg, 2014, pp. 31-33). As accomplished as more famous early modern travellers, Jacques de Coutre surged on a wave of authorship that demonstrated eagerness to know the world intimately (Subrahmanyam, 2011). In that perspective, the examples that Jacques de Coutre gave of the destitution he was living in and the hardship he encountered cater to the popularity of the genre of travel narratives (Mancall, 2007). For instance, on their first voyage, he and his brother are sick and are taken care off in a hospital in Mozambique. When the ship leaves, he hears that his brother has gone away and fears the worst, that he is dead. But then he finds his brother and is overcome with joy, yet at the same time the tears stream from his eyes as he reflects on their extreme poverty. His brother has only trousers, a shirt and a woolen cap, but no stockings or shoes (de Coutre, [1700], book 1, chapter 2). This is one of numerous examples in the *vida* of rapid social downgrading as a result of several factors, in this case disease, isolation and theft. Although inversely self-glorifying in the best picaresque fashion, the ultimate experience of his adventurous life was to assess structural dangers at every instance.

Throughout his autobiography, Jacques presents himself as a picaresque hero surfing on contradictory emotions. However, arguments about having lost everything, including every piece of clothing he carried with him, wear thin against the overall impression of his memoirs that he is a finely skilled negotiator who always finds a way out. This is exactly what a picaresque traveller does. He takes up an impossible assignment, gets into deep trouble but emerges triumphant, at least for the time being. A second function of the narrative is that it presents life as an ongoing affair with unexpected turns at every corner. This has the flavour of storytelling for its own sake. The story gives very much an impression of having been dictated to his son Esteban (Rubiés, 2000, p. 381). "I go on with my story" and similar interventions suggest long sessions of storytelling. In contrast to most other European travel narratives,

eagerly copying each other and plundering older narratives, de Coutre's life story is full of details little read elsewhere. Misspelt names of rulers and cities and inaccuracies suggest Jacques de Coutre was speaking from memory to his son while presumably also using notes, as the many attestations testify he presented to the Crown. The closest we come to de Coutre's mind is when he tells us he cannot stay at one place yet always wants to see something new. This sums up his boundless curiosity and charming passion.

Go-between in South India

From the moment his mother sent him in 1591 from Bruges on board a Spanish ship to his time in Madrid in the 1620s awaiting the final verdict of his case before the Council of Portugal and his death in 1640 and burial in the San Andrés Hospital of the Flemish in Madrid, Jacques de Coutre was a privileged subject of the Spanish-Habsburg monarch under whose protection he lived and to whom he was responsible. His upbringing in a family of burghers and craftsmen of Bruges had set him on that path. His personal achievement of being good at languages and as a clever and cunning go-between was an additional asset to consolidate his position and social status. Nevertheless, he always bumped into inconsistencies and that made him sharply aware of imminent social downgrading in adverse circumstances. Perhaps this was his motivation to resettle several times over during his lifespan. Structural discrimination was best avoided by starting all over again in a different place. This was also what diamond trade was all about. Throughout his career, gem trading secured him access to the highest rulers in any country. From these encounters he quickly learned that he was a mere pawn in their hands. It made him sensitive to labour relations.

Early modern global encounters implied the use of several languages. When he started off from Bruges and Vlissingen, Jacques de Coutre presumably only spoke Flemish/Dutch. When he sailed from Lisbon to Goa in 1592, he spoke neither Portuguese nor Spanish. At the end of his life he wrote in Spanish advice for the king on policy matters in South and Southeast Asia. His autobiography was written in Spanish with a vocabulary full of Portuguese twists that perhaps alluded to the conversations between father and son at the basis of the document. Portuguese was arguably his common language while in South Asia. Travelling on the Deccan plateau in South India, he learned Marathi, the language of communication in a region with numerous other languages. He also often relied on local interpreters as he travelled in so many countries and regions.

Jacques de Coutre lived in a time when merchants were still allowed to travel on their own to the diamond mines, a practice that disappeared later when the big companies had to use Indian go-betweens to get diamonds from the mines. Like other diamond traders in his days de Coutre was eagerly sought after by both Asian rulers and the Portuguese authorities in supplying them with diamonds, benzoin, and textile. But, more than his contemporaries Jacques de Coutre wrote about how we explored all stages of the trade itself, the acquisition of rough stones from the mines, their transport and sale, selling gems to other traders and looking for new consumers. Early modern global trade networks hovered between official and unofficial practice and encouraged individuals to cross borders, cultures and institutions (Antunes, 2017). Jacques de Coutre fitted perfectly in this ecosystem. However, the dealings he had with the powerful also implied that he was in a position of inferiority to Portuguese authorities as to Indian and South-Asian rulers and dependent on their goodwill and protection. This was the

reverse side of the big gains that he made with the highly volatile diamond trade. Perhaps the fact that as a Flemish he was an outsider to the monarchs of the East as well as to the big empires of the West stimulated him to cross cultures at his ease.

De Coutre had learned to trade in rough precious stones from the Venetian Sequin Martinela in Melaka and others who had been in the business for a long time. The gem trade had been a motor of Eurasian exchange already before Vasco da Gama set sail to India. Italian, Jewish and Armenian traders used overland routes through Persia to connect to the rich gem trade networks in South and Southeast Asia. However, the tense political situation in the early years of the seventeenth century gave de Coutre's activities as a diamond merchant an extra twist. This was so in the 1590s, when Jacques de Coutre was in the front line of Portuguese-Dutch rivalry in Southeast Asia. In 1595 de Coutre was part of the embassy sent by the Portuguese Captain of Melaka, Francisco de Silva de Menezes, to the King of Siam to negotiate the release of Portuguese captives during the war of Siam with Cambodia in 1594 (de Souza, 1989). Two of these prisoners were the Flemish brothers Antonio and Miguel Ans. They were the sons of a Flemish man who had married in Melaka. The father and his sons had provided many services to the King of Cambodia, Chey Chettha I, last of the Varman dynasty and the Lovek period of Cambodia, who had been defeated by the Siamese in 1594 and had fled the country. During the Portuguese embassy of 1595 to Siam, Antonio and Miguel Ans worked as interpreters while they were also captives of Siamese King Somdet Phra Naresuan the Great. Although de Coutre hoped to benefit from the luxury of the Ayutthaya court and get substantial profit from royal gifts, nothing came of it. On the contrary, the Ans brothers apparently were loyal to King Naresuan and did not give in to attempts by de Coutre to get them on his side (de Coutre, [1700], book 1, chapters 7 to 11). Confrontations between the Portuguese and the Dutch in Manila and Patani in 1600-1602 alerted Jacques de Coutre that the trade in precious stones, bezoar and textile was fraught with threats of captivity and worse. He decided in 1603 to take safer Goa as his base.

But also in South India political tensions ran high. In the 1590s the Mughals set their eyes on the Deccan (Alam & Subrahmanyam, 2012, pp. 162-203). By 1600 the Ahmadnagar Sultanate was subdued to Mughal rule. The frontier for the coming decades were two other sultanates, Bijapur of the Adilshahis and Golconda of the Qutbshahis, both to the northeast of Goa. Precisely on the borders of these two sultanates Jacques de Coutre acted as an indefatigable trader. He had close contacts with their rulers, but his relations with them always seemed precarious. Ibrahim Adil Shah II (r. 1580-1627) of Bijapur and Muhammad Quli Qutb Shah (r. 1580-1612) and his nephew and son-in-law Muhammad Qutb Shah (1612-1625) ruled independently, although under Mughal threat. Their close connections with the Shi'i Safavid rulers of Persia, enemies of the Sunni Mughals, resulting in many Iranians at their courts, secured the Adilshahis and Qutbshahis of some autonomy. Jacques de Coutre alleged that Ibrahim Adi Shah II of Bijapur paid expensive gifts to the Mughal to soothe him (Alam & Subrahmanyam, 2012, pp. 193-194), but there was more political expediency in the tactics of the sultan than mere flattery. As a result of Mughal pressure, Bijapur, and to a lesser extent, Golconda, befriended the Portuguese, while previously they had been rivals. This provided traders such as Jacques de Coutre with the excellent opportunity to undertake private trading in gems and textile in the Deccan. Profits were huge and de Coutre made his fortune. Jacques de Coutre happened to be the right man in the right place in this quarter century during which the Muslim sultans of Bijapur and Golconda maintained accommodating relations with Portuguese. By the 1630s this

was over. Goa declined, the Dutch East India Company settled in the region and Mughal expansion into the Deccan regained momentum. At that time, Jacques de Coutre was already in prison on the Iberian Peninsula.

In 1604 and 1605 Jacques de Coutre spent much time in Bijapur. Farmers and ordinary people in the region were among the most destitute he had ever met, he noted, while the ruling elite was immensely wealthy (de Coutre, [1700], book 2, chapter 2). According to his own testimony, de Coutre was good friends with the sultan and the crown prince, but on other occasions in his story the de Coutre derided Ibrahim Adil Shah as a perverted, arbitrary despot. Similar attitudes characterized his relationship to other rulers in the Deccan and beyond. Good personal relations were key to the survival of foreigners in the region, but were never guaranteed. Moreover, the region was multi-religious. The sultanates of Bijapur and Golconda ruled over extensive populations of Hindu and Jain. Invariably, de Coutre rejected their rituals, temples, practitioners such as brahmins and yogis, and worship of cows and monkeys as superstitious (de Coutre, [1700], book 2, chapter 17). Nevertheless, he also indulged in extensive descriptions of religious practice. Further south large Christian communities added up to the diversity. Not surprisingly, local rulers tolerated Armenians, Jews, Italians, Portuguese, Flemish and Dutch in the region.

From 1604 de Coutre was very active in the gem trade and especially in the 1610s he became a successful and wealthy merchant. On his numerous journeys on the Deccan plateau and South India he found out that textile and precious stones had created a country of innumerable riches. The cities were well built and protected and surpassed those of Flanders, he alleged (de Coutre, [1700], book 2, chapter 16). The contrast between the wealth of local rulers and the destitution of the local population continued to draw his attention. It had a faint echo of his own life story, or at least that is what he wanted to emphasize in the picaresque retelling of his life. Jacques de Coutre made several successful business deals, but on as many occasions he suffered great losses. A few times, he and his brother Joseph were totally ruined. Private trading was a risky business, especially in such goods as precious stones that always needed secrecy. The margins between official trade and mere smuggling were thin. In that sense, de Coutre was not different from what other gem merchants experienced. What is different in his case, is that he is extremely detailed about his dealings with local rulers and owners of diamond mines. Even more exceptional, and spectacularly, is that at the height of his experience as a gem trader he turned his attention to the diggers of rough stones.

The first description of a diamond mine from Dutch East India Company officials dates from 1615. At that time Jacques de Coutre already had extensive experience of diamond mines. He had visited several of them in 1611 and 1612, as will be explained in more detail in the next section. In 1616 he went on another tour, visiting no less than eight diamond mines in Bijapur, Golconda and other sultanates in the Deccan on the edge of what remained of the Vijayanagara Empire (de Coutre, [1700], book 3, chapter 3). By then, his reputation was well established. A Jew from Istanbul, who spoke excellent Spanish, joined him as de Coutre was by now more familiar with the region. In fact, the Flemish diamond merchant amply demonstrated he was at home on the Deccan plateau and beyond in South India. There is no trace in his *vida*, however, that he ever sided with the local population. He was not a man of cross-cultural understanding. What he offered was a micro-analysis of the stages of gem extraction, trade and sale because this was what he did. But in the process he discovered structural inequalities that ran deep in South-Indian society.

Intersectionality in the Deccan Diamond Mines

Strikingly, de Coutre took note of those groups in early 17th century South-Asian society that we now label the underpaid workers of globalization: food provisioners, miners, carriers. Discrimination of these people caught his attention. Their low social status, distressed physical appearance, extreme poverty, challenging manual labour, horrible labour conditions, reputation as thieves in the eyes of their employers, distressing social life and (in de Coutre's view) ill-defined religion concurred to single them out as discriminated by the owners of diamond mines and the rulers of the region. Particularly in 1611 and 1612, after nearly twenty years of experience in South Asia, Jacques de Coutre provided an intelligent review of the working conditions of diamond miners in the Deccan plateau. No other European author before him had done so.

French descriptions of Indian diamond mines followed only half a century later (Subrahmanyam, 2021), but were not as sophisticated as de Coutre's (Hofmeester, 2012). Most descriptions focused mainly if not exclusively on the trade in gems and not mining (Ogden, 2018, pp. 243-255). William Methold, later deputy governor of the East India Company, was the first Englishman to visit the diamond mines of Golconda in 1622 and noted the miserable working conditions of the tens of thousands of workers digging rough stones in small pits for a very small wage while food was expensive, but added no further details (Methold, 1707, pp. 22-26). In striking contrast to this, Jacques de Coutre practised mimesis. He went down to the diamond mines to see for himself how the miners worked and even took up their tools to work alongside them. As a participating observer he explored in minute detail how diamond excavating was done. To report on this and as substantiated below, he relied on humour, indignation and cunningness to get a full understanding of the working process. Temporarily becoming an Indian, he gained implicit understanding (Schwartz, 1994) of the human toll of the gem culture. In 1611-1612 the structural factors of intersectionality hit Jacques de Coutre in the face due to a mix of personal motivations and the tense political situation already referred to which actually allowed him to trade in the region under Portuguese protection. By going down into the Golconda diamond mines, Jacques de Coutre attested intersectionality.

During his many travels in Southeast Asia in his first decade in the East, Jacques de Coutre, as many authors before him, noted how closely related the opulence of despotic rulers was to the poverty of their population. However, unlike others, he applied an ethnological gaze. In the second year when he was in Asia, in 1594, in the Straits of Singapore, de Coutre singled out the orang laut fishers or *saletes*, as he called them, as precariously living (de Coutre, [1700], book 1, chapter 3; Borschberg, 2014, p. 39). He described them as very poor and living miserably with their families and house pets on tiny and narrow boats. They were very skilful fishers, the man sitting at the front with the harpoon and his wife and children peddling very fast. There were some very old men among them. De Coutre had met some who boasted to be a hundred years old. This is a typical European claim of longevity that emphasizes their exceptional life. Moreover, the orang laut fishers were crucial as guides for naval communication among the hundreds of islands in the Straits of Singapore, and few foreign observers had noted that before. However, little experienced, de Coutre also repeated prejudice. They were not to be trusted, de Coutre alleged, as their poisoned daggers or krisses were lethal. They came aboard ships in large numbers to attack and kill entire crews, under the pretense of selling fresh fish. Hesitating between blatant stereotype and a sensitivity to actually meet these people and see how they lived, de Coutre at least demonstrated an inclination to look at the poor. In this

case, his observations on how their professional skills matched their precarious living conditions, suggested a discrimination of which these people would definitely suffer much later under colonial English rule.

In the early seventeenth century Jacques de Coutre was one among a good number of *frangi* (Franks) or Christians from the West to get acquainted with the Deccan plateau in South India. The exception is that he wrote about it. On 2 May 1603, Jacques de Coutre had returned to Goa and made diamond trading the core business of the de Coutre brothers. Jacques' elder brother Joseph had settled in Goa since 1593 and always remained at home there while Jacques was on the road. Joseph made sure payments were made and transactions concluded, for the diamond trade from Goa had intersections to many parts of the then known world, including the Americas (Hofmeester, 2013; Cunha, 2001). Jacques travelled throughout the Deccan plateau. Apparently he felt very much at home there in this disrupted region at the time. To familiarize himself with the local people and customs he relied in first instance on an Armenian called Francisco Gonçales, who acted as de Coutre's translator. Soon he learned Marathi. The Hindu principalities of Bijapur and Golconda, then under Muslim and Mogul influence and with Muslim rulers, were his two main destinations.

By the 1610s Jacques de Coutre had become accustomed to being transported in a palanquin (de Coutre, [1700], book 2, chapter 15). It served him as a mobile hotel. He even slept in it and travelled during the day. The Indian people who carried him provided him with rice and milk for food. But, one day, on arriving in a major city, the Indian carriers all ran away. This made him angry and he thought they were cowards. Moreover, in the city where he found himself, he did not speak the local language. He entered a food shop and gestured that he wanted to eat and paid the man a golden pagoda coin. He got food for two days. Then he encountered Gujarati gem merchants who spoke the Deccani language, Marathi. He told his name and they knew him. But, they found it hard to comprehend, as they saw him skinny and with worn-out clothes. His reputation was that he was very rich. He persisted that he actually was Jacques de Coutre. The merchants provided him with food and sought a palanquin to bring him to the Ramallakota mines. They also tipped him that the Portuguese Fernão Jorge was waiting in the mines for de Coutre with lots of money to invest in diamond trade. This little story shows Jacques de Coutre on the move. His *modus operandi* was to be alert to situations that switched easily and talk to everyone, rich and poor alike.

In the spring of 1611 Jacques de Coutre travelled from Goa to visit actual diamond mines (de Coutre, [1700], book 2, chapters 13, 14 and 15). Having gained sufficient experience of the region, its rulers and its commercial possibilities, he wanted to see with his own eyes how rough stones were extracted. Two Gujarat merchants showed him the road to the Ramallakota mines, south of Kurnool (current state of Andhra Pradesh). The exact location of the mines de Coutre visited is hard to pin down as later in the seventeenth century new mines were also called Ramallakota (Winius, 1988). De Coutre estimated that about fifty thousand people laboured in the Ramallakota mines (de Coutre, [1700], book 2, chapter 15). His description suggests a miner's existence of hardship that persisted but also changed in the course of the seventeenth century (Hofmeester, 2012, pp. 21-29). The miners were men, women and children, thus adding gender and age to poverty as structural factors of their existence. Each and every one of them was extremely poor, de Coutre noted. They hardly had any food. Families lived with their tools in tiny huts of two metres by two metres covered with straw. Poverty was so extreme there that it is hard to imagine, as de Coutre phrased it. Diamond workers went

naked except for a loincloth. They looked dirty and were covered in mud from the mines below. They had no bed to sleep, but only a mat.

However, poverty making these men and women so vulnerable that they could not sustain themselves, as de Coutre alleged, was not an impossible road. Diamond workers had organized themselves into groups (*compagnies*), he noted (de Coutre, [1700], book 2, chapter 15). Some traders supported them by providing the workers with food and billy goats for offerings, on condition that all the diamonds they extracted in a specific month were brought to the merchant. The trader was thus able to buy the stones cheaply and even subtracted the food and billy goats from the payment. This left quite a few workers in debt, but they survived on further loans from the merchant for the next month. De Coutre does not explicitly mention this, but the workers' companies seem to have functioned as a credit system to enable the workers to pay at least some sums back to the merchants and to guarantee that they were actually paid for the diamonds they found. In other words, the awareness of their discrimination had prompted solidarity among the workers. De Coutre provides no further context for this, nor does the literature on diamond trading in early modern India. It may be read as proof that de Coutre laid bare an accumulation of discriminations of social class and gender leading to social downgrading, but also to a desperate struggle of economic survival. He formulated the latter explicitly: "They always live in miserable conditions and usually die during their work. No matter how many offers they offer to the devil, they are never rich and they do not enjoy from what they find" (de Coutre, [1700], book 2, chapter 15). Whether they had extracted diamonds or not, everyone had to pay half a pagoda each month to the owner of the mines, Gopal Raya, a nephew of the Hindu ruler of Vijayanagara, Venkatapati Deva Raya alias Venkati II. The reference to the devil alludes to a factor of discrimination that de Coutre formulated in prejudicial terms about Hindu religion, but it might also reflect his scepticism about such religious practices.

The Ramallakota mines were situated in Hindu territories of which, according to de Coutre, the population and their rulers were all bad and worse than the Muslims. This was a reminder that the Sultanates Bijapur of the Adilshahis and Golconda of the Qutbshahis ruled over mixed religious populations and were on a frontier with Hindu and Jain territories (de Coutre never distinguished religious practices, only referred to heathens and Moors or Muslims). However, he explicitly linked religious ritual to digging practices in his description of the Ramallakota mines (de Coutre, [1700], book 2, chapter 15). When starting to dig in the ground, the workers first built a platform with a fence and a small temple on it with a marble block inside as a statue that they smear with saffron. Once their worship was over, they started digging with iron instruments. Wet earth was piled and formed a small hill, the height of a man. The earth was spread out to dry on the platform. Then, seven or eight men sat on the platform. Each one took a square hard stone, the size of the palm of his hand, and crushed it into small pieces. They then carried the pieces in baskets to the edge of the platform and threw them on the ground. The wind took the dust away, so that only a small pile of little stones remained. In these the seven men searched for diamonds, which they set aside. Usually they found only small stones. This is a typical description of digging practices in southern India as noted by William Methold or in the early fifteenth century by Niccolò de' Conti (Poggio Bracciolini, 2004, pp. 156-157). De Coutre added many more details and his perception that the workers saw their plight as endless. They sometimes worked for two or three months without finding any diamond. Yet, all the time they spied on each other to see if someone hid a big gem that ought to be given to the owner

of the mine. Their exploitation was as certain as their solidarity among each other was feeble. Notwithstanding the social control among each other, the sifting miners did sell diamonds to strangers for half the price. On a very rainy day, a mine collapsed and one hundred and fifty people were killed. The next morning the crying in the village about this disaster "engulfed the world" (de Coutre, [1700], book 2, chapter 15).

Although the narrative suggests emotional attachment, Jacques de Coutre was not driven by sensitivity to discrimination out of solidarity or sympathy with the workers. The mere mechanics of social downgrading fascinated him. His views on local religion as yet another accumulating factor of discrimination endorse this. For de Coutre, economic hardship and barbarous religious customs were two sides of the same coin. For instance, de Coutre's economic explanation of the low wages of diamond diggers is immediately followed by the comment in his autobiography that the region swarmed with magicians and that almost everyone was a magician (de Coutre, [1700], book 2, chapter 15). He had witnessed four of them, elderly men, entering a house, singing and dancing, drawing circles and triangles on the floor with betel and betel nut in the centre. This made the people present ecstatic and under the influence of the devil, as de Coutre saw it. He did not explicitly say that such behaviour was a trap of poverty, but the juxtaposition in his autobiography of their low wages and the power of magicians suggested persistent structural dominance over them. On the other hand, Jacques de Coutre added to the prejudicial, exotic views of the *frangi* by picturing the Deccan workers as under the influence of magicians. In another one of his picaresque asides, in the same chapter, he told a story of how a magician got him in his power. He wanted to eat and taste a tender and young billy goat and left the village in search of one among a large herd of goats. This one had white and block spots whereas all the other goats were simply black. He bought the albino version of the billy goat and took it home to the house where he was then living in the village of diamond diggers. In the streets everyone laughed at him as he carried the young billy goat in his arms. His servants killed, skinned and roasted the billy goat, but when it came on the table he saw that it was huge. It smelt horrible and he had it thrown on the dung heap. "The magician had blinded me", de Coutre concluded. As a participant observer, yet tenaciously stereotyping, Jacques de Coutre not only added barbarous religion to class and gender as factors of discrimination explaining the extreme poverty of the workers, but also demonstrated that strangers like him were not to take up their cause, but, on the contrary, with their stereotyped, orientalizing views merely confirmed the fate of the workers.

In 1612, de Coutre visited the diamond mines of Poli, Gostoal and Marmur in Golconda, near Kollur. It is hard to attest where these were situated exactly. Poli was the oldest diamond mine of Vijayanagar. There were no large diamonds to be found in Poli, only small stones that were set in hard rock. This made the Bruggeling curious (de Coutre, [1700], book 2, chapter 16). From the diggers he bought some one hundred and sixty stones that contained small diamonds and sent these to his brother Joseph in Goa with the message to send them further to their friends in Europe. He prided himself he was the first European to notice how the extraction of such small stones happened. To experience it for himself, he followed the diamond workers underground. Dressed only in white pants and with a bare upper body he followed a digger who carried a lamp. They walked a distance of two musket shots underground along a very narrow and bumpy path where a man could barely pass. Finally, they entered an underground gallery that could have contained a thousand people. The workers had carved the cave with their bare hands. Many people were at work with the light of lamps and used iron tools.

They cut in the stone. The cave was steaming hot. Water dripped from the rock. Jacques de Coutre came out of this mine completely soaked and full of clay, just like the diamond workers. This testimony of his personal visit endorses the view of de Coutre as an adventurous and enterprising man. In the cave he bought a thirty-carat stone from a worker. But the owner of the mine found out and de Coutre had to return the stone. However, he also got his money back, which was taken from the poor worker, who was caned until he was left for dead. So, although showing concern for the plight of the workers, at the end of the day Jacques de Coutre was the privileged merchant who only noted the discrimination but in no way suffered from it. On the contrary, the worker from whom he had bought the thirty-carat stone suffered abuse because of de Coutre's cunning deal and he was not shy to tell it outright.

During his visits to the Ramallakota mines in 1616 de Coutre employed twenty-five natives to carry his goods. Their number is surprising, but he insisted the freight was extensive and consisted of gold, pearls and emeralds. De Coutre hired them as acknowledged professionals as everyone did. In this region of much political rivalry their trade was to carry precious stones, gold and pearls from one state to another, without external witnesses and without knowing who they exactly were. "They are so poor that they hardly have a rag to cover themselves. As to reliability, they are an example to the entire world" (de Coutre, [1700], book 3, chapter 3). By joining these two observations, de Coutre demonstrated that he understood very well how professional status was acquired. In this case their poor appearance was precisely the reason why they were trusted by carriers, even by the richest people in India. In other words, de Coutre named the exploitation of unnamed transport workers but in one breath also glorified it as a ruse. Yet again, he wanted to find out himself. First he explained their *modus operandi*. If they feared an encounter with thieves they buried their goods next to the road. As the thieves saw people in the poorest clothes, they did not pay them any attention. And if they risked being betrayed as diamond transport workers, according to de Coutre, they would rather be killed over than reveal where the goods had been hidden. Carriers always operated in large groups, so that there was always someone to finish the job. The ambiguity of de Coutre's comments is striking. He turned their exploitation into suggestions of self-sacrifice underpinning their absolute loyalty to those who employed them. Although undoubtedly keeping an eye on his self-interest and indulging in some exotic fantasy about loyalty of the poor, de Coutre arguably also displayed a sensitivity to the work ethic of low class workers. Firsthand experience confirmed for him the thorny issue of trust. To carry his large amounts of diamonds and precious goods, Jacques de Coutre sent the twenty-five porters he had hired two days in advance of him to a village where he would meet them. He did this because all suspected that in the woods where they would pass thieves were hidiny and waited for them. When he reached that village, however, he did not find his carriers. He feared they had been killed. But he found them in the next city. Nothing was missing from his precious luggage. They had taken an entirely different road. For Jacques de Coutre this was the best evidence that these very poor transport workers were doing an excellent job and he continued to employ them and was happy that they assisted him in every way. In other words, de Coutre endorsed the dangers the carriers faced as part of their working conditions.

Conclusion

Jacques de Coutre found his second home on the Deccan plateau rather than in Goa. As the years went by, dealings with local rulers and local workers attracted him more than Portuguese colonial society. We know next to nothing about his closest family, except that his wife must have died quite early and that he had at least one son, Esteban. His brother Joseph in Goa was his main link to the colony on the coast. In the 1610s, Jacques preferred the Indian cities in the interior and countryside. As a privileged diamond trader, de Coutre's curiosity extended to the diamond diggers, their families and diamond transport workers. Ridiculing their religion, he was not sensitive to their culture nor presumably to their misery. What he did comment upon in some detail was the accumulation of discrimination factors that put these workers at the bottom of Indian society in the Deccan. Perhaps the fact that as a trader he was always subject to the whims of rulers buying or refusing to buy diamonds explains some of his analytical views. As a Flemish in Portuguese-Indian society, he worked in the interstices of overlapping empires in the region and that vulnerability may have made him sensitive to potential social downgrading. After all, there were not so many Flemish in Asia (Everaert, 2000). His deportation to Madrid and Lisbon in 1623, against which he had fought for a very long time, underlines his unstable position as a foreigner.

De Coutre himself had two explanations for the fragile social position of diamond diggers. The first one is economic. "Such hard work of these people to extract diamonds can only be paid for in the East, where the cost of living and services are very cheap. A mine worker can live on a daily allowance of eight maravedi and even then he can live well according to his position in society, which he would not be able to do in Spain with six real" (de Coutre, [1700], book 2, chapter 15; the maravedi was the thirty-fourth part of a real, both accounting units in use in Spain). Such economic reasoning about cutting wage costs suggests de Coutre was not much concerned with social inequality. Nevertheless, having himself descended into the horribly hot diamond mines, it struck him that the diamond workers were being exploited and he investigated the different dimensions of this. His second explanation is closely linked to this. De Coutre considered religious rituals among them as barbarous. In his Christian vocabulary the devil misled them. To him this explained the workers' vulnerability. On the other hand, throughout his memoir, he acknowledged the interweaving of factors that carried the risk of social downgrading. Amidst all this complexity of early seventeenth century India, the diamond diggers and diamond transport workers struck him as the lowest class at the intersection of precarious identities of class, gender, bodily appearance and religion.

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Egypt through a Belgian Lens: Jean Capart and the Collection of Photographic Glass Plate Negatives of the Royal Museums of Art and History in Brussels[*]

by

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Keywords. — Jean Capart; History of Belgian Egyptology; Photographic Archives; Egypt.

Summary. — Under the impetus of a growing interest within the international Egyptological community in the history of its own discipline, many institutions have recently made considerable investments to disclose historical photographic archival collections by digitization efforts. The famous Egyptological library of the Royal Museums of Art and History (RMAH) in Brussels also keeps an important photographic archive of which the large subcollection of almost fourteen thousand historical glass plate photographic negatives were studied in the framework of the SURA project. These photos date from the first half of the 20th century and document the pioneering years of Egyptology in Belgium from the perspective of Jean Capart, founding father of Belgian Egyptology and the first curator of the Egyptian department of the RMAH, and his collaborators.

Trefwoorden. — Jean Capart; Geschiedenis Belgische egyptologie; Fotografische archieven; Egypte.

Samenvatting. — *Egypte door een Belgische lens: Jean Capart en de collectie fotografische glasnegatieven van de Koninklijke Musea voor Kunst en Geschiedenis in Brussel.* — Onder de impuls van een groeiende interesse van de internationale Egyptologische gemeenschap in de geschiedenis van haar eigen discipline hebben verschillende instellingen recent aanzienlijke inspanningen geleverd om historische fotografische archiefcollecties digitaal te ontsluiten. De beroemde Egyptologische bibliotheek van de Koninklijke Musea voor Kunst en Geschiedenis (KMKG) in Brussel bewaart ook een belangrijk fotografisch archief waarvan de grote deelcollectie van circa veertienduizend historische fotografische glasnegatieven werden bestudeerd in het kader van het SURA project. Deze foto's dateren uit de eerste helft van de 20ste eeuw en documenteren de pioniersjaren van de Belgische Egyptologie vanuit het perspectief van Jean Capart, de grondlegger van de Belgische Egyptologie en eerste conservator van de Egyptische collectie van de KMKG, en zijn medewerkers.

Mots-clés. — Jean Capart; Histoire de l'égyptologie belge; Archives photographiques; Égypte.

Résumé. — *L'Égypte dans l'objectif belge: Jean Capart et la collection de photographies sur plaque de verre des Musées royaux d'Art et d'Histoire à Bruxelles.* — Dans un contexte international marqué par l'intérêt croissant de la recherche égyptologique pour l'histoire de sa propre discipline, de nombreuses institutions scientifiques ont récemment consenti à des investissements importants afin de numériser leurs collections d'archives photographiques et en permettre le libre accès. La célèbre bibliothèque

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égyptologique des Musées royaux d'Art et d'Histoire (MRAH) de Bruxelles possède également de riches archives photographiques, dont la sous-collection importante de près de quatorze mille négatifs sur plaques de verre a fait l'objet d'une étude dans le cadre du projet SURA. Ces photos datent de la première moitié du XX^{e} siècle et documentent les années pionnières de l'égyptologie belge, alors dominée par les activités de Jean Capart, fondateur de l'égyptologie en Belgique et premier conservateur de la collection égyptienne aux MRAH, et de ses collaborateurs.

Photographing Egypt

Egypt has long appealed to the imagination of a large and worldwide audience. From the Middle Ages onwards, pilgrims, explorers and adventurers visited Egypt, often in harsh conditions, but it was only after the French expedition to Egypt led by Napoleon Bonaparte (1798-1801) and the publication of the resulting *Description de l'Égypte* (1809-1829) that the ancient Egyptian civilization became known to a large public. Ever since, multitudes of travellers, writers and artists have journeyed up and down the Nile Valley and explored the Egyptian deserts. They have left an enormous amount of documentation in the form of travel accounts, drawings, paintings, and sketches. The invention of photography in the mid-1820s offered new possibilities for depicting the world and thus added a whole new dimension to these already existing forms of documentation. Egypt played a pivotal role in the early history of photography (for excellent overviews on this subject, see Howe, 1994; Hüttner, 2016; Perez, 1988; Stapp, 2008; Zevi & Bostico, 1984; see also Yelles, 2020 for a more global perspective on the history and development of photography in the context of the archaeological exploration of the Mediterranean basin). In August 1839, the French physicist and politician François Arago held a speech to the French National Assembly in which he presented the importance of the invention of the daguerreotype process by Louis Daguerre and Joseph Nicéphore Niépce. He made several references to Egypt and particularly stressed the use that photography could have had for the scientific members of the Napoleonic expedition to Egypt who copied Egypt's monuments and which resulted in the publication of the *Description de l'Égypte*:

> Pour copier les millions et millions d'hiéroglyphes qui couvrent […] les grands monuments de Thèbes, de Memphis, de Karnak, etc., il faudrait des vingtaines d'années et des légions de dessinateurs. Avec le Daguerréotype, un seul homme pourrait mener à bonne fin cet immense travail. Munissez l'Institut d'Égypte de deux ou trois appareils de M. Daguerre, et sur plusieurs des grandes planches de l'ouvrage célèbre [the *Description de l'Égypte*], fruit de notre immortelle expédition, de vastes étendues d'hiéroglyphes réels iront remplacer des hiéroglyphes fictifs ou de pure convention […] (Arago, 1839, pp. 28-31).

In the following decades, photography continued to develop with Egypt serving as an extensive practising field for this new medium. The photographic œuvre of several major photographers from these pioneering years like Maxime Du Camp, Francis Firth, Félix Bonfils or Antonio Beato is well known. Photography paved the way for new possibilities of visual communication and documentation, and became an indispensable tool for Egyptologists involved in fieldwork in Egypt. For instance, influential Egyptologists such as William Matthew Flinders or George Andrew Reisner, who can both be considered pioneers in the development of modern scientific archaeology, strongly advocated the use of photography to document the archaeological record [1]* (Petrie, 1904, pp. 73-84; for Reisner's unpublished manual on archaeological

* Numbers in brackets [ ] refer to the notes, p. 38.

photography, see Der Manuelian, 1992). Although many of the published reports of these early excavations and surveys were illustrated with photos, the original and unpublished field documentation often still contains vast amounts of photographs that are hardly known to the scholarly community. Fortunately, many of these archives are preserved in public research institutes. Under the impetus of a growing interest within the international Egyptological community in the history of its own discipline (Gertzen, 2017), together with a greater awareness of the importance and wealth of information these unpublished research archives may contain, many institutions have recently made considerable investments to digitally disclose these collections [2]. A number of publications dealing with the subject of photographing Egypt, both academic and for the general public, have also appeared in recent years (Azim & Réveillac, 2004; Piacentini, 2010; Driaux & Arnette, 2016; Berman, 2018; Juret, 2019; Larson, 2006; Riggs, 2019).

Jean Capart and his Photographic Collection

The Royal Museums of Art and History (RMAH) in Brussels keep an important collection of ancient Egyptian artefacts, but are also home to one of the world's finest and most complete Egyptological libraries. Besides a large collection of books and journals, this library houses a substantial photographic archive. The real development of both the collection and the library took place during the first decades of the 20th century under the initiative of Jean Capart (1877-1947) (Bierbrier, 2019, pp. 88-89; Brasseur Capart & Brasseur Capart, 1974; Bruffaerts, 2022). Capart was the first curator of the RMAH's Egyptian department and is the founding father of Belgian Egyptology (fig. 1). He studied with some of the great Egyptologists of his time, initiated the first Belgian excavations in Egypt and occupied the first Belgian chair in Egyptology at the University of Liège. He set up an extensive network with Egyptologists abroad and succeeded in putting Brussels firmly on the map as a globally known centre of Egyptology (Bruffaerts, 2013, 2021, pp. 168-171). Capart was not only an ambitious man but also a visionary. He was the first in Belgium to combine education with scientific research as key principles for museology and curatorship (Mairesse, 1995). In this respect, Capart recognized the importance of a strong and well-developed library. In 1901, he donated his personal collection of over seven thousand books and journals to the RMAH, laying the foundation for the international reputation of the RMAH's Egyptological library. This donation also included over a thousand photographs. In fact, the availability of photographic documentation was for Capart equally important to carry out his tasks as a museum curator and researcher. During his career, he constantly invested in the development of this collection by adding the photos he took during his trips, excavations, and other scientific missions to Egypt and elsewhere. The creation of the *Fondation Égyptologique Reine Élisabeth* (FÉRÉ) in 1923 provided Capart with additional means to further develop this photographic collection. As Capart explained in 1928, the organization and management of the collection was entrusted to some of his collaborators:

> […] Dès leur arrivée à Bruxelles, toutes ces photographies sont numérotées, inscrites dans un registre, classées et indexées sur fiches. Mlle Werbrouck a trouvé, pour ce long travail, une aide aussi intelligente que dévouée en Mlle E. De Mot (Capart, 1928a, p. 10).

Two years after the creation of the FÉRÉ, Capart decided to make the scientific classification of the photographic collection one of the top priorities. To fill the gaps in the collection, several study trips to Egypt were organized to photograph sites and monuments. Photos were also

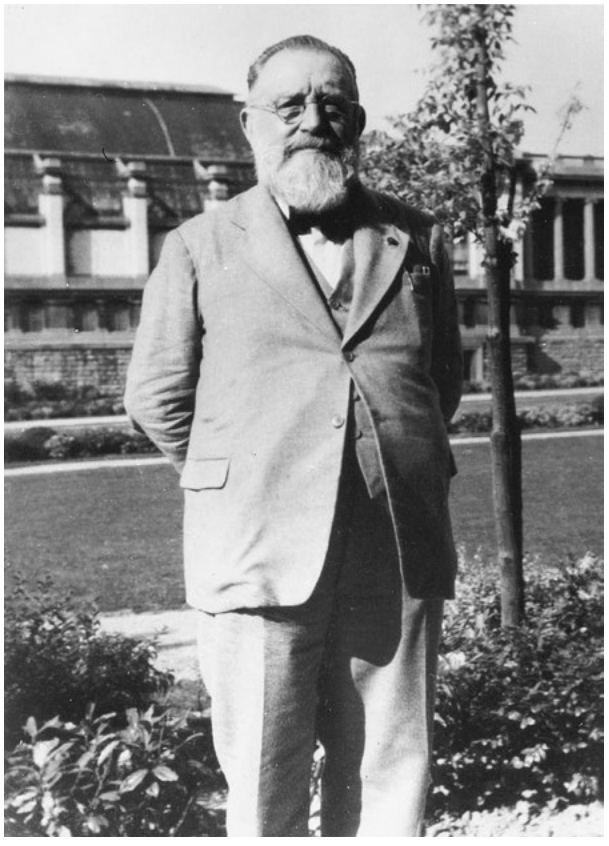

Fig. 1. — Jean Capart in front of the Royal Museums of Art and History, Brussels. Photo by Baudouin van de Walle, 3 June 1947 (© RMAH, inv. EGI-2 12414).

bought from other institutions such as the *musée du Louvre*, the Ashmolean Museum, the NY Carlsberg Glyptotek or the Egyptian Museum in Berlin to name but a few, while colleagues like Georges Legrain or John Garstang provided Capart with photos of their fieldwork. 'Commercial' photos were also acquired in order to have additional and new documentation. In the inventory records, the names of well-known photographers appear, such as the Italian-British photographer Antonio Beato [3] or the Egyptian photographers Abdullah Attiya Gaddis and Georges Seif (Capart, 1928a, p. 9) [4].

This photographic archive was primarily used for research purposes but also for public conferences and publications. It was furthermore intended to illustrate a monumental encyclopaedia on ancient Egypt which Capart prepared but unfortunately never completed. Its multivolume manuscript is kept at the RMAH's Egyptological library. Capart realized that his photographic collection could also make a valuable contribution to scientific research and he wanted to share it with the Egyptological community. For that purpose, he started the publication of a series of books focusing on the history of Egyptian art, illustrated with numerous photographs of objects and monuments he had taken in Egypt and in European and American museums. The series was entitled *Documents pour servir à l'étude de l'art égyptien* and intended to comprise a total of five volumes. Unfortunately, the first two ones, published in 1927 and 1931, were not particularly well received and therefore the series was discontinued. There was nevertheless an obvious international enthusiasm for Capart's photographic project. After his intervention at the *Congrès des Orientalistes* in Oxford (Capart, 1928b), where he presented the Brussels photo collection [5], a number of international colleagues at the conference urged others to not only donate copies of their Egyptological publications to the RMAH's library but also to send photographs of Egyptian objects from excavations and Europe's numerous museum collections in order to enrich the photographic collection.

The Collection of Glass Plate Negatives

When Capart was appointed curator at the RMAH in 1901, the photographic collection of the Egyptian department included about five hundred pictures. By 1930, it had grown to over thirteen thousand items, almost doubling to twenty-two thousand photos by 1940 (fig. 2). Today, this photographic archive holds over fifty-three thousand individual non-digital items. However, the

core of the collection consists of almost fourteen thousand glass plate negatives that were made during the first half of the 20th century. From a technical point of view, these glass plates can be subdivided into three types. First, there are the photos made by Capart and his collaborators such as Arpag Mekhitarian (1911-2004) (Bierbrier, 2019, p. 312) or Marcelle Werbrouck (1889-1959) (Bierbrier, 2019, p. 486; Bruffaerts, 2018). From 1901 onwards, they travelled in Egypt from the Mediterranean coast to its southern borders on many occasions. Besides notebooks and personal diaries, these field trips and research stays resulted in thousands of glass plate negatives, which make up the bulk of the collection. A large proportion of these negatives consist of stereoscopic photographs or stereograms. In addition, the collection contains a limited number of photographic copies of photos. Of the many photographs Capart bought or obtained from colleagues, a selection was re-photographed on glass plates so that they could be used in lectures or public conferences (fig. 3). Finally, the collection also contains a considerable number of reproductions of illustrations from Egyptological publications photographed with the aim, again, of using them to illustrate publications, public conferences and lectures.

Fig. 2. — Wooden cabinet containing the glass plates in the Egyptological library of the RMAH. Photographer unknown, ca. 1930 (© RMAH, inv. EGI-2 21543).

These glass plates are unquestionably of great historic value and can be divided into different categories. A first category concerns photos that document the pioneering years of Egyptological research at the RMAH. They cover not only the development of the Brussels museum collection but also the deployment of its scientific activities in Egypt, including archaeological expeditions organized by both the RMAH and FÉRÉ at Heliopolis (1907; fig. 4), Sheikh Fadl (1924), Tell Hiw (1927; fig. 5) and especially Elkab (1937-1946). Many of these photographs were never published and had been forgotten. In particular, the three excavation seasons at Elkab were extensively photographed (fig. 6). In addition to documenting the progress of the excavations and the original find context of some three hundred objects in the RMAH's Egyptian collection that come from these excavations and surveys, there are a remarkable number of photographs in which the Egyptian workmen (fig. 7), the local house staff and life in the various villages in the immediate vicinity of Elkab are the focus of attention (De Meyer, Claes, Mahran, Van der Perre & Gräzer Ohara, 2023). With the help of various archival documents kept at the RMAH, such as the original field diaries or the registers in which the salaries of the different workmen and other expenses were recorded, it is possible to identify many of them and thus highlight and recognize their fundamental role in the successful excavation campaigns at Elkab. As such, these photos are of key importance to the RMAH as they illustrate and tell the story of the formative period of the Egyptian department of the museum in terms of the development of its collection and its scientific activities in Egypt (compare with Stevenson, 2019 for British Egyptology).

Fig. 3. — The Ramesseum, Luxor. Photo by the Italian-British photographer Antonio Beato, date unknown (© RMAH, inv. EGI 2487).

Fig. 4. — Excavations at Heliopolis, setting up camp. Photo by Jean Capart, 1907 (© RMAH, inv. EGI 1052).

From a broader perspective, these images also document the state of preservation and conservation, as well as the setting and landscape of a vast array of monuments and sites spread across the entire Nile Valley. As several parts of the Egyptian landscape have profoundly changed since the early 20th century through expanding agriculture, construction works (*e.g.*, the Aswan High Dam in the 1960s) or the growth of modern villages, towns and cities, but

also as a result of archaeological fieldwork or because looting and destruction of archaeological sites and monuments in Egypt obviously had a deep negative impact on these sites and monuments, the historical value of these photos becomes ever more significant. Even today, and especially after the uprisings in Egypt and the Arab Spring of 2011, various sites have been raided and looted, causing irreparable damage. Older photographic documents such as these glass plates may ultimately be the only potential source for studying and assessing certain monuments and sites (fig. 8).

Fig. 5. — Excavations at Tell Hiw, falcon mummy. Photo by Jean Capart, 1927 (© RMAH, inv. EGI 6113).

Fig. 6. — Excavations at Elkab, removal of a ceiling slab of crypt B in the temple of Nekhbet. Photo by Jean Capart, 5 March 1938 (© RMAH, inv. EGI 11477).

Fig. 7. — Excavations at Elkab, Rais Chared, his three sons (Anwar, Seif and Kamal) and the workmen from Quft. Photo by Jean Capart, 1945-1946 (© RMAH, inv. EGI 12234).

Fig. 8. — The 'Royal Tomb' of the First Dynasty at Naqada, which is now largely destroyed. This is a rare photo of the tomb after it was excavated at the end of the 19th century. Photo by Jean Capart, 1930 (© RMAH, inv. EGI 7235).

Fig. 9. — Armant, excavation of the Bucheum by Robert Mond & Oliver Myers. Photo by Jean Capart, 1930 (© RMAH, inv. EGI 7248).

Fig. 10. — Karnak, great hypostyle hall of the temple of Amun, restoration works by Georges Legrain. Photo by Jean Capart, 21 April 1909 (© RMAH, inv. EGI 1518).

The international dimension of this collection, which also reflects Capart's extensive professional network, is illustrated by several hundreds of photographs Capart and/or his collaborators took of ongoing excavations conducted by the *Service des Antiquités de l'Égypte* and other institutions. Among the sites they visited are Abydos (University of Liverpool), Amarna (*Deutsche Orientgesellschaft* and Egypt Exploration Society), Armant (Egypt Exploration Society) (fig. 9), Deir el-Bahari (Egypt Exploration Fund and the Metropolitan Museum of Art), Edfu (*Institut français d'Archéologie orientale*), Giza (Harvard University/Museum of Fine Arts Boston), Karnak (*Service des Antiquités de l'Égypte*, fig. 10), Medamud (*Institut français d'Archéologie orientale*), Tanis (*Mission française*) and Tod (*Musée du Louvre*). In a few instances, these visits were spread over several days as was the case for Abydos and Amarna where Capart was a guest of respectively John Garstang (University of Liverpool, 1909) and John Pendlebury (Egypt Exploration Society, 1934).

At the invitation of the Educational Foundation of the Commission for Relief in Belgium, Capart toured the USA between 1924 and 1925 as visiting professor and lectured at forty-four universities and institutions across the country (Capart, 1928b; De Meyer, 2023; forthcoming). In 1932, he was appointed advisory curator at the Brooklyn Museum where he was also instrumental for the development of the Egyptian collection. He divided his time between Brussels and Brooklyn until the outbreak of World War II but also spent much time in Egypt for excavations and research, and visited various museums across the European continent. During these trips, he photographed hundreds of objects from Egyptian collections around the world. His personal notebooks and diaries, kept at the RMAH, frequently provide additional information on the objects he photographed, thereby adding to the international dimension of this collection of photographs from a museological point of view.

A special set of glass plates consists of several dozen images depicting the local Egyptian fauna, and particularly flora. These photos were taken by German Egyptologist Ludwig Keimer (1892-1957) who was in close contact with Jean Capart. After the death

of Keimer's mentor Georg Schweinfurth in 1925, Capart encouraged him to make his first trip to Egypt. Keimer already had a strong interest in Egypt's rich botanical heritage, but this interest was further stimulated by Capart, and their collaboration was formalized in a signed agreement. In exchange for an annual allowance, Keimer would provide the RMAH with duplicates of his photographic documents related to his research on Egypt's fauna and flora (van de Walle, 1958, pp. 67-68). This gave Keimer additional means to pursue his research, and Capart was able to further develop and enrich the photographic archive of the RMAH's Egyptian department with a new subject matter that previously did not receive much attention from the Egyptological community.

Finally, these images also illustrate the daily life of the local Egyptian population and the way Westerners experienced travelling through Egypt in the early 20th century, commonly referred to as the 'Golden Age of Travel' (Humphreys, 2014, 2015). Over two hundred photos illustrate, for instance, the two royal voyages Capart made in the company of Queen Elisabeth of Belgium. In 1923 they attended the official opening of the burial chamber of the tomb of Tutankhamun (Bruffaerts, 1998), while seven years later, in March-April 1930, Capart accompanied the Belgian Queen and King on a cruise along the Nile following an official state visit (Bruffaerts, 2006) (fig. 11). The photos from this archive provide an exceptional glimpse behind the scenes of both trips and complement the already known archival sources of these journeys which are kept in the Belgian Royal Palace's archives. Prior to this second trip with Queen Elisabeth of Belgium, Capart had already travelled through Egypt for two months in the company of several members of the Goldman family, known from the American investment bank Goldman Sachs. Invited by his good friend Ashton Sanborn, secretary of the Museum of Fine Arts in Boston, close collaborator of the well-known American Egyptologist George Reisner, and son-in-law of Julius Goldman, Capart acted as a guide for a boat trip that took them from Cairo to beyond the Second Cataract at Semna (fig. 12). Several hundreds of photographs of this journey are preserved in the RMAH's archives along with various other archival documents that will allow us to reconstruct this voyage in full detail.

Fig. 11. — Queen Elisabeth of Belgium on top of the pylon of the temple of Edfu. Photo by M. Polinet, 1930 (© RMAH, inv. EGI 7566).

A Future for the Collection: Digitization and the SURA Project

Despite its great historical value, this collection has been much neglected over the past decades and its existence and content are hardly known to the larger Egyptological community. The

Fig. 12. — Aswan, visit of Jean Capart and the Goldman family to the unfinished obelisk. Photo by Jean Capart, 17 February 1930 (© RMAH, inv. EGI 7323).

most important reason for this is undoubtedly the absence of an online searchable database and the lack of descriptive metadata.

The SURA project, a collaboration between the RMAH and Egyptologists of KU Leuven, was launched in 2020 with the aim of studying and digitally disclosing this important photographic collection (Gräzer Ohara, Van der Perre, De Meyer & Claes, 2023). As a first step, the entire collection was digitized in high resolution at the Royal Observatory of Belgium (ROB), using state-of-the-art technology initially developed for the digitization of astrophotographic plates [6]. Current digital imaging technologies enable to visualize these digitized photos in full detail and the stereo pairs in enhanced 3D viewing. The available metadata of this photographic collection consist of two paper index card catalogues that only contain very limited information. Sometimes the photos are dated and the photographer's name is known, but more detailed information about the specific parts of the monuments, orientation, or names of the persons that appear in the photos is lacking. This evidently complicates retrieval and severely limits the research potential. The SURA project addresses this stalemate through an interdisciplinary approach that ties together Egyptology, digital imaging, archival studies, and digital humanities. Its main purpose is to make this historical collection available online to the international scholarly community as well as to the general public, and to valorize its importance. To do so, several clearly defined research objectives are envisaged.

Detailed and High-quality Metadata

This objective calls for a critical revision of the available data of each individual image while at the same time augmenting them with as much additional detailed information as possible, both regarding the content of the photo and its photographic framework (photographer, date). Special attention is also paid to information that places these photos in a broader context. For this purpose, bibliographical references to key publications regarding the depicted subject matter are recorded as well as references to relevant sources from the RMAH's archives such as Capart's personal notebooks, diaries, letters, etc. These references will be made available as cross-links with the RMAH's online library and archival catalogue, including access to electronic versions of publications and archival material when possible. Cross-links to objects in the RMAH's online museum catalogue will also be integrated as well as to online catalogues of other museums when applicable. This type of information significantly enriches the metadata and enhances the scientific potential of this collection for Egyptological, archaeological, or historical research. Finally, technical information (dimensions, type of photo, state of preservation) is also added.

Online Database

Together with their respective metadata, the digitized images will be catalogued in the RMAH's central collection management system (MuseumPlus-RIA/Carmentis) [7]. An Egyptological and historical approach is followed in order to describe the contents of each individual image as detailed as possible. Information is catalogued following the predefined metadata scheme of the MuseumPlus-RIA system, which is compliant with international standards and guidelines for metadata descriptions and data exchange (Spectrum, LIDO, CDWA, Dublin Core, …). It also uses well-developed controlled vocabulary lists and thesauri which will facilitate data exchange with other research platforms. MuseumPlus-RIA also has integrated solutions for the creation of relevant crosswalks with other entries, images, or digital media.

Preservation and Collection Care

In order to preserve this collection for future generations, the physical housing of the glass plates is addressed as well. Due to neglect in previous decades and its current housing conditions, some glass plates already show signs of incipient chemical and biological degradation. To avoid the incurring risk of irreversible damage, a long-term preservation plan will be developed and specific measures in terms of conservation are taken, including repacking in acid-free cases and individual envelopes, to optimize the protective environment in which these glass plates are currently stored.

Scientific Exploitation and Collaborative Research

Finally, the scientific potential of this collection is mined, not only for the RMAH but also for other national and international research institutes. Specifically for the RMAH, the focus is first and foremost on images that relate to the objects of the RMAH's collection which originate from the different sites investigated by Capart and his collaborators. The original find contexts of these objects as described in the registration cards and the original field documentation are confronted with the available photos. This has already resulted, for instance, in new information with regard to the original location of the mastaba of Neferiretenef, acquired by Jean Capart in 1905 and still one of the centrepieces of the RMAH's Egyptian collection, and several other mastaba tombs that were declined by Capart (Gräzer Ohara, Delvaux, Van der Perre, De Meyer & Claes, 2024).

The SURA project is also actively looking for new collaborative research opportunities, not only with other similar online research platforms and databases to mutually expand their scientific potential, but also with individual researchers, research consortia or institutions that could have a potential interest in the content of these glass plate negatives. Since the start of the project, several institutions and researchers have already expressed a keen interest in these photos. The project also has an inherent overlap with the interdisciplinary EOS project 'Pyramids and Progress: Belgian expansionism and the making of Egyptology, 1830-1952', a Belgian consortium comprising KU Leuven, the Université libre de Bruxelles, Ghent University, the RMAH and the Royal Museum of Mariemont, which is conducting research on the emergence of Belgian Egyptology against the background of Belgian expansionist policies (De Meyer *et al.*, 2019). After the completion of the SURA project, this photographic collection

will be firmly embedded in and fully available to the international Egyptological community and the public at large.

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NOTES

[1] For more than two decades, Reisner employed Mohammedani Ibrahim, an Egyptian photographer who was in charge of the photographic documentation of his excavations in different parts of the Egyptian and Nubian Nile Valley. Ibrahim was a very talented and skilled photographer and the quality of his photos still receives much acclaim today (Berman, 2018; Wray, 2021).

[2] *E.g.*, Griffith Institute Archives, Oxford [www.griffith.ox.ac.uk/archive/], Digital Giza Project, Harvard University [giza.fas.harvard.edu/], Egypt Exploration Society, London [www.ees.ac.uk/collections/archive.html], Institut für Ägyptologie, Ludwig-Maximilians-Universität & Staatlichen Museen Ägyptische Kunst, München – Mudira Database (mudira.gwi.uni-muenchen.de), Oriental Institute, University of Chicago [isac-idb.uchicago.edu/], Netherlands Institute for the Near East, Leiden [www.nino-leiden.nl/collections/nino-collection-glass-slides], Frobenius Institute, Frankfurt am Main [bildarchiv.frobenius-katalog.de]. Worth mentioning in this respect is also the Egypt Documentation Project, supported by the British Museum, in which about fifty thousand glass plate negatives from the collections of the Egyptian Museum in Cairo and the Scientific Archives of the Egyptian Ministry of Tourism and Antiquities are currently being digitized.

[3] Capart most probably bought these photos at the Egyptian Museum in Cairo. After Beato's death in 1905, the remaining photographs and negatives were bought from Beato's widow by Gaston Maspero for the Egyptian Museum in Cairo (Bierbrier, 2019, p. 41; see also Busi & Piacentini, 2008, particularly pp. 22-23).

[4] An important collection of glass negatives taken by Gaddis and Seif is currently kept at the research archives of Chicago House, Luxor.

[5] «[…] L'ensemble de la collection présente une image toujours plus complète des monuments importants de l'archéologie égyptienne. Je voudrais qu'à l'avenir les égyptologues fassent plus souvent appel à notre collaboration pour illustrer leur enseignement. Ils pourront toujours se procurer à Bruxelles les clichés de projection qui leur seront nécessaires» (Capart, 1928b, p. 20).

[6] For more information on the ROB digitization facility, see: https://espace.oma.be/science/rob-facilities.html. Technical information can also be found in De Cuyper, 2012 and De Cuyper, de Decker, Winter & Zacharias, 2011.

[7] https://carmentis.be/eMP/eMuseumPlus.

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Eleven to Thirty Years after: What happened to the Severely Malnourished Children hospitalized at Lwiro in the Eastern Democratic Republic of Congo?[1]

by

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Keywords. — Long Term; Childhood Acute Malnutrition; Chronic Diseases; Follow-up; DR Congo.

Summary. — The aim of this study was to trace subjects with a history of severe acute malnutrition (SAM) in childhood, to assess their long-term socioeconomic (SES) and health outcomes, and finally to investigate the different cardiometabolic markers of chronic non-communicable diseases (NCDs). Our results have shown that SAM childhood was associated with deleterious effects on anthropometry and body composition in adulthood (smaller weight, height, muscle strength and less fat free mass). In addition, adults with SAM history showed reduced human capital (reduced SES, self-esteem and cognition). However, with regard to the risk of NCDs, apart from an increased risk of visceral obesity, metabolic syndrome and glucose homeostasis, no additional risk was observed for other cardiometabolic markers of NCDs (blood pressure, fasting blood glucose and lipid profile) and risk of NCD occurrence (hypertension, diabetes mellitus, low HDL-C, and hypertriglyceridemia). Policymakers and donors involved in combating the global spread of NCDs in adults should consider the long-term benefit of reducing SAM in childhood as a preventive measure.

Mots-clés. — À long terme; Malnutrition infantile aiguë; Maladies chroniques; Suivi; RD Congo.

Résumé. — *Onze à trente ans plus tard: qu'est-il advenu des enfants souffrant de malnutrition sévère hospitalisés à Lwiro, dans l'est de la République Démocratique du Congo?* — L'objectif de cette étude était de retracer des sujets avec antécédents de malnutrition aiguë sévère (MAS) durant l'enfance, d'évaluer leur devenir à long terme sur le plan socio-économique et sanitaire, et enfin de rechercher les différents marqueurs cardiométaboliques des maladies chroniques non transmissibles (MNT). Il ressort de nos résultats que la MAS infantile est associée à des effets délétères sur l'anthropométrie et la composition corporelle à l'âge adulte (faible poids, petite taille, force musculaire et masse grasse libre réduites). En outre, les adultes avec antécédents de MAS présentent un capital humain réduit (statut socio-économique, estime de soi et cognition réduits). Toutefois, en ce qui concerne le risque de MNT, hormis un risque accru d'obésité viscérale, de syndrome métabolique et de troubles d'homéostasie du glucose, aucun risque supplémentaire n'a été observé au sujet d'autres marqueurs cardiométaboliques des MNT (pression artérielle, glycémie à jeun et profil lipidique) et de risque de survenue de MNT (hypertension,

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diabète sucré, faible taux de HDL-C et hypertriglycéridémie). Les décideurs politiques et les bailleurs de fonds impliqués dans la lutte contre l'expansion mondiale des MNT chez l'adulte devraient considérer le bénéfice à long terme de la réduction de la MAS chez l'enfant en tant que mesure préventive.

Background

Acute malnutrition (AM) is a public health problem in the world and particularly in low- and middle-income countries (LMICs) (FAO, FIDA, UNICEF, PAM & OMS, 2020). There are currently seventeen million children across the world suffering from severe acute malnutrition (SAM), of whom 27 % live in Africa. Each year, approximately seven million children under the age of five die worldwide and 45 % of these deaths are attributed to undernutrition (FAO *et al.*, 2020). The Sustainable Development Goals (SDGs) incorporated the World Health Assembly targets to reduce the proportion of children suffering from wasting to < 5 % by 2025 and < 3 % by 2030. However, since these targets were adopted, the proportion of wasted children has remained largely unchanged. In 2020, an estimated 7.3 % (fifty million) of all children under five are suffering from wasting at any given time (FAO *et al.*, 2020; Boero *et al.*, 2021).

Nevertheless, Sub-Saharan Africa (SSA), like most other LMICs, is undergoing a rapid epidemiological transition. In this region, there is a rapid increase in the prevalence of non-communicable diseases (NCDs) (diabetes, cardiovascular diseases, dyslipidemias, etc.) among adults, as well as their risk factors, notably overweight and obesity. The prevalence of overweight and obesity exceeds that of undernutrition (Caleyachetty *et al.*, 2018). In contrast, undernutrition still largely predominates among children in these regions (UNICEF, WHO & World Bank Group, 2017; Ng *et al.*, 2014; Caleyachetty *et al.*, 2018; Kimani-Murage, 2013; Hanandita & Tampubolon, 2015; Wells *et al.*, 2020). This well-documented phenomenon is known as the "double burden of malnutrition" and is a public health priority (Caleyachetty *et al.*, 2018).

The situation of wasting in the Democratic Republic of Congo (DRC) has been a cause for concern for the past decades. The DRC is one of the ten countries that account for 60 % of the global burden of wasting in children under five years of age. According to the Global Nutrition Report 2025, it is estimated that approximately 42.8 million people suffer from wasting globally, including 4.4 million children under five in the DRC (UNICEF, WHO & The World Bank, 2025). The DRC is one of the countries selected at global level to be part of the Global Action Plan on Child Wasting initiative, initiated by the United Nations General Secretariat.

In South Kivu, in the eastern part of the DRC, 7.9 % of all children under the age of five are suffering from AM (INS & MICS-Palu, 2019). The persistence of armed conflict over the past twenty years, limited accessibility of quality healthcare for the majority of the population, difficult access to farmland and inadequate nutrition are the main causes of this (Lindskog, 2016).

Lwiro paediatric hospital (LPH) was one of the first facilities to be involved in treating SAM in the DRC. A team of researchers developed a SAM treatment model in the 1980s and began digitizing clinical data in 1986. The electronic records contain sociodemographic, anthropometric, clinical and biological data gathered from inpatients between 1988 and 2007, from admission through to discharge from hospital. Even though the treatment programme has led to the recovery of most of the children, their medium- and long-term nutritional and health outcomes remain unknown.

In South Kivu, the prevalence of obesity, hypertension (HTA), diabetes mellitus (DM), metabolic syndrome (MetS) and abdominal obesity are 9.8 %, 19.0 %, 3.5 %, 7.2 % and 10.0 % respectively (Katchunga *et al.*, 2016). A recent study conducted in a rural area in this region has found a rising trend in the prevalence of HTA and obesity, as well as an increase in mean body mass index (BMI) and waist circumference (Katchunga *et al.*, 2019). However, the presumed role of SAM childhood in the increased NCD burden in the DRC has not yet been sufficiently examined, although suggested in several studies conducted in other regions with endemic childhood undernutrition.

This growing prevalence of NCDs is partly driven by the nutrition transition with changes in environmental factors impacting nutrition: urbanization, globalization, technological advances,... leading to a decrease in physical activity and a change in dietary behaviours with a higher consumption of processed products at the expense of traditional food, resulting in a higher intake of high glycemic index sugars, fat and salt (Wells *et al.*, 2020). However, the role of episodes of undernutrition in the foetal period and in childhood is also increasingly recognized as a risk factor for the development of certain NCDs or for risk factors of the latter in adulthood (Caleyachetty *et al.*, 2018; Wells *et al.*, 2020). This phenomenon, known as the "developmental origins of health and disease", is well documented today (Barker, 2004). It was especially studied in high- and middle-income countries (HMICs) (Victora *et al.*, 2008; Barker, 2004; Roseboom *et al.*, 2001). Despite growing evidence on the negative long-term effects of childhood undernutrition observed in HMICs, data related to the long-term outcomes of children treated for SAM in low-income countries (LICs) are surprisingly scarce (Lelijveld *et al.*, 2016; Asiki, Newton, Marions, Kamali & Smedman, 2019).

In fact, studies conducted in Uganda and Malawi have shown that catch-up growth after an episode of SAM or delayed childhood growth, respectively, were associated with increased blood pressure (BP) in adolescence (Asiki *et al.*, 2019), and that pre-pubescent survivors of SAM childhood were at greater risk of subsequent NCDs, even though no clinical or biological marker of these subsequent morbidities was identified seven years after nutritional rehabilitation (Lelijveld *et al.*, 2016).

The aim of our study was to trace, eleven to thirty years after their nutritional rehabilitation, subjects with a history of SAM in childhood, to assess their long-term growth, socioeconomic and cognitive outcomes, and finally to investigate the different cardiometabolic markers of NCDs. All this was done in order to establish an association between SAM during childhood and different NCDs (hypertension, diabetes, obesity, dyslipidemias and body composition) as well as with sociodemographic and economic status in adulthood, in a context without nutritional transition.

Methodology

Study Framework

The study was conducted at the *Centre de Recherche en Sciences naturelles de Lwiro* (CRSN-Lwiro) in the health zones of Katana and Miti-Murhesa in South Kivu. The nutrition department of this centre has a paediatric hospital and four integrated health centres which monitor the state of the health and nutrition of children in the community (Paluku, 2002).

Study Design and Population

This is an observational follow-up study comparing young adults with a history of previous hospital admission for SAM with community controls. The study was conducted among young adults who were treated for SAM during childhood between 1988 and 2007 at LPH, South Kivu, DRC.

The nutritional status of the study subjects at the time of their admission to the hospital (Paluku, 2002) was reassessed in relation to the WHO child growth standard of 2006 (WHO Multicentre Growth Reference Study Group, 2006). A new classification was established according to the following criteria. Children were classified as having SAM if they met ≥ 1 of the following criteria: mid-upper arm circumference (MUAC) < 115 mm, weight-for-height z-score <-3, and the presence of nutritional oedema in the hands and/or feet and/or face (WHO Multicentre Growth Reference Study Group, 2006).

Between December 2017 and April 2019, we set out to identify these subjects in the Miti-Murhesa and Katana health zones. Study subjects were identified from the LPH database. They were then traced to their home villages and afterwards divided into four categories (living in or near the village, deceased, displaced, or lost to follow-up) (Mwene-Batu *et al.*, 2020a,b, 2021a,b).

The malnutrition survivors (still alive and identified) who agreed to participate made up the exposed group. For each exposed, a community unexposed was randomly selected for comparison. An unexposed was defined as a subject who had no hospital history of SAM, had the same sex, was living in the same community, and was no more than twenty-four months older or younger than the exposed. We selected community unexposed randomly by spinning a bottle at the adult exposed's home and enquiring door to door, starting from the nearest house to where the bottle pointed (Mwene-Batu *et al.*, 2020a,b, 2021a,b). Though the optimal study design would be a 1:1 ratio of exposed and unexposed. However, unexposed participants proved harder to recruit than exposed ones, as many feared being associated with SAM childhood and its social stigma (Mwene-Batu *et al.*, 2020a,b, 2021a,b). For that reason, a ratio of 0.75 non-exposed per exposed was eventually achieved (Mwene-Batu *et al.*, 2020a,b, 2021a,b). Respondents provided signed informed consent for participation in the study, either by written signature or by fingerprints, depending on literacy. For children below eighteen years old, consent was obtained from their parents or guardians.

Data Collection

Data collection, from December 2017 to April 2019, was conducted in two phases with two stages each. It was carried out through the intervention of twenty trained community health workers (CHWs) and two supervisors and facilitated by neighbourhood leaders, licensed nurses and community relays.

The first phase focused on identification, sociodemographic data and the various clinical and biological markers of NCDs. The first stage concerned home visits. During these visits, the CHWs administered a questionnaire translated into Kiswahili to the participants, took their anthropometric measurements and gave them an appointment, scheduled twenty-four to forty-eight hours after their visit, at the nearest hospital for the second stage. This appointment involved venous and capillary blood samples and blood pressure (BP) measurements taken by properly trained nurses working in the various health facilities in the two zones.

The general questionnaire contained variables relating to the participant's identity, education, self-reported academic performance, cognitive function assessed using the MMSE and MMSE I tests, self-esteem (Rosenberg Self-Esteem Scale), and health-related daily functional and social disabilities. The final data concerned the frequency with which they listened to the radio and used social networks.

Due to copyright on the use of the MMSE and our limited means, we only used it in a subgroup of two hundred subjects (one hundred exposed and one hundred unexposed) (Newman & Feldman, 2011). HbA1c analysis was done in a subgroup of one hundred and sixteen subjects (fifty-eight exposed and fifty-eight unexposed) due to limited financial means (Mwene-Batu *et al.*, 2020a,b, 2021a,b).

The second phase involved the measurement of body composition. It was determined by the deuterium dilution method (D2O). Body composition was determined from the total body water (TBW). TBW was calculated from the saliva sample by the equilibration technique, assuming that the equilibration peak was reached at three to four hours after deuterium ingestion (IAEA, 2010). Fat free mass (FFM) was determined by dividing the participant's TBW by 0.732 (hydration factor for adults aged twenty-one or older). Fat mass (FM) was deduced from the difference between body weight and FFM. Curve fitting and calculation of results were performed using a spreadsheet model provided by the International Atomic Energy Agency (IAEA, 2013).

Outcomes

Our outcomes of interest were first and foremost NCDs including primarily metabolic syndrome, HTA, global obesity, visceral obesity, diabetes mellitus (DM), dyslipidemias as well as body composition (FFM, FM and TBW assessed by deuterium dilution method) assessed by their different clinical and biological markers (BMI, waist circumference, hip circumference, waist-to-height ratio (WHtR) and waist-to-hip ratio (WHR), muscle strength, triglyceride (TG), total cholesterol, high-density lipoprotein (HDL-C), low-density lipoprotein (LDL-C), glycated hemoglobin (HbA1c), FFM, FM, TBW, fasting glycemia, albumin, creatinine and blood pressure (systolic, diastolic and mean). The definition of different NCDs was based on international standard (American Diabetes Association, 2010; Mancia *et al.*, 2013; National Heart, Lung, and Blood Institute Obesity Education Initiative, 2000; Longo-Mbenza, Kasiam Lasi On'kin, Nge Okwe & Kangola Kabangu, 2011; Alberti *et al.*, 2009; National Cholesterol Education Program, 2002; Ashwell & Gibson, 2009; Celis-Morales *et al.*, 2018). Secondly, we evaluated the human capital through the socio-economic status (deduced from the education, the profession and the living conditions), self-esteem (measured using the French version of the Rosenberg Self-Esteem Scale – Schmitt & Allik, 2005) and the cognitive disorders assessed using the Mini-Mental State Examination (MMSE) (French consensual MMSE version – Derouesné *et al.*, 1999). Finally, we collected data on long-term nutritional status assessed by anthropometrics in adulthood.

Socio-economic status (SES) was established on the basis of an empirical score taking into account the subject's level of education and occupation, as well as living conditions (Mwene-Batu *et al.*, 2021a,b). These living conditions were calculated on the basis of the sum of material possessions owned, land ownership (yes/no) and type of housing in which the subject was living (with three categories: precarious, average, good) (Ministère du Plan de la R.D. Congo

& UNICEF, 2010). The latter was defined on the basis of house components (walls, roof, presence or otherwise of a cement floor in the house), type of toilet and water supply (Ministère du Plan de la R.D. Congo & UNICEF, 2010). The type of occupation was based on the *Classification internationale type des Professions*, the French version of the 'International Standard Classification of Occupations' adapted to the European Union (Genoud, 2011). Based on all this information, subjects were sorted into three SES categories (low SES, average SES and high SES) (Mwene-Batu *et al.*, 2021a,b).

With regard to NCDs, primary exposure was a history of SAM during childhood. Other variables, such as age, sex, SES, anthropometric measurements in adulthood, lifestyle (alcohol, tobacco and diet diversity), and family history of DM and/or HTA in parents were added to the modelling as potential confounding factors (Mwene-Batu *et al.*, 2020a,b, 2021a,b). Diet diversity was assessed using a dietary diversity score established by the WHO and the Food and Agriculture Organization of the United Nations (IFPRI, 2014; WFP, 2008).

Statistical Analysis

We used the software Stata, version 13.1. The size of the sample was predetermined by the number of patients admitted for SAM at Lwiro paediatric hospital from 1998 to 2007, living in Miti-Murhesa and Katana in 2018, who were found and agreed to participate in our study. Categorical variables were summarized in the form of frequency and proportion. Quantitative data were presented in the form of a mean and standard deviation (SD) or a median and minimum-maximum (min-max) depending on whether the distribution was symmetrical.

Linear and logistic regression models were used, respectively, for the continuous variables [(BMI, waist circumference, hip circumference, WHtR and WHR), muscle strength, TG, total cholesterol, HDL-C, LDL-C, HbA1c, FFM, FM, TBW, fasting glycemia, albumin, creatinine and blood pressure (systolic, diastolic and mean)] and dichotomous variables (overall obesity, thinness, visceral obesity, diabetes mellitus, hypertension, metabolic syndrome and dyslipidemia). However, for the TG, we made a logarithmic transformation given the usually asymmetrical nature of the distribution, and this variable was shown as geometric mean and dispersion interval. The basic models only included primary exposure — SAM —, giving a crude mean difference between the exposed and unexposed for the quantitative variables, and crude odds ratios (OR) for the categorical variables. The mean differences and ORs are shown with confidence intervals of 95 % (95 % CI). For the TG, the exponential of the regression coefficient provides the geometric means ratio.

Different models were then constructed in order to obtain adjusted effects of SAM. For each outcome, the adjustment variables were those significantly associated with the outcome and with the exposition.

Lastly, ordinal logistic regression was used to analyse the differences between the exposed and their community unexposed with regard to socioeconomic, education and occupation variables and the dietary score. However, for the dichotomous variables, Pearson's Chi^2 test or Fisher exact test were used for comparison.

In all analyses, we considered a p value of 0.05 to show a statistically significant difference between the groups.

Ethical Standards

All procedures performed in this study were approved by the Institutional Ethics Committee of the *Université catholique de Bukavu* and were in accordance with the 1964 Helsinki declaration and its later amendments.

Results

Recruitment of the Exposed Group

After a detailed analysis of the archives of the nutrition department of the CRSN for the period 1988 to 2007, a total of two thousand eight hundred and thirty medical records of children admitted for SAM, according to the criteria of the time, were retrieved and reviewed. After verification and on the basis of inclusion criteria, out of the two thousand eight hundred and thirty records obtained, only one thousand nine hundred and eighty-one records (70 %) were selected for the actual study. On admission to hospital, the median age was forty-one months, with 70.8 % of patients aged between six and fifty-nine months. There were more boys (57.5 %). Nearly three quarters of the patients were not up to date with their vaccination (Mwene-Batu *et al.*, 2020a,b).

Based on the WHO child growth standard, only 84 % of the children were classified as having SAM. The others were classified as having moderate acute malnutrition (6.7 %) and not suffering from AM (9.3 %). Nearly 90 % of the children admitted for SAM at the LPH also had stunting (Mwene-Batu *et al.*, 2020a,b).

Out of the one thousand nine hundred and eighty-one subjects hospitalized, one thousand three hundred and thirty-five (67.4 %) were traced and six hundred and forty-six (32.6 %) were lost to follow-up. Among those traced, one thousand one hundred and thirty-four subjects (84.9 %) were still alive and two hundred and one (15.1 %) were deceased. Among the living, six hundred (52.9 %) were seen by the CHWs and five hundred and thirty-four (47.1 %) had moved to other regions. Out of the six hundred subjects seen, five hundred and twenty-four agreed to participate in the study and seventy-six declined (Mwene-Batu *et al.*, 2020a,b).

Long-term Growth after Nutritional Rehabilitation (tab. 1)

The median age in the two groups was 22 (16-40), males accounted for 52.1 % and 50.6 % of the exposed and unexposed respectively. Compared to the unexposed, the exposed had significantly lower weight, shorter stature (sitting and standing), shorter leg length, and smaller brachial circumference. There were no significant differences in BMI, chest length, and head or chest circumference between the two groups (Mwene-Batu *et al.*, 2020a,b).

Adjusted Effect of Exposure on TBW (kg) and Fat Free Mass (kg)

As shown in table 2, compared to the unexposed, the SAM-exposed had a significantly lower TBW and FFM. Importantly, these effects did not diminish after adjustment (for sex, food diversity and age) (Mwene-Batu *et al.*, 2021a,b).

Sociodemographic and Economic Characteristics of the Population

Compared to the unexposed, the exposed had a lower level of education, poorer housing, less land, and less satisfactory diet diversity. These differences were statistically significant. However, no significant difference was observed with regard to material possessions or occupational categories (tab. 3). The synthetic indicator for SES, constructed by using the variables for living conditions, education and occupation, was significantly better in the unexposed than in the exposed group (tab. 3) (Mwene-Batu *et al.*, 2021a,b).

Academic Performance, Cognitive Function and Self-Esteem

Differences in terms of cognitive function and self-esteem between the exposed and the unexposed are shown in table 4.

Self-reported academic performance was also significantly lower in the exposed compared to the unexposed. By comparing the cognitive function of the two groups using the MMSE and MMSE-I (MMSE for illiteracies), we noted that the global mean scores were significantly lower in the exposed than in the unexposed (Mwene-Batu *et al.*, 2021a,b). The proportion of individuals who had a normal test was significantly lower in the exposed than in the unexposed. Overall, the exposed had statistically significant lower self-esteem than the unexposed. Lastly, compared to the unexposed, a significantly lower proportion of exposed regularly listened to the news on the radio or used social networks (Mwene-Batu *et al.*, 2021a,b).

Mean Differences in Clinical and Biological Markers for NCDs between Exposed and Unexposed

In terms of clinical and biological markers of NCDs, compared to the community unexposed, the malnourished elders had an increased waist circumference and a higher waist/standing height ratio. On the other hand, they had a decreased hip circumference and reduced muscle strength. Regarding cardiometabolic markers of NCDs, apart from a higher HbA1c, no differences were found in blood pressure (SBP, DBP and MBP), fasting blood glucose, creatinine, lipid profile (total cholesterol, LDL-C, HDL-C and TG) and albumin levels in the exposed compared to the unexposed (tab. 5) (Mwene-Batu *et al.*, 2021a,b).

Risk of Developing NCDs in the Exposed compared to the Unexposed

Compared to unexposed individuals, exposed individuals had an increased prevalence of metabolic syndrome, visceral obesity and thinness. In contrast, the prevalence of hypertension, diabetes, overweight and dyslipidemia was similar in both groups (tab. 6) (Mwene-Batu *et al.*, 2021a,b).

Table 1

Differences in long-term growth and anthropometry between exposed and unexposed (Mwene-Batu *et al.*, 2020a,b)

	All participants (931)	**Exposed (524)**		**Unexposed (407)**		**Difference exposed-unexposed (95 % CI)**	**p value**
	%	**%**	**Mean (SD)**	**%**	**Mean (SD)**		
Age (years) median (min.-max.)			22 (16-40)		22 (16-40)		
Male	51.4	52.7		49.8			
Weight (kg)			53.5 (7.9)		55.1 (7.2)	-1.7 (-2.6 to -0.6)	0.001
Height (cm)							
Sitting			112.6 (7.3)		113.9 (6.9)	-1.3 (-2.2 to -0.3)	0.006
Standing			155.9 (8.9)		157.6 (8.9)	-1.7 (-2.9 to -0.6)	0.003
Leg length			91.6 (7.3)		93.2 (8.6)	-1.6 (-2.6 to 0.5)	0.002
Thoracic length			44.6 (7.9)		44.9 (9.3)	-0.3 (-1.3 to 0.8)	0.64
BMI (kg/m^2)			22.1 (2.9)		22.2 (2.5)	-0.2 (-0.5 to 0.2)	0.29
< 18.5	5.9	7.5		3.8			
18.5-24.9	81.0	79.2		83.2			0.11
25-29.9	12.2	12.3		12.2			
≥ 30	0.9	1.0		0.8			
MUAC (mm)			253.5 (25.6)		256.6 (22.7)	-3.2 (-6.3 to 0.0)	0.051
Circumferences (cm)							
Head			54.9 (1.9)		55.1 (1.8)	-0.2 (-0.4 to 0.0)	0.07
Thoracic			83.5 (7.8)		83.9 (6.4)	-0.4 (-3.3 to 3.7)	0.29

Table 2

Adjusted effect of exposure on TBW (kg) and fat free mass (kg) (Mwene-Batu *et al.*, 2020a,b)

	TBW (kg)		**Fat free mass (kg)**	
Variable	**b (95 % CI)**[1]	**P**	**b (IC 95 % CI)**[1]	**P**
SAM		0.027		0.024
Exposed	-1.13 (-2.12, -0.13)		-1.56 (-2.93, -0.20)	
Unexposed	0		0	
Age (years)	0.10 (-0.01, 0.21)	0.062	0.17 (0.02, 0.31)	0.022
Sex		< 0.001		< 0.001
Female	-5.01 (-6.00, -4.02)		-6.82 (-8.18, -5.47)	
Male	0		0	
Food diversity		0.118		0.136
Insufficient	-0.80 (-1.80, 0.20)		-1.04 (-2.41, 0.33)	
Satisfactory	0		0	
	R^2: 0.28		R^2: 0.28	

[1] Difference with 95 % CI (confidence interval) calculated by linear regression.

b is the regression coefficient; TBW = total body water; SAM = severe acute malnutrition.

Table 3

Sociodemographic and economic characteristics of the two groups of the population study (Mwene-Batu *et al.*, 2021a,b)

	Exposed		Unexposed		p value[1]
	N (total)	%	N (total)	%	
LEVEL OF EDUCATION	515		405		
None		27.8		20.0	
Primary		37.1		33.6	< 0.001
Secondary		34.2		42.0	
University		1.0		4.4	
OCCUPATIONAL CATEGORY	479		359		
Executive		3.1		7.5	
Administrative + office worker		0.8		1.1	0.137
Farmer + fisher + market vendor		64.9		62.1	
Unskilled worker		31.1		29.3	
Living conditions					
LIVING CONDITIONS					
A. Housing (wall + roof + cement floor + water + toilet)	524		407		
Precarious		33.4		21.1	
Average		63.5		74.4	< 0.001
Good		3.1		4.4	
B. Material possessions (sum of all possessions)	524		407		
Few (at least three possessions)		81.7		82.8	
Average (four to six possessions)		18.1		17.2	0.848
Many (more than six possessions)		0.2		0.0	
C. Land ownership (yes)	524	59.9	407	67.8	0.013
SOCIO-ECONOMIC STATUS (education + living conditions + occupation)	472		357		
Low		64.0		55.5	
Average		33.1		37.8	0.007
High		3.0		6.7	
DIET DIVERSITY SCORE	524		407		
Insufficient		11.1		6.9	
Borderline		39.3		31.7	< 0.001
Satisfactory		49.6		61.4	

[1] p value calculated with ordinal logistic regression for ordinal variables.

Table 4

Difference in education, self-esteem and cognition between exposed and unexposed (Mwene-Batu *et al.*, 2021a,b)

	Exposed			Unexposed			p value[1]
	N (total)	%	Mean (SD)	N (total)	%	Mean (SD)	
EDUCATION							
1. Level of education	524			407			
None		27.8			20.0		
Primary		37.1			33.6		< 0.001
Secondary		34.2			42.0		
University		1.0			4.4		
2. SR academic performance	378			325			
Low		23.8			15.2		
Average		45.1			49.0		0.014
High		31.0			35.8		
COGNITION	100			100			
Mean MMSE score (SD)		50.0	25.6 (2.6)		72.0	27.8 (2.2)	0.001
Mean MMSE-I score (SD)		50.0	22.8 (2.1)		28.0	26.3 (2.9)	< 0.001
Normal		78.0			90.1		< 0.001
SELF-ESTEEM	518			405			
Low		20.5			12.1		
Average		72.6			78.5		0.003
High		6.9			9.4		
Listens to the news							
Listens to the radio news (yes)		40.0			49.2		0.007
Uses social networks		14.0			21.7		0.003

[1] p value calculated with ordinal logistic regression for ordinal variables.

Table 5

Mean differences (CI 95 %) in clinical and biological markers for NCDs between exposed and unexposed (Mwene-Batu *et al.*, 2021a,b)

	Crude difference (95 % CI)	Adjusted difference (95 % CI)
Anthropometry		
Waist circumference (cm) (n = 925)	1.2 (0.02, 2.3)	
Hip circumference (cm) (n = 922)	-1.5 (-2.6, -0.5)	
Waist-to-hip ratio (n = 921)	0.03 (0.02, 0.05)	
Waist-to-height ratio (n = 925)	0.01 (0.01, 0.02)	
Muscle strength (kg) (n = 688)	-2.9 (-4.2, -1.6)	-3.0 (-4.3, -1.7)[a]

Blood pressure (mm Hg)		
Systolic BP (n = 627)	-0.7 (-2.8, 1.4)	
Diastolic BP (n = 687)	-0.7 (-2.3, 0.9)	
Mean BP (n = 627)	-0.9 (-2.5, 0.7)	
Glucose		
Glycemia (mg/dL) (n = 717)	1.4 (-0.9, 3.7)	1.1 (-1.3, 3.4)[a]
HbA1c (%) (n = 110)	0.5 (0.3, 0.6)	0.4 (0.2, 0.6)[a]
Lipid profile (mg/dL)		
Total cholesterol (n = 755)	-4.9 (-10.1, 0.3)	-3.8 (-9.3, 1.8) (n = 672)[c]
HDL-C (n = 755)	-0.6 (-1.8, 0.7)	-0.5 (-1.9, 0.8) (n = 672)[c]
LDL-C (n = 731)	-4.1 (-8.6, 0.4)	-2.8 (-7.6, 2.0) (n = 650)[c]
Triglyceride (n = 734)	1.01 (0.97, 1.04)[1]	1.00 (0.97, 1.04)[1,a]
Creatinine (mg/dL) (n = 752)	-0.01 (-0.03, 0.02)	
Albumin (mg/dL) (n = 752)	-0.06 (-0.10, -0.01)	-0.04 (-0.09, 0.01)[b] (n = 669)

Difference with 95 % CI (confidence interval) calculated by linear regression. BP = blood pressure.
[1] Geometric means ratio.
[a] Adjusted for diet diversity.
[b] Adjusted for SES.
[c] Adjusted for diet diversity and SES.

Table 6

Risk of developing NCDs (95 % CI) in the exposed compared with the unexposed (Mwene-Batu *et al.*, 2021a,b)

	Crude OR (95 % CI)	**Adjusted OR**
1. Dyslipidaemia		
High LDL-C (n = 731)	1.56 (0.53, 4.62)	
Low HDL-C (n = 755)	1.20 (0.89, 1.63)	
High triglyceride (n = 734)	1.24 (0.72, 2.15)	
2. Diabetes (n = 717)	1.30 (0.76, 2.21)	
3. Hypertension (n = 683)	1.03 (0.55, 1.90)	0.98 (0.52, 1.85)[b] (n = 613)
4. Visceral obesity (n = 864)	1.41 (1.08, 1.85)	1.44 (1.09, 1.89)[a]
5. BMI (n = 905)		
Overweight	1.06 (0.71, 1.57)	1.11 (0.75, 1.65)[a]
Thinness	2.12 (1.15, 3.92)	1.92 (1.03, 3.57)[a]
7. Metabolic syndrome (n = 597)	2.35 (1.22, 4.54)	

Odds ratio (OR) with 95 % CI (confidence interval) calculated by logistic regression.
[a] Adjusted for diet diversity.
[b] Adjusted for SES.

Discussion

Our findings suggest that SAM childhood has persistent deleterious effects on growth in adulthood. Moreover, it exposes survivors to potential risk of NCD occurrence and reduced human capital in adulthood, even in a setting without nutritional transition.

However, regarding the risk of NCDs, apart from higher risk of visceral obesity, metabolic syndrome and glucose homeostasis, we didn't note any statistically significant difference in the two groups in terms of cardiometabolic markers of NCDs (blood pressure, fasting blood glucose, HDL-C and TG). In addition, no difference was observed in terms of risk of NCD occurrence (hypertension, diabetes mellitus, low HDL-C and hypertriglyceridemia). Our results are in contradiction with almost all studies from HICs (Barker, 2004; Roseboom *et al.*, 2001; Painter, Roseboom & Bleker, 2005; Ravelli, van Der Meulen, Osmond, Barker & Bleker, 1999; Ekamper, van Poppel, Stein, Bijwaard & Lumey, 2015) and agree with those of some studies conducted in LMICs (Lelijveld *et al.*, 2016; Moore, Halsall, Howarth, Poskitt & Prentice, 2001; Li *et al.*, 2010; Burger, Drummond & Sandstead, 1948; de Rooij *et al.*, 2006).

This discrepancy may be caused by several factors, including different ethnicities, since our subjects were all sub-Saharan Africans whereas the vast majority of HICs inhabitants are Caucasians. These ethnicity-related differences could be attributed in part to genetic (Wells, 2012) and environmental factors. As such, sub-Saharan populations are characterized as having different determinants for the development of HBP and metabolic handling of normal or excess salt intakes, which could have a confounding effect on the data observed.

Secondly, there were major differences in age between the populations. The majority of our subjects were young adults (mean age: twenty-two), unlike those in studies from HICs (median age: fifty) (Roseboom *et al.*, 2001; Painter *et al.*, 2005; Ravelli *et al.*, 1999; AlGhatrif *et al.*, 2013). This would also partly explain the absence of age effect on NCDs, given that the effects of natural ageing on NCDs become more apparent after the age of fifty (AlGhatrif *et al.*, 2013). As our population was still relatively young, and given that the risk of NCDs increases with age, an additional ten to twenty years of hindsight would be needed to likely increase NCDs prevalence in this population.

Thirdly, lifestyle and socio-economic status before and after exposure to the episode of undernutrition differ between the two regions. In contrast to the studies conducted in HICs, our subjects spent their childhood in precarious nutritional conditions before experiencing one or more episodes of SAM, and then continued to live in an unfavourable environment in terms of food quality and security, without nutrition transition. In HICs, famines occurred in populations that generally had a high socio-economic status and good health prior to the episode of famine, and rapidly recovered this status afterwards (Roseboom *et al.*, 2001; Painter *et al.*, 2005; de Rooij *et al.*, 2006) whereas our cohort remained relatively disadvantaged during and after the episode of SAM, and therefore unexposed to an obesogenic environment up to adulthood. As a rule, people in South Kivu have little access to processed and/or industrialized food. The population keeps on consuming local food, with reduced fat content and poor in refined carbohydrates. However, one cannot rule out that target organ damage could become more apparent once they are subsequently exposed over long periods to Western-style lifestyles promoting weight gain.

The fourth reason could be the life history period of exposure to undernutrition. Our subjects were exposed to SAM during childhood and not in utero, as was the case in the majority of HICs. In contrast to changes to organ structure and function during the intra-uterine period, which are only partially reversible (Barker, 2004), the majority of organs have already reached full developmental maturity during childhood, and the changes associated with SAM could be less permanent than those occurring during the rapid foetal growth period, reducing the long-term effects of SAM childhood compared with foetal malnutrition.

Lastly, the difference between the criteria for diagnosing undernutrition should be taken into consideration. In HICs, undernutrition was defined on the basis of a reduction in weight gain whereas, in our population, undernutrition was defined on the basis of weight-to-height ratio, mid-upper arm circumference and/or presence of nutritional oedema. In addition, more than 90 % of our subjects had delayed growth during childhood (Mwene-Batu *et al.*, 2020a,b). Consequently, the effect of weight gain could be different in children who gained weight and height in a balanced way compared to those who gained weight and BMI, but had delayed growth. All of these factors may explain the differences in the findings observed.

There are several limitations to this study. First, the survival bias should be emphasized, which appears to be a major limitation of this study. In fact, only five hundred and twenty-four of the one thousand nine hundred and eighty-one subjects in the original cohort were examined, and they might have different characteristics from those of the unanalysed subjects. Nevertheless, we believe that this would not have significantly altered our main findings because the hospital admission characteristics did not differ between lost and traced subjects (Mwene-Batu *et al.*, 2020a,b). Another possible bias is that subjects with good socio-economic status and higher risk of NCDs may have moved to Bukavu or other cities, which could also lead to an underestimation of the effects of SAM on the variables studied.

Secondly, we do not have early life health information, including gestational age, birth weight and height, growth rate during the first two years of life, and data on the evolution of subjects between hospital discharge and the conduct of this study. We also do not have any data on the social and physical environment during the childhood of our subjects (episodes of infectious diseases, especially diarrhoea, birth rank), nor any socio-economic data of the mothers (level of education and age at delivery). These variables could be potential confounders, as they are related to both malnutrition and long-term deleterious effects.

Thirdly, it is questionable whether all of the recruited non-exposed individuals were in good nutritional status. Although they did not present with kwashiorkor and were not treated for SAM, it is possible that some of them presented with MAM related to the unfavourable socio-economic conditions of the region, but did not result in hospitalization. This permanent unfavourable situation in which both groups evolved probably could have mitigated intergroup differences for most of the studied cardiometabolic markers.

Fourthly, the fact that our study is an observational one requires us to be very careful in terms of causality analysis. Apart from SAM exposure, other factors may be associated with the different events studied. These factors may have occurred before the SAM episode, notably during pregnancy or early childhood. They may also be related to the physical and social environment in which our subjects have lived since their discharge from the hospital.

Fifthly, in our study we had access to only one capillary (not venous) blood sample for blood glucose determination, and no oral glucose tolerance test was performed. In addition, BP was

measured on a single day, with no post testing (although measurements were optimal). All of this could have altered the observed differences in either direction.

Sixthly, we used psychometric tests (MMSE and MMSE-I) that have not been validated in the Congolese population, especially their Kiswahili versions. Therefore, we do not know to what extent this impacted the quality of the results. Nevertheless, having used a rigorous approach with pre-tests and a pilot study to address possible cross-cultural biases in terms of misunderstanding or lack of clarity, we believe that the lack of validation did not substantially alter the relevance of our findings.

Furthermore, given that 90 % of our study participants suffered from stunting as children, it is not impossible that some of the observed outcomes are more related to stunting than to SAM. Nevertheless, given that one child in two in South Kivu suffers from stunting and that food consumption was precarious in both groups (more so in the exposed group), we believe that the stunting effect would have been distributed across both groups and would not have greatly influenced our findings.

In spite of the mentioned limitations and given that there is a real paradox between the high prevalence of SAM in LMICs and the lack of information in the scientific literature about the potential long-term consequences of SAM, this study provides original data to help increase knowledge in this area. Therefore, policymakers and funders seeking to combat the global expansion of NCDs in adults should consider the long-term benefit of reducing SAM in childhood as a preventive measure.

Lessons learned from the DRC Lwiro Cohort Study and Research Perspectives

What we can learn from this research is that improving the childhood nutritional environment, BMI control, and lifestyle in adulthood is important for the prevention of NCDs occurrence and economic development. In addition, there is a high medium-term morbidity and mortality even after nutritional rehabilitation. Policymakers and donors seeking to address the global epidemic of NCDs and to reduce poverty rates should be aware that appropriate investment in young children's health is an important and often overlooked means of reducing the burden of extreme poverty and the cost of care for NCDs and complex psycho-medico social disorders in adults.

In the light of this and our observations, certain research perspectives deserve to be considered:

— Initiating follow-up of this cohort (every five years) or other cohorts of the same profile around the world over a longer term to detect a possible increase in the incidence of NCDs during follow-up of older subjects.
— Studying the long-term effect of the different subtypes of childhood malnutrition (kwashiorkor, marasmus, mixed form, moderate acute malnutrition, stunting), age at exposure to SAM, and type of treatment during the SAM episode on adult outcomes. This perspective is justified on the one hand by the fact that it has been documented that the effects of undernutrition would depend on the age of its occurrence. On the other hand, it has been shown that the risk of NCDs would differ according to the subtype of SAM.

— Studying with a comparable methodology cohort originally or secondarily established in urban areas, where the nutritional transition is more present.
— Studying the intergenerational effect of SAM on the offspring of exposed women in our cohort.
— Studying with medical imaging (brain CT-scan, abdominal and cardiac ultrasound) the long-term effects of SAM on the development of specific organs such as the central nervous system, gastrointestinal tract, pancreas, liver, kidney and cardiovascular system. This will allow us to explain certain clinical and biological abnormalities observed in this cohort.
— Studying the impact of birth weight on the risk of NCDs in adulthood in our context.

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Towards Better Future Climate Information over Central Asia*

by

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Keywords. — Regional Climate Modelling; Climate Projections; Climate Change.

Summary. — Unprecedented, widespread and rapid changes in the climate system have been observed in every region across the globe. Moreover, the increase in global surface temperature is expected to continue until at least 2050, which will lead to more extreme events. Regional climate models (RCMs) are used to downscale the information of global circulation models (GCMs) over particular regions of interest to study the effect of global warming at higher spatial and temporal resolutions. Such high-resolution climate information is still scarce for Central Asia, while this region covers a wide range of climatic zones and includes some densely-populated cities. High-resolution climate projections over Central Asia are presented under 1.5° C, 2° C and 3° C global warming.

Trefwoorden. — Regionale klimaatmodellering; Klimaatprojecties; Klimaatverandering.

Samenvatting. — *Op naar betere, toekomstige klimaatinformatie over Centraal-Azië.* — Ongeziene, uitgebreide en snelle veranderingen in het klimaat zijn waargenomen in elke regio van de wereld. Bovendien wordt tot minstens 2050 een verdere toename van de globale oppervlaktetemperatuur verwacht, wat zal leiden tot meer extreme gebeurtenissen. Regionale klimaatmodellen worden gebruikt om informatie van globale modellen om te zetten naar data met een hogere ruimtelijke en temporele resolutie over een beperkt studiegebied om zo het effect van klimaatverandering gedetailleerder te kunnen bestuderen. Dergelijke hoge resolutie klimaatinformatie over Centraal-Azië is echter schaars, terwijl deze regio een groot aantal klimaatzones vertegenwoordigt en enkele steden met een zeer hoge bevolking omvat. Hoge resolutie klimaatprojecties over Centraal-Azië worden toegelicht bij een globale klimaatopwarming van 1,5° C, 2° C en 3° C.

Mots-clés. — Modélisation climatique régionale; Projections climatiques; Changement climatique.

Résumé. — *Vers une meilleure information du climat futur de l'Asie centrale.* — Des changements inédits, étendus et rapides du système climatique ont été observés dans toutes les régions du monde. De plus, il est prévu que la température de surface mondiale continue d'augmenter au moins jusque 2050, ce qui entraînera une hausse des phénomènes extrêmes. Les modèles climatiques régionaux sont utilisés pour améliorer l'information des modèles globaux en se focalisant sur des régions d'intérêt particulier afin d'étudier l'effet du réchauffement climatique à des résolutions spatiales et temporelles plus élevées. Ces informations climatiques à haute résolution sont encore rares pour l'Asie centrale. En outre, cette région couvre beaucoup de zones climatiques et comprend plusieurs villes densément peuplées. Des projections climatiques à haute résolution sur l'Asie centrale sont ici présentées dans le cadre d'un réchauffement planétaire de 1,5° C, 2° C et 3° C.

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Introduction

Extreme events such as heatwaves, heavy precipitation, droughts, and tropical cyclones become more intense and occur more frequently (IPCC, 2021). These observations have been linked to the unprecedented and rapid changes in the climate system (IPCC, 2021). In 2020 a global near-surface temperature rise of 1.26° C (1.12° C - 1.37° C) relative to the baseline period 1850-1900 was reached (IPCC, 2021, p. 191). This stands for the approximate temperature rise since the pre-industrial period. Parties all over the world pledged in 2016 in the Paris Agreement to pursue a limitation of global warming to 1.5° C or to stay well below 2° C with respect to the pre-industrial temperature levels. The IPCC special report on the impacts of global warming of 1.5° C above pre-industrial level (IPCC, 2018) states with high confidence that global warming will reach 1.5° C between 2030 and 2052 if greenhouse gas concentrations continue to increase at the same rate. The increase in global temperature is moreover expected to continue at least until 2050 under the socio-economic scenarios that are considered as feasible (IPCC, 2021). A global warming of 2° C will therefore be exceeded during the 21st century unless greenhouse gas emissions are drastically reduced in the coming decades. A further ongoing global warming will lead towards even more extreme events and will for example induce more frequent exceedance of human health heat thresholds, causing reduced well-being, labour productivity and an excess in mortality (Casanueva *et al.,* 2020; IPCC, 2021).

In order to study the potential future climate pathways and their impacts, future climate simulations are necessary. Global circulation models (GCMs) make such simulations possible by including physical laws to describe the atmosphere and its interactions. They simulate global climate information at a coarse resolution of typically ~100 km by ~100 km, with 25 km being the finest resolution currently reached (Demory *et al.,* 2020). Regional climate models (RCMs) consist similarly to GCMs out of physical laws, but the physical laws of RCMs describe smaller-scale processes that cannot be resolved by the coarse resolution of GCMs. RCMs are therefore used to downscale the data of GCMs over particular regions of interest to study the effect of global warming at higher spatial and temporal resolutions. The spatial resolution is typically 25 km by 25 km or finer. Such high-resolution climate information is still scarce for Central Asia (Kotova *et al.,* 2018). Additionally, the Central Asia region covers a wide range of climatic zones and comprises some densely-populated cities, which increases the potential value of high-resolution climate information when it would be available for this region (IPCC, 2021). Moreover, high-resolution climate information is needed to study the possible impact of climate change on, for example, crop yields (Vannoppen *et al.,* 2020), ecosystems (Cai *et al.*, 2020), urban climate (Cugnon *et al.,* 2019), building materials (Hedayatnia *et al.,* 2021), etc. The following sections describe therefore the method and outcomes of the future climate projections that have been produced with the RCMs ALARO (Giot *et al.*, 2016) and REMO (Jacob & Podzun, 1997). ALARO was developed and maintained by the Royal Meteorological Institute of Belgium (RMIB) (Termonia *et al.*, 2018), while REMO was developed at the Max Planck Institute for Meteorology and is maintained and used by the Helmholtz-Zentrum Hereon Climate Service Center Germany (HZH-GERICS) (Jacob *et al.*, 2012).

Before presenting the outcomes of climate projections, the first section explains how regional climate modelling works, why we can trust the results and which methods were applied to obtain the results described in the following sections. The second and third sections present the future changes in respectively temperature and precipitation over Central Asia, together with their uncer-

tainties. In this way we have reduced the gap in high-resolution climate data and knowledge of the possible future climate evolutions under 1.5° C, 2° C and 3° C over this region.

Regional Climate Modelling over Central Asia

The model domain applied over Central Asia, as depicted in figure 1, was defined by the Coordinated Regional Climate Downscaling Experiment (CORDEX). This international initiative was launched with the aim of designing and conducting several high-resolution experiments on prescribed spatial domains across the globe. Furthermore, CORDEX creates a framework to perform downscaling towards high-resolution climate data, to evaluate these downscaled data, and to characterize uncertainties of regional climate change projections by combining data of different RCMs into ensemble projections (Giorgi & Gutowski, 2015). Although this initiative resulted in an added value since the joint agreements and modelling efforts led towards large multi-model ensembles over several regions produced by different modelling groups, some regions such as Central Asia are until today sparsely covered by high-resolution climate data. Therefore, climate data with the unprecedented spatial resolution of 25 by 25 km were produced over this region in the course of the AFTER-project (Kotova *et al.,* 2018). The evaluation data, historical runs and future projections can be retrieved from the ESGF data nodes (website: http://esgf.llnl.gov/; last access: 31 August 2022) and can be freely used for further research.

Before RCMs can be trusted for producing climate projections and their data applied in impact models, a model evaluation is needed to retrieve possible model errors or biases and to gain confidence in the RCM downscaling procedure. Top *et al.* (2021) evaluated both ALARO and REMO over the Central Asia CORDEX domain (CAS-CORDEX) (see fig. 1) by comparing their downscaled results to observed and re-analysis data. Top *et al.* (2021) concluded that the RCMs ALARO and REMO are able to capture the general climate, but both models have some deficiencies for a certain variable over particular parts of the modelling domain. For example, ALARO is subject to significant positive temperature biases in winter, followed by large negative biases in spring for the northern part of the CAS-CORDEX domain and REMO simulated excessive precipitation amounts over the Tibetan Plateau during all seasons. These shortcomings have to be taken into account when using and interpreting the data of these RCMs for climate projections.

To downscale future climate data of a GCM to a finer grid the dynamical downscaling procedure was applied. Hereby data produced by a GCM of the fifth Coupled Model Intercomparison Project (CMIP5) cycle was used as the lateral boundary condition to force an RCM that produces climate data at higher spatial and temporal resolutions. The RCM ALARO was forced by the GCM CNRM-CM5, while REMO was forced by three GCMs, namely: HadGEM2-ES, MPI-ESM-LR and NorESM1-M. In this way a small ensemble of four GCM-RCM members was created to reduce biased conclusions. The multi-model mean of the ensemble is obtained by taking an equal average over the four members. The variation between the outcomes of the different GCM-RCM members was quantified by calculating the standard deviation between the different members to see whether the general outcome is supported by each GCM-RCM combination and whether a particular change in temperature or precipitation is likely to occur or not under a 1.5° C, 2° C and 3° C warmer world. A larger spread between the GCM-RCM members in the ensemble means that there is a higher uncertainty in the future prevalent temperature or precipitation at that location. Since the ensemble only consists of four members, one should keep in mind that only a small part of the full uncertainty range will be covered.

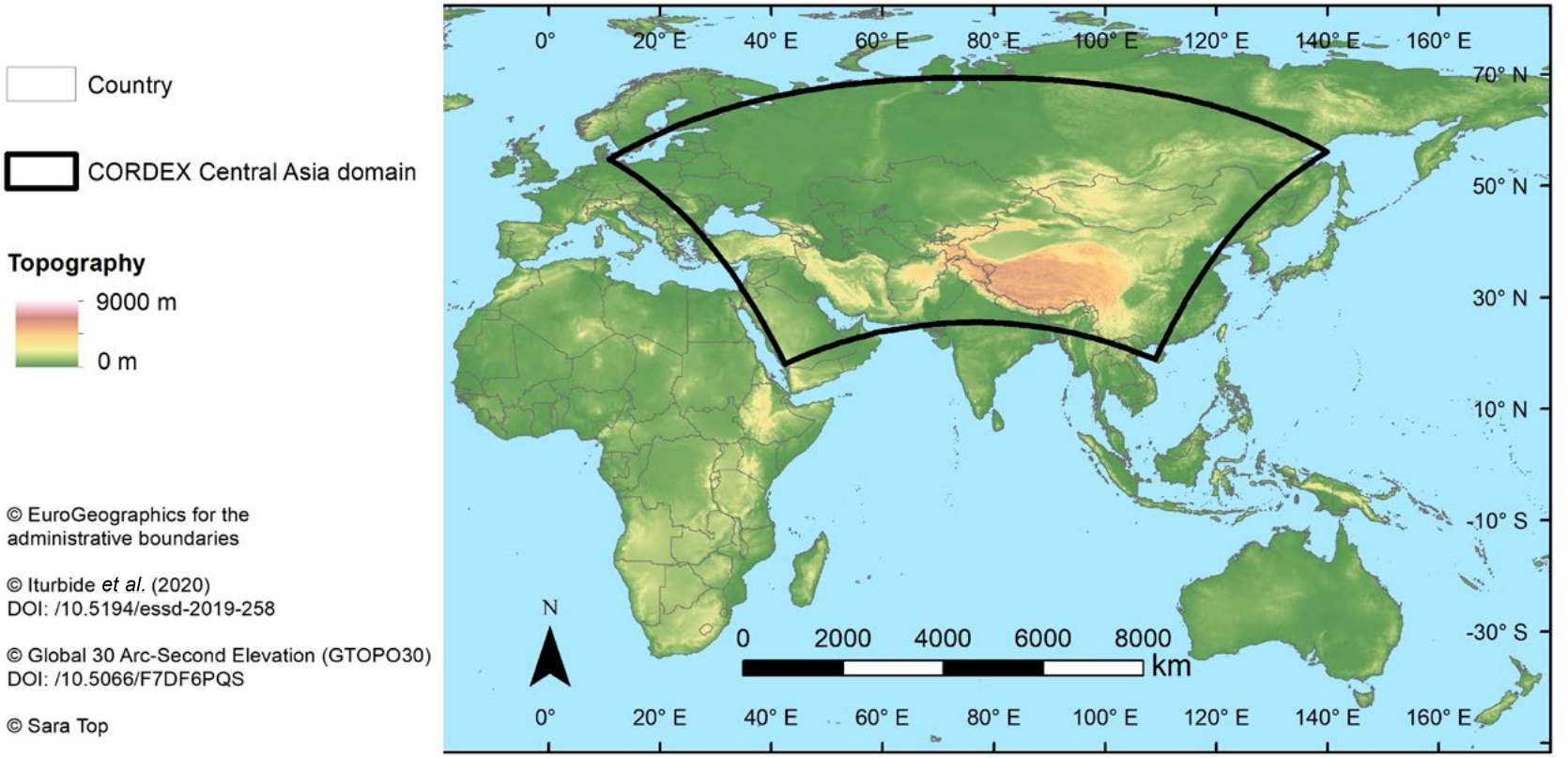

Fig. 1. — IPCC6 subregions in the CORDEX Central Asia (CAS-CORDEX) domain (based on Top, 2022).

Climate projections are always conditional on the considered future socio-economic scenario. To determine possible future climate outcomes different shared socio-economic pathways (SSPs) are combined with representative concentration pathways (RCPs) to include time series of emissions and concentrations of all greenhouse gases, aerosols and chemically active gases, as well as land-use/land-cover changes. RCPs prescribe these possible future changes in time by using radiative forcing values. For example, in the RCP 2.6 scenario the radiative forcing peaks to 3 W m^{-2} before 2100 and then declines to 2.6 W m^{-2} by the end of the century (van Vuuren *et al.*, 2011). Future simulations were run from 2006 to 2100 and are for all GCM-RCM members performed for a low and very high emission scenario, RCP 2.6 and RCP 8.5 respectively. RCP 8.5 represents rather an unlikely high-risk future scenario since it assumes a five-fold increase in coal use by 2100, while coal use peaked in 2013 (Hausfather & Peters, 2020). This scenario is, however, taken into account to identify all potential risks and to be prepared for extreme cases since it includes, for example, the uncertainty of important feedback effects that might be underestimated by current climate models, such as the carbon cycle feedbacks. By using the low and very high RCPs as boundary condition for climate projections, both the optimistic and worst case climate change scenarios are taken into account.

To investigate how the temperature and precipitation patterns will evolve over time, the period 1976-2005 is selected as historical modelling period. The climate change signal with respect to the near past is then obtained by subtracting the historical thirty-year mean from a future thirty-year mean. To present the spatial variation in climate change under a global warming of 1.5° C, 2° C or 3° C with respect to the pre-industrial era, the 1850-1900 period has to be used as reference period as done by the IPCC (IPCC, 2021). To obtain the results under a 1.5° C, 2° C or 3° C warmer world, the warming from 1850-1900 until the historical period 1976-2005 has to be taken into account and amounts 0.69° C (0.52° C – 0.82° C) (Jacob *et al.*, 2018; IPCC, 2021). The central years and thirty-year periods when the different GCMs coupled to the RCMs reach 1.5° C, 2° C and 3° C were determined by using the method of Vautard *et al.* (2014) and are presented in tables 1, 2 and 3 respectively. The 1.5° C, 2° C and 3° C periods differ for each RCP scenario because human-induced emissions evolve differently under these scenarios (tabs. 1, 2, 3). These years in tables 1, 2 and 3 make it possible to trace back when changes in temperature and precipitation patterns, described in the following sections, are likely to take place given a certain emission scenario. Some GCMs do not reach the 2° C and/or 3° C global warming threshold by 2085 under RCP 2.6, which makes it impossible to define the thirty-year period for these GCMs, indicated by “inf” in tables 2 and 3.

Table 1

Central year and thirty-year period when global warming reaches +1.5° C for general circulation models (GCMs) used under different representative concentration pathways (RCPs) (adopted from Top, 2022)

	RCP 2.6		**RCP 8.5**	
GCM	**+1.5° C central year**	**+1.5° C period**	**+1.5° C central year**	**+1.5° C period**
CNRM-CM5-r1i1p1	2040	2026-2055	2029	2015-2044
HadGEM2-ES-r1i1p1	2019	2005-2034	2018	2004-2033
MPI-ESM-LR-r1i1p1	2049	2035-2064	2026	2012-2041
NorESM1-M-r1i1p1	2063	2049-2078	2031	2017-2046

Table 2

Central year and thirty-year period when global warming reaches +2° C for general circulation models (GCMs) used under different representative concentration pathways (RCPs) (adopted from Top, 2022) – "inf" indicates that the warming level was not reached by 2085.

	RCP 2.6		**RCP 8.5**	
GCM	**+2° C central year**	**+2° C period**	**+2° C central year**	**+2° C period**
CNRM-CM5-r1i1p1	inf	inf	2044	2030-2059
HadGEM2-ES-r1i1p1	2037	2023-2052	2030	2016-2045
MPI-ESM-LR-r1i1p1	inf	inf	2044	2030-2059
NorESM1-M-r1i1p1	inf	inf	2046	2032-2061

Table 3

Central year and thirty-year period when global warming reaches +3° C for general circulation models (GCMs) used under different representative concentration pathways (RCPs) (adopted from Top, 2022) – "inf" indicates that the warming level was not reached by 2085.

	RCP 2.6		**RCP 8.5**	
GCM	**+3° C central year**	**+3° C period**	**+3° C central year**	**+3° C period**
CNRM-CM5-r1i1p1	inf	inf	2067	2053-2082
HadGEM2-ES-r1i1p1	inf	inf	2051	2037-2066
MPI-ESM-LR-r1i1p1	inf	inf	2067	2053-2082
NorESM1-M-r1i1p1	inf	inf	2072	2058-2087

Under RCP 8.5 1.5° C, 2° C and 3° C global warming is reached by all four GCMs (tabs. 1, 2, 3). The fact that this is the only scenario that makes it possible to investigate which regional changes will take place under an extreme global warming of 3° C is an additional reason to take this scenario into account. In table 2, the 2° C level is not reached under RCP 2.6, except for the GCM HadGEM2-ES. The central year when 1.5° C is reached for the GCMs CNRM-CM5 and MPI-ESM-LR lies between 2030 and 2052, which is according to the IPCC the period when it is very likely that 1.5° C global warming will be reached, while NorESM1-M reaches 1.5° C global warming later (tab. 1). According to the observations within the framework of the IPCC (IPCC, 2021), the steep warming trend of HadGEM2-ES, reaching 1.5° C in the central year 2019 (tab. 1), is too fast compared to the observed global warming. Different to NorESM1-M, CNRM-CM5 and MPI-ESM-LR, the GCM HadGEM2-ES simulates a positive shortwave cloud radiative forcing which can partly explain the strong climate sensitivity of HadGEM2-ES (Andrews, Gregory, Webb & Taylor, 2012).

In the following sections the spatial differences in future and historical climate are presented based on the changes in the multi-model mean of temperature and precipitation. The multi-model mean of the thirty-year periods representing a 1.5° C, 2° C and 3° C global warming since the pre-industrial period is compared to the historical period 1976-2005. Since the 1976-2005 period already experienced a warming of 0.69° C, the differences between the 1.5° C, 2° C and 3° C scenarios show the effect of 0.81° C, 1.31° C and 2.31° C global warming when compared to the historical 1976-2005 period. To define whether changes in the distribution of the simulated variables under 0.81° C, 1.31° C and 2.31° C global warming are significant, a Mann-Whitney U-test, also named the Wilcoxon rank sum test, at a 95 % significance level is performed. This test puts the values of both historical and future periods into one sample with an indication to which period

the values belong. When the historical and future values are randomly ranked, then the values of the two periods are not different and no increase or decrease is found and vice versa (Corder & Foreman, 2011). A one-sided test is applied for temperature since a warming trend is expected over the CAS-CORDEX domain (IPCC, 2021) and a two-sided test is used for precipitation because an increasing or decreasing precipitation trend is expected depending on the region (IPCC, 2021).

Future Change in Temperature over Central Asia

Figure 2 shows the spatial distribution of the multi-model mean for temperature during the historical period 1976-2005 and presents the regional warming under different global warming levels. The Wilcoxon signed-rank test at a 95 % significance level shows at annual level and for each season that the complete CAS-CORDEX region is expected to undergo significant warming under all three investigated global warming levels when compared to the temperature distribution during the historical 1975-2005 period. Furthermore, it can be derived from figure 2 that a more severe regional warming will take place under more severe global warming. Moreover, the regional warming trend is steeper than the global warming trend since an increase in 0.81° C globally leads to a change of 1 to 3° C over most of the CAS-CORDEX domain. The northern region of the CAS-CORDEX domain will undergo a faster temperature increase than the mean warming trend over the CAS-CORDEX domain, while Southeast China experiences a slower warming. When seasons are compared, the warming trend is more prominent during autumn and winter over most parts of the domain.

Figure 3 presents the spread between the different model members of the ensemble for the three warming scenarios. The very similar patterns in spread that appear for each warming scenario (columns in fig. 3) show that the dissimilarities between the models remain the same over time. This implies that the dissimilarities between the models are mainly due to the inter-model uncertainty on regional processes that do not change over time. Over the northeastern region of the CAS-CORDEX domain there is a large standard deviation up to 5° C, indicating a large uncertainty at annual level (see fig. 3). This corresponds to the region for which a large deviation with the reference datasets was found during the evaluation of RCMs and for which ALARO had a cold bias, while REMO had a warm bias (Top *et al.,* 2021). Large uncertainties are also found during winter over the full domain, with the highest uncertainty in the eastern part of the domain up to a standard deviation of 10° C in northern China, Mongolia and eastern Russia. Also during spring there is a large model spread in the northern part of the region, with the largest standard deviation being up to 7° C over eastern Russia. These large uncertainties can again be linked to the deficiencies that were reported in the evaluation study of RCMs. The variation between the models is smaller during summer with values up to 3° C, except for some parts in East Europe and Lake Baikal in southeastern Russia. In autumn the RCMs had the best performance during the evaluation study (Top *et al.,* 2021) and this results in a small standard deviation up to 2° C between the models over most of the region, except for northern China, Mongolia and eastern Russia. This makes the resulting significant regional warming during autumn very robust and likely to occur. The variation between the model outcomes of the different GCM-RCM members is small during the seasons and over the regions for which the two RCMs performed well (Top *et al.*, 2021). This is remarkable since the different ensemble members could project different future climates. The deficiencies that were reported during the evaluation of RCMs lead to a larger spread between the model outcomes for the future projections, which causes an increase in uncertainty. Therefore, the RCMs should be improved or a bias adjustment should be carried out to reduce the uncertainty in the future projections.

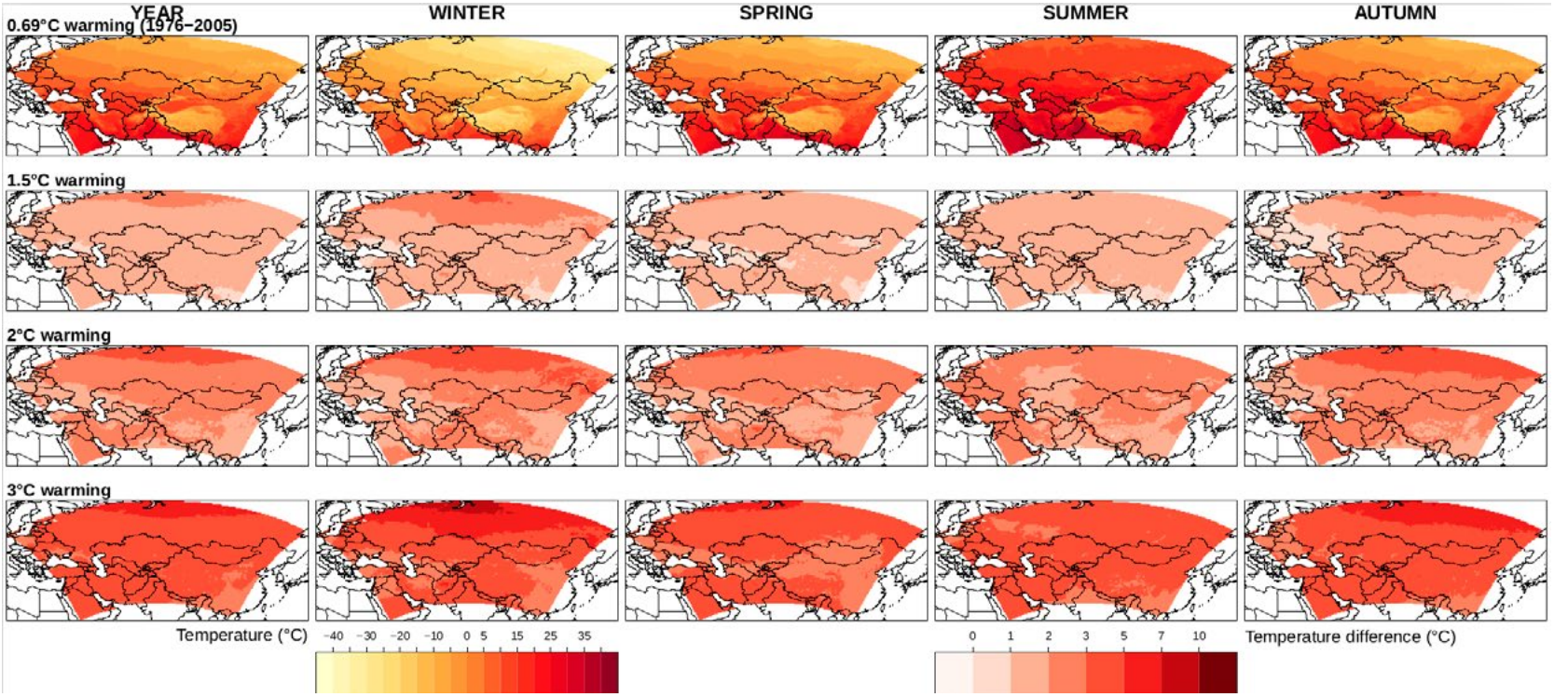

Fig. 2. — Spatial variability in the annual and seasonal temperature means for the historical period (1976-2005) and temperature change under 1.5° C, 2° C and 3° C global warming showing the effect of 0.81° C, 1.31° C and 2.31° C global warming with respect to the historical period shows that additional global warming causes a significant additional warming over the Central Asia domain (based on Top, 2022).

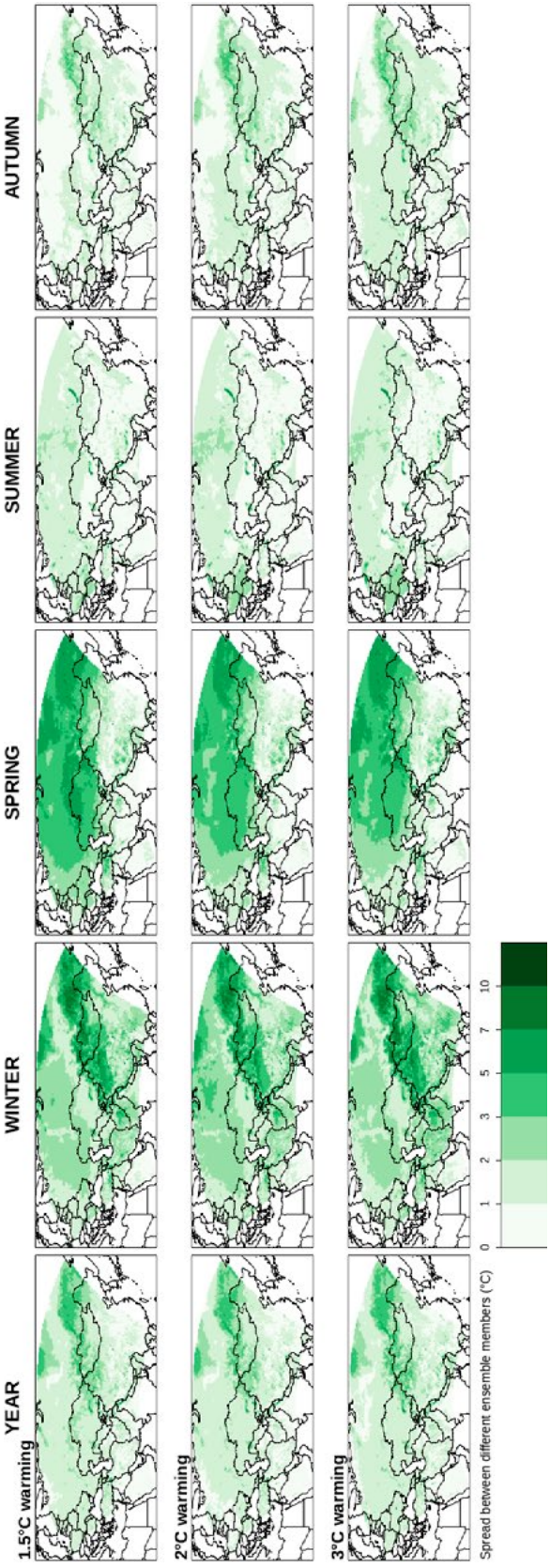

Fig. 3. — Spatial variability in the annual and seasonal spread, quantified by the standard deviation, between temperatures of the different ensemble members and RCP scenarios under global warming of 0.81° C, 1.31° C and 2.31° C with respect to the historical period (1976-2005) or 1.5° C, 2° C and 3° C global warming with respect to the pre-industrial baseline period (based on Top, 2022).

Future Change in Precipitation over Central Asia

Figure 4 shows the spatial changes of the multi-model mean in relative precipitation amounts under the three different global warming levels compared to the historical period 1976-2005. Based on the Mann-Whitney U-test with a 95 % significance level, not all parts of the CAS-CORDEX will experience a significant change in precipitation under 0.81° C, 1.31° C and 2.31° C global warming, which is indicated with grey dots on figure 4. Furthermore, the projections in figure 4 show that a more pronounced global warming causes a larger area of significant changes in precipitation. At annual level, significantly increased precipitation amounts are projected over the northern and central regions of the CAS-CORDEX domain for all warming levels, covering parts of Russia, Kazakhstan, Uzbekistan, Kyrgyzstan, Turkmenistan, Tajikistan, Mongolia and western China. On the contrary, a decrease in precipitation is projected over the Middle East and northern India, but this decrease is only significant under a global warming of 1.31° C and 2.31° C for Syria, northern Iraq and southern Afghanistan, while it is only significant under a 1.31° C global warming for East Europe and northern India. Additionally, there is no clear change in annual precipitation over eastern China under all three warming levels.

For all seasons except for summer a significant increase in precipitation is projected over the northern and central regions of the CAS-CORDEX domain, with the strongest increase and largest region of significant increase occurring in winter. Under more severe global warming, the increase in precipitation during winter is steeper for the northeastern part of the domain compared to the rest of the CAS-CORDEX domain. During spring and summer large, however, insignificant relative precipitation changes are found over the Middle East. This is due to the small precipitation amounts this region experiences. Furthermore, a significant decrease in precipitation is projected over East China for all global warming levels during summer and under 1.31° C and 2.31° C global warming during autumn. During summer there is also a significant decreasing precipitation trend projected for East Europe under a global warming of 1.31° C, while under a global warming of 2.31° C this is only the case for southeastern Europe. During winter, East Europe is projected to experience a significant increase in precipitation under the 2.31° C warming level, which explains why at annual level the decreasing precipitation trend is only projected under a global warming of 1.31° C.

Figure 5 shows large variations in precipitation between the projection model members over the southeastern part of the domain and East Europe, resulting in a large uncertainty for the future precipitation amounts. Over Kazakhstan and regions with small precipitation amounts, namely the Arabian Peninsula, Eastern Iran and the Gobi Desert the standard deviation between the different model simulations is small, which indicates that the models agree well. Compared to the autumn and winter the standard deviation in the northwest and northeastern parts of the CAS-CORDEX domain indicates a larger uncertainty between the modelled precipitation during spring and summer. Top *et al.* (2021) revealed that not all members of the ensemble simulate the East-Asian monsoon equally well and this probably causes the larger uncertainty over southeastern China except during winter since there is no East-Asian monsoon precipitation in winter. Similar as for temperature, the standard deviation remains more or less the same for the three global warming levels indicating that the dissimilarities between the model outputs are mainly due to the inter-model uncertainty on regional processes that do not evolve over time.

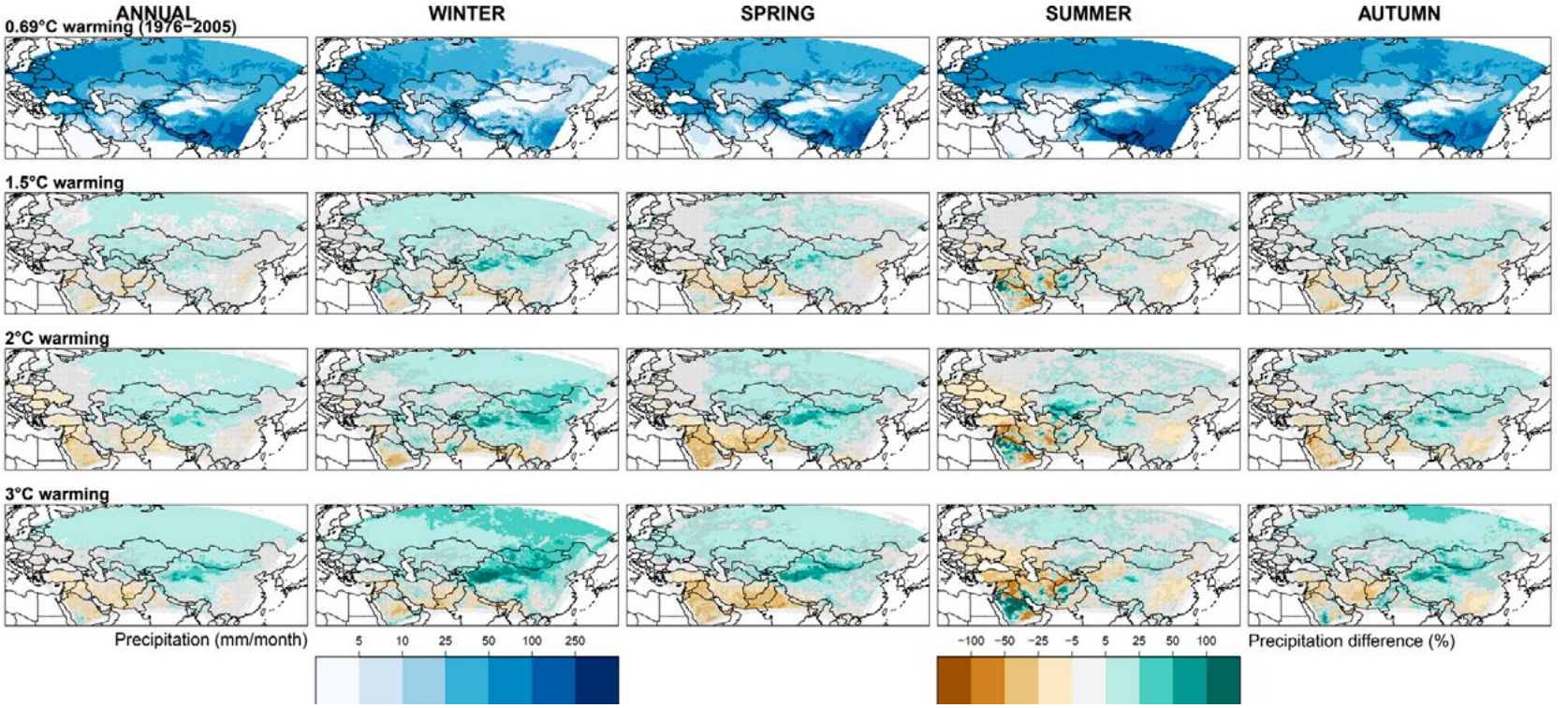

Fig. 4. — Spatial variability in the annual and seasonal precipitation amounts for the historical period (1976-2005) and change in precipitation amounts under 1.5° C, 2° C and 3° C global warming showing the effect of 0.81° C, 1.31° C and 2.31° C global warming with respect to the historical period. Grey dots, on top of the precipitation difference class, indicate where precipitation does not differ significantly from the historical and future period over the Central Asia domain (based on Top, 2022).

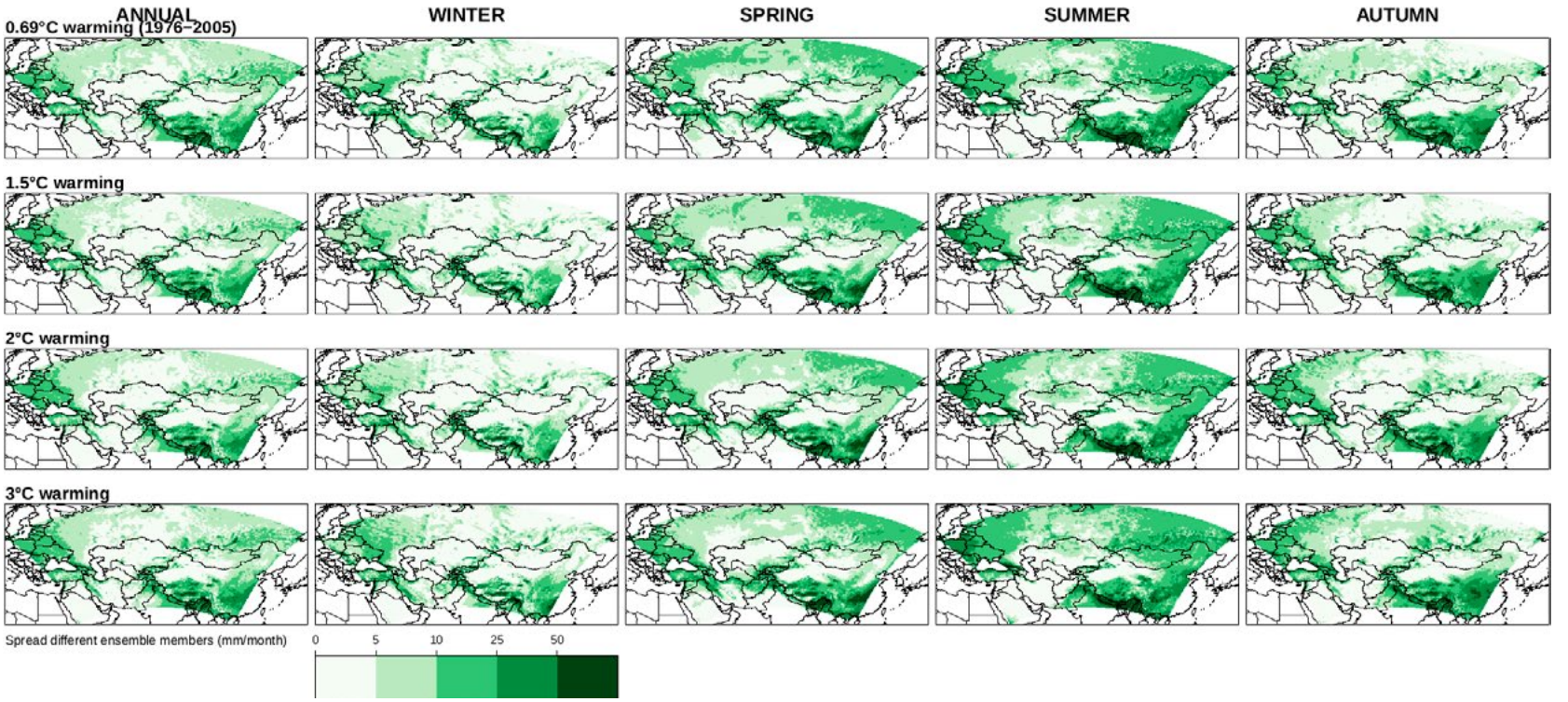

Fig. 5. — Spatial variability in the annual and seasonal spread, quantified by the standard deviation, between regional precipitation amounts of the different ensemble members and RCP scenarios under global warming of 1.5° C, 2° C and 3° C (based on Top, 2022).

Conclusion

Highly needed high-resolution climate data over Central Asia were produced, evaluated, studied and made available for the scientific community through the ESGF data nodes (website: http://esgf.llnl.gov/). Hopefully this effort will enhance the creation of more high-resolution climate information and increase the number of climate impact studies over this region, so that there is more certainty on how the future climate will evolve over this region and what the potential impacts of ongoing global warming are.

The future temperature projections have shown that the warming rate differs depending on the location in the Central Asia domain, with in general a faster warming in the north. Future changes in precipitation amounts will also depend on the location, *e.g.* an increase in annual precipitation is expected in the northern and central part of the CAS-CORDEX domain, while a significant decrease is expected for the Middle East and northern India under an additional global warming of 1.31° C and 2.31° C compared to the historical period 1976-2005, or 2° C and 3° C when compared to the 1850-1900 period. For both temperature and precipitation larger regional changes in Central Asia are expected under more severe global warming. Reducing greenhouse gas emissions is thus of major importance for limiting the adverse impacts of climate change within Central Asia.

The variation between model members remained smaller for the regions where both RCMs performed well during the evaluation study and variations in projected temperature and precipitation between the different model members are mainly due to the inter-model uncertainty on regional processes that do not evolve over time. For future research an improvement of the RCMs in simulating the current climate features or a bias adjustment is therefore recommended since this will probably reduce uncertainty in the future projections, which is important for impact studies.

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Technical Sciences

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Les observations météorologiques instrumentales du père Louis Furet à Naha, Okinawa (1855-1860), et leur contexte historique*

par

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Mots-clés. — Histoire de la météorologie; Charles Sainte-Claire Deville; Société météorologique de France; Relevés quotidiens; Japon.

Résumé. — L'article est consacré à l'analyse des observations météorologiques instrumentales faites par Louis Furet, prêtre de la Société des Missions étrangères de Paris, à Naha, dans l'actuel département japonais d'Okinawa, essentiellement de décembre 1856 à octobre 1860. Aujourd'hui conservées dans la bibliothèque de Météo-France, elles constituent l'une des plus anciennes séries de données météorologiques instrumentales pour le Japon. Les relevés ont été effectués cinq fois par jour, à 6 h et 10 h du matin, 1 h, 4 h et 10 h du soir. Les valeurs ainsi obtenues sont consignées dans des tableaux journaliers, mensuels et annuels conformes aux instructions météorologiques en vigueur à l'époque. Une comparaison est esquissée avec le climat d'aujourd'hui pour la température de l'air et l'humidité relative. Ces observations sont une contribution exemplaire au développement de la météorologie scientifique en France sous l'impulsion de la Société météorologique de France récemment créée par Charles Sainte-Claire Deville, principal correspondant de Furet, et Émilien Renou.

Trefwoorden. — Geschiedenis van de meteorologie; Charles Sainte-Claire Deville; *Société météorologique de France*; Dagelijkse waarnemingen; Japan.

Samenvatting. — *De instrumentele meteorologische waarnemingen van Pater Louis Furet te Naha, Okinawa (1855-1860), en hun historische context.* — Het artikel is gewijd aan de analyse van de instrumentele meteorologische waarnemingen aangemaakt door Louis Furet, priester van de *Société des Missions étrangères de Paris*, te Naha, in de huidige Japanse prefectuur van Okinawa, merendeels van december 1856 tot oktober 1860. Deze waarnemingen worden nu bewaard in de bibliotheek van *Météo-France*. Het is een der oudste reeksen van instrumentele meteorologische gegevens in Japan. De waarnemingen grepen vijf keer per dag plaats, om 6 en 10 uur 's morgens, en om 1, 4 en 10 uur 's namiddags. De waargenomen gegevens werden weergegeven in dagelijkse, maandelijkse en jaarlijkse tabellen volgens de instructies die toen geldig waren. Een schets van de vergelijking met het hedendaagse klimaat wordt gemaakt voor de luchttemperatuur en de relatieve vochtigheid. Deze waarnemingen zijn een voorbeeldige bijdrage tot de ontwikkeling van de wetenschappelijke meteorologie in Frankrijk onder de impuls van de *Société météorologique de France* recentelijk gesticht door Charles Sainte-Claire Deville, Furet's voornaamste correspondent, en Émilien Renou.

Keywords. — History of Meteorology; Charles Sainte-Claire Deville; *Société météorologique de France*; Daily Records; Japan.

Summary. — *The Instrumental Meteorological Observations made by Father Louis Furet in Naha, Okinawa (1855-1860), and their Historical Context.* — The paper focuses on the analysis of the instrumental meteorological observations made by Louis Furet, a priest of the *Société des Missions étrangères de Paris*, in Naha, in today's Japanese prefecture of Okinawa, mostly from December 1856 to Octo-

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ber 1860. These observations are now kept at the library of *Météo-France*. This is one of the oldest series of instrumental meteorological data for Japan. Variables were measured five times a day, at 6 and 10 a.m., 1, 4, and 10 p.m. The values obtained were recorded in daily, monthly and yearly tables in compliance with the meteorological instructions in force at the time. A comparison is made with today's climate for air temperature and relative humidity. These observations are an exemplary contribution to the development of scientific meteorology in France under the impetus of the *Société météorologique de France* recently set up by Charles Sainte-Claire Deville, Furet's main correspondent, and Émilien Renou.

1. Introduction

Les six années au total que Louis Furet passe à Okinawa entre 1855 et 1862, dans l'attente de pouvoir gagner le Japon, sont marquées par la dégradation du «Concert européen», cette relative ère de paix entre les puissances européennes instaurée par le Congrès de Vienne (1815) à l'issue des guerres napoléoniennes. Le rapprochement entre la France et le Royaume-Uni, déjà manifeste sous le gouvernement de Louis-Philippe dans le règlement de différends européens, se poursuit et se renforce avec la guerre de Crimée qui met aux prises, d'octobre 1853 à mars 1856, l'Empire russe avec une coalition associant ces deux puissances à l'Empire ottoman et au royaume de Sardaigne. Le conflit s'étend jusqu'au Pacifique Nord où les marines britannique et française mènent de conserve plusieurs opérations contre la flotte et les défenses russes (Stephan, 1969; Érulin, 2008; Rath, 2015). Le missionnaire Furet lui-même y participe de façon marginale. La France, malgré l'infériorité notable de sa force navale, profite de l'ébranlement induit par la *Royal Navy* dans cette région du monde pour y accroître son influence diplomatique et commerciale et pour commencer à établir sa domination sur l'Indochine.

Dans le même temps, le gouvernement des États-Unis entreprend de contraindre le Japon à renoncer à sa politique isolationniste [1]*. Il rassemble à cette fin une puissante escadre qui est placée sous les ordres du commodore Matthew Calbraith Perry (1794-1858). En juillet 1853, celui-ci pénètre avec quatre navires dans la baie d'Edo, siège du gouvernement shogounal. Sa détermination inquiète suffisamment les autorités japonaises pour les décider à prendre en considération, non sans tergiversations, la lettre que le président Millard Fillmore adresse à l'empereur du Japon. En termes courtois, elle invite son pays à nouer des relations d'amitié et de commerce avec les États-Unis et à autoriser leurs navires baleiniers et de transport à se ravitailler ou à s'abriter dans des ports japonais. L'année suivante, comme il l'a annoncé, le commodore Perry revient dans la baie d'Edo, cette fois avec huit navires. La démonstration de force, tempérée par de mutuelles manifestations de bonne volonté, est convaincante et le gouvernement shogounal se résigne à conclure avec les États-Unis, le 31 mars 1854, une convention, dite de Kanagawa. Dans la foulée, le Royaume-Uni et la Russie obtiennent de semblables accords. Les navires de ces pays sont autorisés à relâcher dans les ports de Shimoda et de Hakodate pour y recevoir assistance. Les accords prévoient aussi la possibilité d'envoyer un consul au Japon. Dès l'été 1856, les États-Unis y sont représentés par un consul général, Townsend Harris (1804-1878), qui prend résidence à Shimoda. Assisté d'officiers shogounaux, il s'emploie à préparer un traité d'amitié et de commerce qui sera conclu le 29 juillet 1858. De nouveaux ports sont accessibles aux navires des États-Unis et leurs marchands, banquiers et autres hommes d'affaires autorisés à s'établir dans les ports ouverts. La même année (le 9 octobre), Edo signe des traités avec les Pays-Bas, la Russie, le Royaume-Uni et la France.

* Les chiffres entre crochets [ ] renvoient aux notes, pp. 116-121.

Missionnaires catholiques et orthodoxes, plus récemment protestants, sont déjà présents, plus ou moins tolérés, en Chine et dans les pays voisins. Les traités conclus avec Edo ne leur donnent pas le droit de prêcher la foi chrétienne à la population japonaise. Cela ne leur sera accordé qu'au début des années 1870. Dans les années 1840, alors que déjà court la rumeur qu'une expédition navale se prépare pour ouvrir le Japon par la force, trois prêtres de la Société des Missions étrangères de Paris et un missionnaire protestant britannique viennent résider à Okinawa, l'île principale du royaume des Ryūkyū [2]. Tributaire à la fois de la Chine et du Japon, ce petit royaume semblait être une possible voie d'accès au Japon, et à tout le moins offrir la possibilité de se familiariser avec la langue japonaise que l'on croyait être son idiome. En réalité, depuis le début du XVII^{e} siècle, le fief de Satsuma, au sud de Kyūshū, exerçait sur lui au nom d'Edo une domination aussi discrète que vigilante. En 1846, l'amiral Jean-Baptiste Cécille avait vainement essayé d'y conclure un traité d'amitié et de commerce (Beillevaire, 2022). L'éloignement géographique d'Okinawa et la crainte de représailles contre leur fief retinrent les dirigeants de Satsuma de réagir par la violence aux intrusions étrangères et à l'installation de missionnaires sur l'île d'Okinawa. La tolérance dont ces derniers bénéficièrent n'alla toutefois jamais jusqu'à leur permettre d'enseigner leur religion.

2. Louis Théodore Furet, aperçu biographique

2.1. Années de formation: l'engagement scientifique et missionnaire

Louis Théodore Furet naît à Commer, un village du département de la Mayenne (dans l'ouest de la France), le 25 novembre 1816. Il est le premier fils d'une famille modeste de huit enfants qui vit de petit négoce et d'artisanat. Élève au collège de la ville de Mayenne, il est ensuite formé à la prêtrise au séminaire Saint-Vincent, le grand séminaire du Mans, dans le département voisin de la Sarthe. Pour ses études cléricales, il bénéficie d'une «bourse entière» de l'État [3]. Ordonné prêtre en mai 1839, il n'est pas affecté à une paroisse, mais devient enseignant en sciences et mathématiques au petit séminaire du diocèse du Mans, à Précigné. Encouragé par l'évêque du Mans à reprendre ses études, il se rend à Paris où il suit des cours de mathématiques et de physique avec des professeurs de renom, à la fois au collège Stanislas, qui l'emploie comme préparateur, et à la Sorbonne [4]. En juin 1847, il est fait «bachelier ès sciences mathématiques». Déclinant la proposition qui lui est faite par le directeur du collège Stanislas, l'abbé Alphonse Gratry, ancien polytechnicien, de rester dans l'établissement comme professeur, il retourne enseigner à Précigné. Tout au long de ces années, il a un rôle de précepteur auprès des deux garçons de la famille de Lorière, à Asnières-sur-Vègre, dont il facilita l'admission au collège Stanislas. Cette relation se poursuivra sous forme épistolaire durant les années qu'il passe en Asie avec Madame Clotilde de Lorière et avec son fils aîné, Gustave, attiré par la paléontologie. Généreuse, Madame de Lorière veillera à assurer au missionnaire une aide pécuniaire fort appréciée.

En ce milieu de XIX^{e} siècle, la France rurale, par sa presse, est informée des événements qui accompagnent l'expansion occidentale en Asie [5]. Au sein de l'Église catholique, comme chez les protestants, la conversion de ces populations lointaines suscite un nombre croissant de vocations. Depuis plusieurs années déjà, Furet songe à se faire missionnaire. Ce n'est cependant qu'en 1852, à l'âge jugé tardif de trente-cinq ans, qu'il franchit le pas et intègre le sémi-

naire de la Société des Missions étrangères de Paris, rue du Bac, où l'on prévoit très vite de l'envoyer en Chine pour qu'il rejoigne la mission du Sichuan (fig. 1).

Au cours de l'année qu'il passe rue du Bac, Furet fréquente le Muséum national d'Histoire naturelle, le Collège de France, l'École des Mines, qui joue un rôle important dans le développement de la météorologie, l'Observatoire de Paris [6] et le Dépôt des cartes et plans de la Marine, qui possède son propre bureau météorologique; il se forme aussi aux soins courants dans un hôpital:

> Tous les grands savants de Paris m'accueillent, comme vous le savez, avec beaucoup de bienveillance et me rendent des services. Tout cela, je le dois aux *x* et aux *y*, et aux sciences en *ie* et en *ique* (Beillevaire, 1999, p. 61).

Il ne fait guère de doute que par sa formation scientifique Furet possédait déjà des notions de météorologie, et certainement toutes les dispositions pour en appliquer avec rigueur les protocoles et les calculs. On ignore toutefois selon quelles modalités concrètes il a pu approfondir ses connaissances théoriques et pratiques en ce domaine durant son année au séminaire de la rue du Bac [7].

Fig. 1. — Louis Furet en 1853 à la veille de son départ pour la Chine (source: Archives des Missions étrangères de Paris – AMEP).

Sa formation scientifique fait de Furet une figure à part dans le milieu missionnaire qui est le sien, bien que l'histoire pluriséculaire des missions fournisse nombre d'exemples comparables (Fournier, 1932, pp. 123-128; Van Overmeire, 2023). Mais plus encore le distingue son dessein très tôt arrêté d'associer sciences et diffusion du christianisme, à l'exemple implicite des jésuites «mathématiciens du roi» envoyés en Chine: «grâce à ce que j'ai appris en fait de sciences, j'espère pouvoir rendre service à la science et, par là, à la religion», écrit-il en novembre 1852. Outre son apport à la Société météorologique de France (1852), au cœur de notre sujet, il contribuera, en qualité de correspondant, à la quête de connaissances de deux autres sociétés qui voient le jour en ces années-là: la Société impériale zoologique d'Acclimatation (1854) et la Société d'Ethnographie que fonde en 1858 Léon de Rosny (1837-1914), savant orientaliste, pionnier des études japonaises. Ce dernier édite une dizaine de ses lettres-articles, à la fois récits de voyage et notices ethnographiques (Furet, 1854, 1856, 1859f; Müller, 1861). La recension de fossiles que contient son court article publié dans les *Comptes rendus de l'Académie des Sciences* le fait aussi reconnaître

aujourd'hui comme le pionnier de la paléontologie aux Ryūkyū (Furet, 1859a) [8]. Quand il s'installe enfin au Japon, les cours de mathématiques et de physique qu'il prodigue à de jeunes samouraïs lui font un temps espérer que les autorités voudront bien se montrer tolérantes à l'égard du christianisme. Comme les jésuites en Chine, bien qu'à une échelle plus modeste, Furet a également cherché à séduire les autorités du royaume des Ryūkyū et de Satsuma par des cadeaux d'objets techniques — le plus notable étant un télégraphe électrique envoyé par ses soutiens en France. Pour autant, ses activités scientifiques nous semblent avant tout témoigner d'une adhésion personnelle à l'immense entreprise de déchiffrement, d'inventaire et d'appropriation du monde idéalisée par l'Occident en ce milieu de XIX^{e} siècle.

Les instruments de météorologie que Furet emporte en Chine sont un prêt du Dépôt des cartes et plans de la Marine [9]. En novembre 1852, il adresse au ministère de la Marine et des Colonies «une demande d'instruments pour trois ou quatre mille francs» et se dit «déjà presque assuré qu'on se ferait un plaisir d'écouter [sa] demande» (*ibid.*). La réponse lui parvient au début de l'année suivante par l'intermédiaire du supérieur du séminaire des Missions étrangères, Jean Barran. Dans une lettre du 25 janvier 1853, le ministre de la Marine et des Colonies, Théodore Ducos, fait savoir à celui-ci «qu'à l'exception d'un pluviomètre, le Dépôt des cartes et plans de la Marine [ci-après Dépôt de la Marine] est en mesure de délivrer [au missionnaire Furet] tous les instruments et ouvrages» qu'il a demandés (Archives des Missions étrangères de Paris, ci-après AMEP, vol. 45, pp. 1159-1160). En conséquence, Furet est invité «à se présenter dans l'établissement, 13 rue de l'Université, afin d'en réclamer la remise et d'en donner un reçu». Les instruments ont été calibrés par Alexandre Delamarche, ingénieur hydrographe en chef de la Marine impériale, et ils sont accompagnés du protocole pour leur usage (Furet, 1859b, p. 394) [10]. La correspondance de Furet nous apprend qu'il fut aussi en relation avec le contre-amiral Pierre Mathieu (1790-1870), directeur général du Dépôt de la Marine, et avec Pierre Daussy (1792-1860), ingénieur hydrographe en chef du même établissement, entré au Bureau des longitudes en 1839, président de la Société de Géographie, élu à l'Académie des Sciences en 1855 (Pyenson, 1993, p. 17) [11].

2.2. Premier séjour à Okinawa. Voyage au nord du Japon

Le 19 avril 1853, Furet quitte Paris pour se rendre au Havre et embarquer sur un navire marchand, *Le Bouca*, à destination de la Chine. Après deux escales, à Singapour du 9 au 19 août et à Manille du 29 août au 27 septembre, il arrive à Hong-Kong le 7 octobre 1853 (Beillevaire, s.d., p. 320). C'est au cours de ce voyage, le 20 mai, après être venu à bout du mal de mer, à peu près à la latitude du sud de la Guinée, qu'il commence ses observations météorologiques (Archives de Météo-France, A00045d, ci-après AMF Furet). À la mi-août, de Singapour, il envoie à Charles Sainte-Claire Deville (ci-après Deville) [12], le fondateur de la Société météorologique de France un an plus tôt, les données qu'il a recueillies depuis le 20 mai. Pour la pression atmosphérique, il dit avoir préféré utiliser un des baromètres du capitaine du navire plutôt que risquer d'abîmer le sien qui était «bien amarré». Sa deuxième lettre à Deville, de Hong-Kong, datée du 27 octobre, accompagnait probablement l'envoi de ses observations depuis Singapour [13]. Durant ce voyage, Furet se sert de tableaux imprimés, ce qui ne sera plus le cas par la suite.

À Hong-Kong, Furet loge à la procure des Missions étrangères, dirigée depuis 1842 par Napoléon Libois (1805-1872) [14]. Dans une description de l'île de Hong-Kong adressée à ses

anciens élèves de Précigné, il indique que lors de son ascension de la plus haute montagne de l'île — le pic Victoria, 552 m — il transportait sur son dos *son* thermomètre et *son* baromètre («que je ménageais beaucoup plus que moi-même», précise-t-il), sans doute afin d'en mesurer l'altitude. Cela pourrait laisser entendre qu'il s'est livré à des observations météorologiques durant les quinze mois qu'il passe dans la colonie britannique, mais il n'y en a aucune mention dans ses écrits, ni aucune trace dans les archives de Météo-France ou de la Société des Missions étrangères (Beillevaire, 1999, pp. 94-95).

Le climat de violence engendré par la révolte des Taiping rendant le Sichuan inaccessible, le séminaire de Paris décide d'adjoindre Furet à la mission du Japon, encore virtuelle, dont Libois est alors provisoirement le supérieur. Il va ainsi être envoyé avec deux confrères, Eugène Mermet (1828-1889) et Prudence Girard (1821-1867), sur l'île d'Okinawa, un poste missionnaire ectopique, resté infertile et abandonné sept ans plus tôt, et que peu de temps encore auparavant on ne songeait pas à réactiver. Mais la convention (*compact*) conclue en juillet 1854 par le commodore Perry, à son retour d'un périple à Hakodate (sur l'île d'Ezo, aujourd'hui Hokkaidō), avec le royaume des Ryūkyū a remis en évidence l'intérêt stratégique de ces îles face à un Japon toujours peu enclin à voir les Occidentaux fouler son sol. Le 9 février 1855, la Marine nationale n'ayant pas d'unité disponible, les missionnaires embarquent avec deux domestiques chinois sur un navire marchand, *Le Lion* [15]. Ils arrivent le 26 février 1855 à Naha (Nafa dans le parler local), port principal de l'île d'Okinawa que les Occidentaux appellent alors communément, se fondant sur la prononciation chinoise du nom Ryūkyū, «Grande île Lou-tchou», «Great Loochoo» ou «Great Lew Chew», entre autres graphies.

Comme leurs prédécesseurs, les missionnaires sont hébergés au Seigenji, le petit monastère shingon d'Ameku (Amiku), quartier du village de Tomari (Tumai) proche du rivage, à la lisière nord de Naha. Les tableaux d'observation de Furet débutent le 2 avril. Ils s'arrêteront dès le 4 mai. Sa correspondance laisse toutefois penser qu'il a commencé ses observations un jour plus tôt et qu'il les poursuit encore, au moins pour la température, le 5 mai:

> La température doit être favorable à la santé. Depuis le 1er avril jusqu'au 5 mai [1855], le thermomètre à minima n'est pas descendu au-dessous de 14° centigrades, et le thermomètre ordinaire n'a pas dépassé 28,4° [16]… D'ailleurs, le froid doit être bien modéré pendant l'hiver, puisque, au commencement de mars, on récolte des patates (Furet, 1856, p. 127; 1860b, pp. 12-13).

Furet ne fait alors de relevés que quatre fois par jour, à 4 h et 10 h du matin, 2 h et 6 h de l'après-midi ou «soir», aux mêmes heures que durant sa traversée du Havre à Hong-Kong. Des relevés à 4 h 30 du soir remplacent parfois ceux de 6 h. Des valeurs font défaut à certaines heures de relevé et aucune n'est mentionnée du 23 au 28 avril, sans raison connue. Les données recueillies durant ces vingt-six jours d'observations effectives tiennent sur deux feuilles dont le quadrillage a été accentué par des traits au crayon et à l'encre. Les heures des relevés forment une colonne à gauche. Celle-ci est suivie de sept autres colonnes intitulées: «Hauteur [barométrique] observée», «Température du mercure», «Thermomètre», «Force et direction du vent», «Abondance des nuages», «Forme des nuages», «Pluie». S'ajoute une huitième colonne où sont notées, seulement à partir du 10 avril, les valeurs du «Thermomètre à minima». Les numéros des jours dans le mois segmentent horizontalement ces colonnes.

À sa grande surprise, début mai, deux mois seulement après son arrivée, Furet se voit proposer de quitter temporairement Okinawa. C'est en effet sur lui, sans doute en raison de son âge,

que s'est porté le choix du procureur Libois pour répondre à une demande du contre-amiral Adolphe Laguerre (1792-1862), commandant en chef la division navale de La Réunion et de l'Indochine. La Marine française était alors engagée avec la *Royal Navy* dans des opérations navales contre la flotte russe du Pacifique, composantes sans grandes conséquences, après le cuisant échec du siège de Petropavlovsk en septembre 1854, du conflit qui avait pour théâtre principal la Crimée (Érulin, 2008). Une nouvelle expédition au nord du Japon était en préparation et l'amiral Laguerre pensait qu'un interprète pourrait être utile dans d'éventuelles discussions avec les autorités japonaises (Furet, 1857c, pp. 306-307). Malgré une connaissance du japonais encore balbutiante, Furet ne se fit guère prier pour accepter l'invitation avec le secret dessein, partagé avec Libois et sans doute aussi avec l'amiral Laguerre, d'explorer les possibilités d'établissement à Hakodate, port déjà fréquenté par quelques Occidentaux. Ainsi s'éloigne-t-il d'Okinawa au matin du 7 mai 1855 à bord de la frégate *La Sibylle* [17] aux ordres d'un capitaine de vaisseau prompt à aider les missionnaires, Louis Simonet de Maisonneuve (1809-1879).

À Nagasaki, où elle mouille le 18 mai, *La Sibylle* rallie *Le Colbert* et *La Constantine*, les deux autres bâtiments composant la division française en partance pour le nord. Celle-ci est sous le commandement du capitaine de vaisseau Tardy de Montravel [18], temporairement chef de la station française en remplacement de l'amiral Laguerre reparti vers la France. Furet est alors sidéré de se voir enjoindre par cet officier de quitter l'expédition en raison du danger que représenterait l'apparition d'un missionnaire sur le sol japonais «et pour la politique de la France et pour la religion elle-même» (Beillevaire, 1999, p. 11). Malgré ses protestations indignées, il n'a d'autre choix que d'embarquer sur *Le Syngapore* en direction de Shanghai où il est accueilli par la mission jésuite de Xújiāhuì. Un mois plus tard, début juillet, il se retrouve à Hong-Kong sans possibilité de regagner Okinawa. Il écrit aussitôt au ministre de la Marine pour l'informer de sa cruelle déconvenue et se plaindre de l'intransigeance du commandant Tardy de Montravel (AMEP, vol. 568, pp. 1011-1038).

Au printemps 1856, le contre-amiral Nicolas François Guérin [19] organise une troisième expédition vers le nord, avec *La Virginie* et *La Sibylle*, dans le but d'évaluer ce qu'il reste des défenses russes dans le détroit de Tartarie. Furet, invité à s'y joindre avec un autre prêtre des Missions étrangères, Pierre Mounicou (1825-1871), embarque à nouveau sur *La Sibylle*, le 6 avril, où il a le plaisir de retrouver le commandant de Maisonneuve (Furet, 1857a,b). Avant de gagner le détroit de Tartarie, les bâtiments français jettent l'ancre à Hakodate le 20 mai 1856. Visitant la ville en compagnie d'officiers français, Furet se convainc, malgré la bonhomie de la population, qu'il est trop tôt pour envisager de s'y installer, la France, du reste, ne pouvant encore se prévaloir d'aucun accord avec le Japon.

L'expédition donne à Furet l'occasion de cohabiter longuement avec le chirurgien-major de *La Sibylle*, également météorologue et naturaliste, Jean Barthe, et comme lui en relation avec Deville [20]. Aussi n'a-t-il pu manquer d'être le témoin des observations météorologiques que celui-ci faisait quotidiennement à bord du navire. Pourtant, hormis deux allusions épistolaires à ce compagnon de voyage, où son nom n'apparaît même pas, les écrits de Furet, comme pareillement ceux de Barthe, sont curieusement muets sur leur rencontre et leur intérêt commun pour la météorologie [21]. Cette apparente ignorance réciproque surprend d'autant plus que c'est à Barthe que Furet confie les observations qu'il a faites au Seigenji pour qu'il les rapporte en France et les remette à Deville. On verra plus loin que dans sa communication à l'Académie des Sciences Deville indique en effet avoir reçu de Barthe, rentré en France en septembre 1857, des relevés météorologiques de Furet qui ne peuvent être, en raison des dates, que ceux du Seigenji.

2.3. Retour à Okinawa. Le poste d'observation de Kumemura

Au terme de l'expédition, *La Sibylle* reconduit Furet sur la côte chinoise. Deux mois plus tard, le 26 octobre 1856, l'amiral Guérin, sur *La Virginie*, le dépose à Naha avec son confrère Mounicou. De grands changements sont intervenus dans les conditions de vie des missionnaires. Le 24 novembre 1855, l'amiral Guérin a arraché au royaume des Ryūkyū, sous la menace des armes, une «convention» qui autorisait de fait les Français à louer des terres, clause difficile à accepter pour le royaume et bien sûr destinée à bénéficier en priorité aux missionnaires (Beillevaire, 2023) [22]. Ceux-ci se firent aussitôt construire une grande maison sur la colline Matsuo à Kumemura (Kuninda), un quartier périphérique de Naha habité principalement par une population d'ascendance chinoise (fig. 2). Ils y emménagèrent au début de l'année 1856. La maison était entourée d'un terrain assez vaste dont une partie fut transformée en jardin vivrier. Furet s'y essaiera à la culture de plantes allochtones et à l'élevage de volailles du cru. L'isolement de cette maison continua à tenir les Français éloignés de la population et rendit tout aussi aisée la surveillance dont ils ne cessèrent de faire l'objet. Les officiers du royaume allaient pourtant devoir bientôt faire assaut de prévenances à leur égard sur ordre du seigneur de Satsuma, Shimazu Nariakira (1809-1858), qui mûrissait le projet de commercer avec la France en usant de leurs bons offices pour nouer contact avec les autorités françaises (Beillevaire, 2010). C'est dans ce nouvel environnement que Furet reprend ses observations météorologiques le 18 décembre 1856, si l'on se fonde sur les tableaux journaliers, après une césure de près de vingt mois.

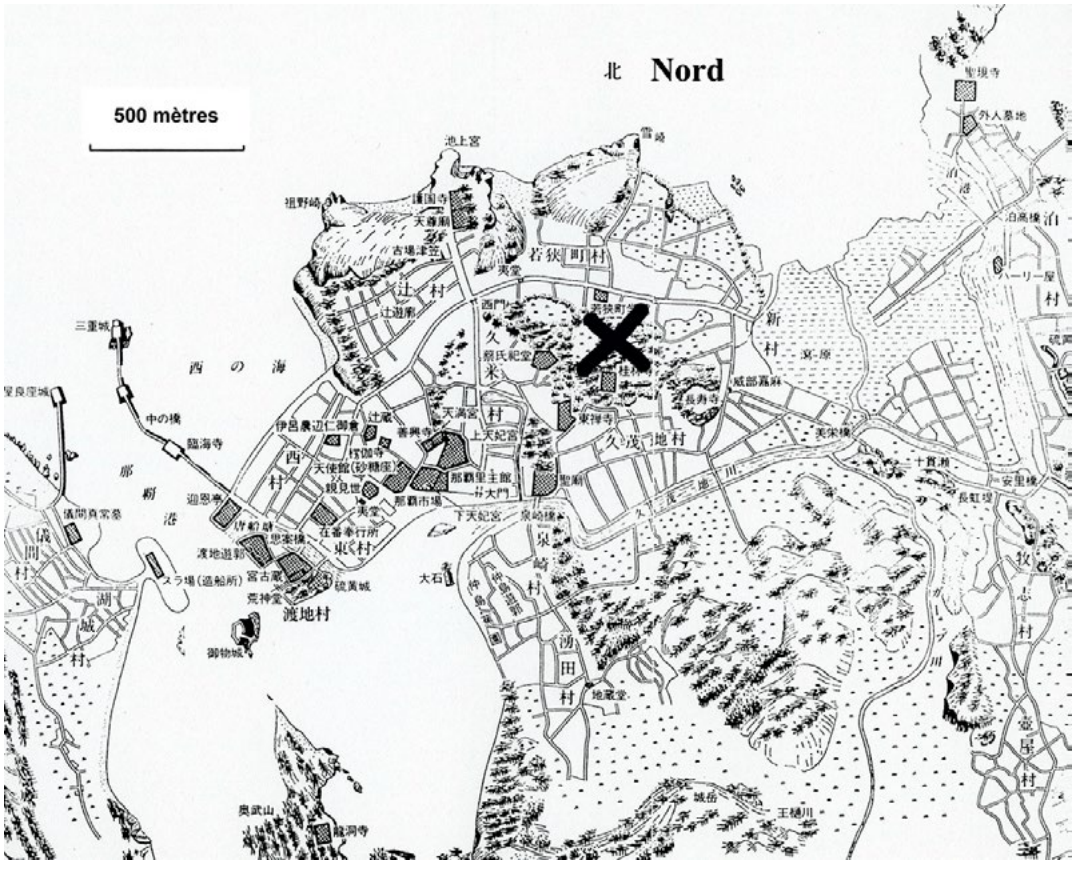


Fig. 2. — Emplacement de la maison des missionnaires à Kumemura (source: *Kyūyō*, Kadokawa shoten, 1974).

2.4. Les années japonaises. Renoncement à la vie missionnaire

Furet ne quittera définitivement Okinawa que six ans plus tard, en octobre 1862, en compagnie de Bernard Petitjean arrivé en octobre 1860 [23]. Leur départ signa l'abandon de cet avant-poste missionnaire demeuré sans ouailles, où Furet et ses confrères n'auront pu que s'initier à la langue et à la culture japonaises auprès de maîtres locaux. Un navire de guerre français les conduisit à Yokohama d'où Furet repartit en janvier 1863 pour ouvrir une mission à Nagasaki. Petitjean l'y rejoignit quelques mois plus tard (Furet, 1864). Le gouverneur de Nagasaki, ville administrée par le pouvoir shogounal, invita Furet à enseigner les mathématiques et la physique, puis Petitjean le français et la géographie, dans le collège d'études occidentales qui y avait été ouvert peu d'années auparavant (Beillevaire, 2008).

Une très longue permission en France, de décembre 1864 à février 1866, rendit difficile la réadaptation de Furet au Japon à un moment où la prise en charge de descendants des convertis des XVI^{e} et XVII^{e} siècles mobilisait jour et nuit ses confrères. En mai 1867, il est affecté à l'arsenal franco-japonais de Yokosuka, au sud de la baie d'Edo, où il œuvre à la fois comme aumônier auprès des employés français et comme enseignant à l'école préparant de jeunes Japonais de la classe guerrière à des fonctions d'encadrement. Mais les bouleversements causés par l'effondrement du régime shogounal ne font qu'accroître son inconfort moral et intellectuel. Finalement, il préfère renoncer au travail missionnaire et rembarque définitivement pour la France en octobre 1869, dans la deuxième année de l'ère Meiji inaugurée par la restauration du pouvoir impérial. Il connaît ensuite l'existence d'un curé de paroisse au sein du diocèse de Laval, de création récente, auquel ses origines le rattachaient (Beillevaire, 1999, et s.d.). Après avoir officié dans le village de Chantrigné, il est nommé en 1875 curé de la paroisse Notre-Dame-des-Cordeliers à Laval et fait chanoine honoraire en décembre 1876. Il meurt dans sa paroisse le 15 janvier 1900, âgé de quatre-vingt-trois ans. Les souvenirs qu'il a rédigés sur ses années passées en Asie restent muets sur ses activités de météorologue.

3. Les observations météorologiques de Furet dans la littérature

Alors que Furet poursuit ses observations à Naha, celles-ci font déjà l'objet d'une communication de Deville à l'Académie des Sciences, le 21 février 1859. La séance est présidée par les commissaires Léonce Élie de Beaumont, secrétaire perpétuel de l'Académie, que Furet a rencontré à Paris en 1852 et auquel il écrit de Naha [24], Claude Pouillet [25] et Deville lui-même. Ce dernier a alors en main les relevés accumulés par Furet à Kumemura durant plus de vingt et un mois consécutifs, de décembre 1856 à septembre 1858, et il n'est question que de ceux-là (les brèves observations faites en 1855 au Seigenji ne sont même pas mentionnées). Il est donc surprenant que Deville cite la «bonzerie d'Amikou, près de Nafa» (le Seigenji) comme étant le lieu où Furet aurait fait toutes ses observations et qu'il ignore son installation à Kumemura en octobre 1856. De ces documents, écrit-il aussi, «la majeure partie [lui] a été transmise par l'habile et zélé chirurgien de *La Sibylle*, M. le Dr. Jean Barthe». Mais celui-ci, on l'a dit, est rentré en France dès septembre 1857, après un voyage d'exploration dans le golfe Persique, et il n'a donc pu en aucune façon transmettre les observations faites par Furet à partir de décembre 1856 (Furet, 1859b; Beillevaire *et al.*, 2018, p. 125). Deville, homme de science très affairé, s'est assurément mépris.

La correspondance de Furet nous renseigne en fait précisément sur la chronologie et les modalités de ses envois à Deville après son installation à Kumemura. Le nom de Barthe en est absent. Joint à une lettre datée du 10 novembre 1857, Furet adresse à Jean Tesson, directeur au séminaire parisien des Missions étrangères, un premier «petit paquet [qui] renferme [ses] observations météorologiques d'une année à peu près», c'est-à-dire de décembre 1856 à octobre 1857. Il pense que Tesson pourrait avoir plaisir à les voir avant de les faire remettre, comme il l'en prie, à Deville (AMEP, vol. 568, pp. 1152-1153). C'est un navire ryūkyū qui les a acheminées en Chine, à Fuzhou, où le royaume des Ryūkyū possédait un comptoir. De là, elles sont parvenues à la procure de Hong-Kong vers la mi-janvier 1858, puis en France, probablement en mars. Le second envoi de Furet est directement adressé à Deville avec une lettre en date du 10 octobre 1858 (AMF Furet). Il contient ses observations de novembre 1857 à septembre 1858, ainsi qu'une description de la comète Donati en date du 25 octobre (sur cette comète, voir plus bas). Le courrier est délivré le 31 octobre à Hong-Kong par *Le Prégent*, de la Marine nationale, qui accomplit la traversée depuis Naha en un temps record de cinq jours. Deux ou trois mois auront ensuite été nécessaires pour que ces observations parviennent à leur destinataire.

Dans sa communication, Deville indique que, «conformément aux instructions que le P. Furet avait bien voulu [lui] demander à son départ», ses observations journalières portent sur les données barométriques et thermométriques, la température de l'air et son état hygrométrique, «d'après les indications comparatives d'un thermomètre à boule sèche et d'un thermomètre à boule humide». En outre, ajoute-t-il, ses feuilles d'observation fournissent «des données sur l'état du ciel, sur la force et la direction du vent, sur l'abondance et la nature des nuages; enfin, sur les phénomènes extraordinaires, tels que typhons, tremblements de terre, etc.».

Le texte de la communication, aussitôt publié dans les *Comptes rendus hebdomadaires des Séances de l'Académie des Sciences*, contient trois tableaux. Le premier présente les «températures moyennes calculées d'après trois observations diurnes (6 h du matin, 1 h et 10 h du soir)» pour chaque mois, entre décembre 1856 et septembre 1858; le deuxième, «les variations diurnes et annuelles du baromètre à Nafa» entre décembre 1856 et novembre 1857. L'oscillation diurne y est définie comme la différence entre les valeurs à 10 h du matin et à 4 h du soir. Deville met en exergue les valeurs extrêmes relevées par Furet pour ces deux variables, température et pression barométrique:

> La température la plus basse a été de 9,1°, le 23 février 1858 [26]; [la température la] plus haute, 33,7°, le 17 juillet de la même année [27].
>
> Minimum barométrique, le 18 mai 1857: 721,4 mm [28] – Maximum barométrique, le 31 décembre 1857: 773,1 mm [29].

Il fait aussi remarquer que la «hauteur barométrique moyenne déduite des cinq valeurs diurnes» est bien moindre que celle observée à la même latitude aux îles Canaries, et presque identique à celle relevée en France sur les côtes de la Normandie, oubliant du reste que, conformément aux instructions, Furet calcule la hauteur barométrique moyenne à partir de seulement quatre observations quotidiennes, à 6 h et 10 h du matin, 1 h et 4 h du soir (voir plus loin; Anonyme, 1852, p. 20).

Dans un troisième tableau, Deville reproduit les chiffres traduisant la marche du baromètre (réduit à zéro et corrigé) et celle du thermomètre lors du typhon du 18 mai 1857 [30]. Sa pré-

sentation se termine par la liste des onze tremblements de terre décrits par Furet entre mars 1857 et septembre 1858, phénomènes dont la survenue n'est pas encore sûrement dissociée des événements météorologiques [31]. La communication de Deville est aussitôt mentionnée ou résumée dans les revues *Cosmos* et *L'Institut, Journal universel des Sciences et des Sociétés savantes en France et à l'Étranger* (Furet, 1859d,e).

Dans la rubrique «correspondance» du même tome des *Comptes rendus hebdomadaires des Séances de l'Académie des Sciences* est publiée une «notice» sur la faune, la flore, la géologie et les fossiles des «îles Lou-Tchou», synecdoque pour la partie sud de l'île d'Okinawa, que Furet a envoyée à son secrétaire Élie de Beaumont (Furet, 1859a). Celle-ci se conclut sur une recension des secousses telluriques:

> Je ne dois pas, en faisant connaître le terrain de Lou-Tchou, oublier une chose qui peut avoir son importance, c'est que les tremblements de terre sont fréquents; les secousses sont très sensibles, cependant il n'y a pas de dégâts. Du mois de mars 1857 au mois de février inclusivement 1858, j'en ai observé six dans les mois suivants: mars, avril, octobre, décembre, janvier, février. Dans l'un de ces tremblements de terre, j'ai cru remarquer que le mouvement de l'oscillation était du nord au sud (Furet, 1859c).

Les observations météorologiques de Furet commentées par Deville ont fait l'objet de signalements et de traductions dans plusieurs revues ou livres hors de France (Furet, 1860a, 1872; Rein, 1876, p. 36, 1881, pp. 146-147, 1884 et 1998, pp. 128-129). De son côté, Furet eut l'occasion de les communiquer à un officier de la Marine américaine, le lieutenant John Mercer Brooke (1826-1906), qui fit escale à Naha du 3 au 12 juillet 1859 aux commandes du schooner *Fenimore Cooper*. Ce dernier est venu une première fois à Okinawa en 1855 avec la mission d'exploration et d'étude du Pacifique Nord qui s'est déroulée de 1853 à 1856. Celle-ci est reprise en 1858 sous sa direction. Son journal relate que Furet lui a transmis *some valuable records* concernant la pression barométrique, la température, l'humidité relative et la direction des vents durant les «trois dernières années», ainsi qu'un relevé des tremblements de terre observés en 1858 et au premier semestre de 1859. Il rapporte que le baromètre de Furet s'est brisé l'année précédente, incident sur lequel nous allons revenir (Brooke, 1986, pp. 107-110). Ces données, qui auraient pu compléter les observations de la Marine américaine, ont, semble-t-il, été perdues dans le naufrage du *Fenimore Cooper* survenu peu après, le 23 août, dans la baie de Kanagawa.

Dans son *Annuaire* pour 1861 la Société météorologique de France mentionne qu'elle «a reçu du P. Furet des observations faites aux îles Loutchou (Lieou-Kieou)», probablement par l'intermédiaire de Deville (Furet, 1861). La possibilité de les retrouver restait incertaine lorsque les auteurs du présent article ont attiré l'attention sur leur intérêt potentiel pour l'histoire de la météorologie au Japon (Demarée *et al.*, 2013, 2015). Dès leur découverte à la bibliothèque de Météo-France à Saint-Mandé en novembre 2015, ils ont entrepris de les faire connaître et d'en exploiter le contenu en collaboration avec des historiens météorologues japonais. Il en est résulté une série d'articles accueillis notamment par la grande revue de géographie *Chigaku Zasshi*. Les observations de Furet et ses premiers travaux sont cités par Mikami Takehiko dans son récent ouvrage, *The climate of Japan: Present and past* (Mikami, 2023, pp. 119-123).

4. Institutions et instructions météorologiques

C'est dans la première moitié du XIX^{e} siècle que la météorologie, alors objet d'une sorte d'engouement avec la popularisation du baromètre, dépasse véritablement le stade de l'observation naïve et des discours spéculatifs pour amorcer sa transformation en une science rigoureuse nourrie de chiffres, de calculs et d'une phénoménologie précise. Pour l'essentiel, les instruments sont ceux du siècle précédent et c'est surtout à travers la création d'institutions nationales, comme c'est le cas à Bruxelles en 1826 ou à Saint-Pétersbourg en 1834, que ce changement s'opère.

En France, dès 1801, le ministre de l'Intérieur, Jean Antoine Chaptal (1756-1832), chimiste et médecin, crée le Bureau de la statistique qui fait appel aux préfets pour que soient recueillies des informations météorologiques pouvant être utiles à la rédaction de mémoires statistiques. Le naturaliste Jean-Baptiste de Lamarck (1744-1829), qui ambitionne d'établir une «météorologie statistique», le convainc de créer un organisme dédié à la centralisation et à l'analyse des observations météorologiques instrumentales qu'il souhaiterait voir bientôt conduites dans tous les départements «par l'effet des Lumières et du zèle des préfets» (Corsi, 2001, pp. 61, 82; Demarée, 2023, pp. 73-74). Ce premier projet d'une science météorologique fondée sur la statistique s'avère aussitôt être un échec. Si avec Chaptal, comme l'écrit Lamarck, «la France […] a pris l'initiative sur les autres pays de l'Europe», il n'en est plus de même en 1841, lorsque le Bureau de la statistique du ministère de l'Agriculture et du Commerce demande aux préfets de rassembler les observations de «météorologie pure», contemporaines ou anciennes, pour combler le retard de la statistique météorologique française par rapport à celles dont disposent déjà Italiens, Britanniques ou Allemands (Locher, 2009). Mais c'est là aussi un échec, en partie à cause de l'exigence de ne retenir que des observations dénuées d'hypothèse ou de finalité particulières.

Cette démarche va toutefois trouver un écho direct, un peu plus tard, dans le patient travail d'observation météorologique quotidien auquel s'astreint à Versailles Julien Haeghens [32], bientôt rejoint par Adolphe Bérigny [33]. Très vite leur apparaît la nécessité de former un réseau d'observatoires pour produire une statistique météorologique fiable couvrant tout le pays et, en mars 1847, ils prennent l'initiative de lancer un appel auprès des professeurs de sciences des lycées et facultés en vue de la création d'un annuaire météorologique. Charles Martins [34], professeur à Montpellier, leur apporte un soutien décisif. Deux ans plus tard paraît l'*Annuaire météorologique de la France pour 1849* [35].

Écrivant au nom des «trois amis de la Météorologie», c'est Martins qui en signe l'introduction programmatique avec pour exorde cette affirmation: «Il est des sciences qui ne peuvent progresser que par l'association; la Météorologie est de ce nombre» (Haeghens, Martins & Bérigny, 1848). La priorité est de réunir et de publier «les observations que des savants pleins de zèle et de désintéressement rassemblent sur divers points de la France», mais qui, demeurant confidentielles ou locales, ne sont qu'accumulation de «chiffres stériles et muets». Soumis aux calculs et à d'adéquates réductions, ceux-ci pourraient au contraire se convertir en «nombres féconds en résultats scientifiques et en applications variées». Dans l'immédiat, il faut veiller à la qualité des instruments et à leur utilisation correcte, donc à la formation des observateurs. Toutes raisons qui amènent Martins à dire combien il serait nécessaire de créer une association météorologique nationale, ce que, selon lui, seul l'État est à même de faire:

> Deux cents stations convenablement espacées à la surface de la France, seraient suffisantes. Ces stations existent, ce sont les télégraphes: en quelques jours leurs employés, habitués déjà par la nature de leur service à l'exactitude et à l'observation, seraient mis au fait de la lecture et de l'emploi des instruments météorologiques [36]. Réunies à celles que nous possédons déjà, ces nouvelles séries météorologiques permettraient de dresser au bout de dix ou douze ans un tableau complet de notre climat (Haeghens *et al.*, 1848).

L'enjeu plus lointain est de faire de la météorologie, par le suivi, la comparaison et les corrélations, «une science aussi positive que la physique expérimentale», ce qui ne pourra se réaliser qu'avec «un réseau d'observatoires […] couvrant toute la surface du globe» (*ibid.*).

En août 1852, devant les difficultés de financement récurrentes de l'*Annuaire météorologique de la France* qui contrarient son souhait d'y publier ses propres observations [37], Émilien Renou sollicite Deville, son ancien condisciple à l'École des Mines, alors vice-président de la Société géologique de France, pour qu'il mobilise les scientifiques afin de constituer une société météorologique nationale [38]. Le projet rallie rapidement beaucoup de soutiens et, en décembre, la Société météorologique de France tient sa première réunion et se dote de statuts. Parmi ses adhérents se trouvent beaucoup d'éminents scientifiques, pas moins de dix-huit membres de l'Académie des Sciences, notamment des géologues et des physiciens du globe, à la discipline desquels se rattache la météorologie, mais aussi des agronomes, des médecins et des géographes. Sa revue, l'*Annuaire de la Société météorologique de France*, commence à paraître dès 1853, prenant le relais de l'*Annuaire météorologique de la France* qui n'aura connu que quatre livraisons.

En août et septembre 1853, sur la proposition de Matthew Fontaine Maury [39], lieutenant dans la Marine des États-Unis, se tient à Bruxelles la «Conférence maritime pour l'adoption d'un système uniforme d'observations météorologiques à la mer» (*Maritime Conference…*, 1853; Delamarche, 1853; De Ridder, 1979). Elle est présidée par Adolphe Quetelet, directeur de l'Observatoire royal de Bruxelles [40]. Les minutes de la conférence sont aussitôt publiées, accompagnées d'un tableau modèle regroupant les variables observées en mer. Dans le sillage immédiat de cette conférence internationale, au cours de la même année 1854, au Royaume-Uni Robert FitzRoy crée un petit service météorologique au sein du *Board of Trade* qui, peu après, devient le *Meteorological Office* ou *Met Office* [41], et le roi des Pays-Bas, Guillaume III, le *Koninklijk Nederlands Meteorologisch Instituut* (KNMI) dont la direction est confiée à Christoph Buys Ballot [42].

La conférence de Bruxelles, relayée par les institutions nationales, fut l'amorce d'un processus d'uniformisation des systèmes de mesure et des procédures, condition nécessaire à l'avènement d'une climatologie comparée et d'une météorologie prévisionnelle. Avant même cette conférence, l'*Annuaire météorologique de la France* donnait des directives concernant les baromètres (Delcros, 1848), les thermomètres, les instruments d'hygrométrie, les tables psychrométriques (Haeghens, 1848a,b) et les pluviomètres (Lortet, 1851; Haeghens, 1851). Au sein de la Société météorologique de France, Renou publie des instructions sur la disposition et la méthode d'exploitation des stations météorologiques visant à unifier les règles d'observation et les mesures. Il aborde ainsi la question du choix des horaires auxquels il convient d'effectuer les relevés diurnes et nocturnes. Dans les stations météorologiques les moins importantes, il prescrit de ne faire des relevés que toutes les trois heures en commençant à 1 h du matin, ce qui permet de disposer des valeurs relevées à 4 h et 10 h du matin, 4 h et 10 h du

soir, ces quatre valeurs devant seules, selon lui, servir à établir les minima et maxima de la pression atmosphérique et les moyennes de la température de l'air (Renou, 1855, 1858).

5. «Instruction sur les observations météorologiques à faire dans les hôpitaux coloniaux» (1852)

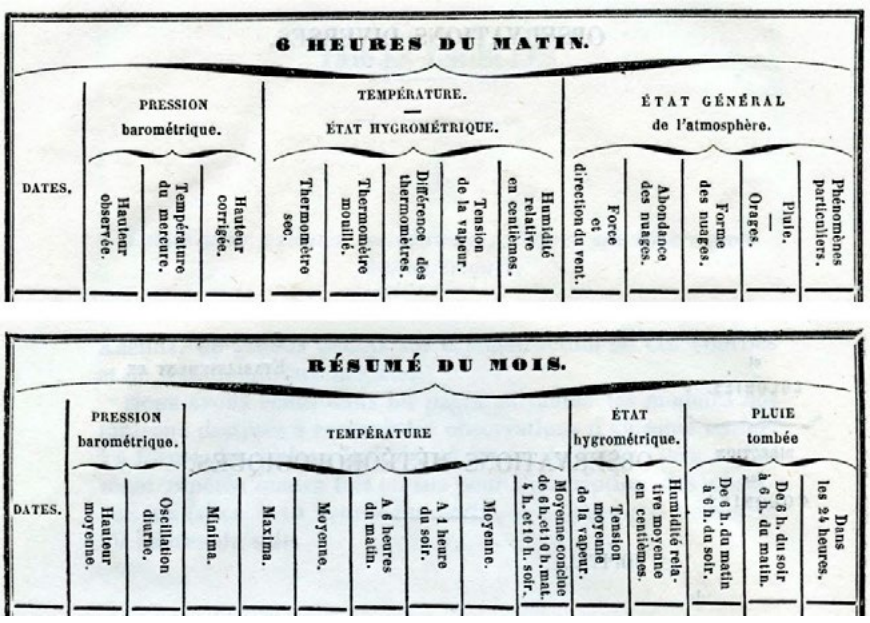
Furet ne nous renseigne pas sur les publications qu'il a consultées pour conduire ses observations et en traiter les données. Une recherche bibliographique approfondie sur la littérature disponible avant son départ pour la Chine et l'examen de ses tableaux d'observation et de ses calculs nous ont toutefois convaincus qu'il s'est certainement appuyé sur l'article «Instruction sur les observations météorologiques à faire dans les hôpitaux coloniaux» paru en 1852 dans la *Revue Coloniale*. Cet article, qui fut une référence pour de nombreux observateurs, sera réédité avec quelques modifications en 1874 par la *Revue Maritime et Coloniale* (Anonyme, 1874). Un opuscule au contenu comparable paraît entre-temps avec presque le même titre: *Instruction sur les observations météorologiques à recueillir dans les hôpitaux militaires* (Anonyme, 1864). Une analyse fine des moyennes journalières barométriques et thermométriques des «résumés du mois» de Furet montre qu'elles ont été calculées en suivant à la lettre l'article de 1852. Nous avons vérifié, en particulier, que les corrections de température apportées aux valeurs barométriques pour le calcul de leurs moyennes résultent bien de l'application de la formule de Haeghens (ou de «Delcros-Haeghens») ou des tables psychrométriques que l'on y trouve, la première comme les secondes (Anonyme, 1852, p. 32, *sq*.; Delcros & Haeghens, 1853):

$$h_t = h - h\,(0.0001614\,t) \text{ ou } h_t = h\,(1 - \tfrac{t}{6196})$$

(Formule où h est la pression barométrique, t la température en° C lue sur le thermomètre du baromètre et h_t la pression atmosphérique corrigée pour la température.)

Anonyme, cette «Instruction» est influencée par l'hypothèse néo-hippocratique, toujours en vogue au milieu du XIX^{e} siècle, selon laquelle il existerait «des relations positives entre les épidémies et certains phénomènes météorologiques» (Anonyme, 1852, pp. 1-2; Demarée, 1996, 2004; Beillevaire *et al.*, 2018, pp. 133-137). Jusqu'à la «révolution microbienne» initiée par Louis Pasteur et Robert Koch, l'hypothèse conservera sa validité, surtout dans un contexte colonial d'hygiène défaillante et de méconnaissance des pathogénies courantes [43]. L'«Instruction» se donne ainsi pour but d'apporter «régularité et uniformité» aux observations de l'atmosphère que médecins et officiers de santé s'appliquent à faire dans les pays d'outre-mer, afin de pouvoir en tirer tous les enseignements.

À la fois théorique et pratique, l'article fournit des explications et des conseils relatifs au fonctionnement et à l'usage des instruments, au recueil des données, au calcul des moyennes et aux corrections, à la confection des tableaux d'observations journalières et des résumés du mois (fig. 3). Les variables à observer sont la température de l'air, la pression atmosphérique, l'hygrométrie, l'état général de l'atmosphère, la pluviométrie, ainsi que les phénomènes d'optique atmosphérique et tous les phénomènes exceptionnels ou singuliers, notamment les tremblements de terre, les ouragans, les raz-de-marée et les sécheresses.



6 HEURES DU MATIN.

DATES.	PRESSION barométrique.			TEMPÉRATURE. — ÉTAT HYGROMÉTRIQUE.					ÉTAT GÉNÉRAL de l'atmosphère.					
	Hauteur observée.	Température du mercure.	Hauteur corrigée.	Thermomètre sec.	Thermomètre mouillé.	Différence des thermomètres.	Tension de la vapeur.	Humidité relative en centièmes.	Force et direction du vent.	Abondance des nuages.	Forme des nuages.	Orages. — Pluie.	Phénomènes particuliers.

RÉSUMÉ DU MOIS.

DATES.	PRESSION barométrique.		TEMPÉRATURE							ÉTAT hygrométrique.		PLUIE tombée		
	Hauteur moyenne.	Oscillation diurne.	Minima.	Maxima.	Moyenne.	A 6 heures du matin.	A 1 heure du soir.	Moyenne.	Moyenne conclue de 6 h. et 10 h. mat. à 5 h. et 10 h. soir.	Tension moyenne de la vapeur.	Humidité relative moyenne en centièmes.	De 6 h. du matin à 6 h. du soir.	De 6 h. du soir à 6 h. du matin.	Dans les 24 heures.

Fig. 3. — Tableaux modèles de l'«Instruction» de 1852 pour les cinq relevés journaliers, tous identiques, et pour les résumés du mois.

Furet ne nous renseigne pas non plus sur les instruments qu'il utilise. Sa lettre à Deville du 10 octobre 1858, dans laquelle il l'informe du bris de son baromètre, nous apprend toutefois qu'il disposait jusqu'alors d'un «baromètre de Bunten», du reste jugé «incommode à cause des additions», ce qui lui fait souhaiter pouvoir à l'avenir utiliser un «baromètre à lecture unique» (AMF Furet) [44]. S'agissant du thermomètre à minima, il est probable que Furet avait avec lui un thermomètre à alcool de type Rutherford, facilement transportable et d'usage courant à la Société météorologique de France. L'«Instruction» de 1852 le recommande comme étant «le meilleur et le plus simple» (Rutherford, 1794; Anonyme, 1852, p. 4; Walferdin, 1854). On ne sait à quel endroit de la maison ou du jardin étaient placés les instruments, ni comment il procédait pour déterminer la direction du vent et des nuages. Pour le thermomètre et le baromètre, il n'y a guère à douter qu'il ait respecté les instructions communes concernant les conditions d'aération et de protection contre les rayons solaires et les courants d'air.

Le Dépôt de la Marine n'ayant pas procuré à Furet de pluviomètre, et lui-même n'en ayant apparemment jamais fabriqué, l'abondance de la pluie n'a pas été mesurée et a seulement fait l'objet de descriptions et d'estimations qui vont de 1 à 5, comme le préconise l'«Instruction» de 1852 (voir en annexe le tableau complet des précipitations notées par Furet). Pour la direction du vent, celle-ci suggère de la définir par rapport à une rose des vents à seize directions ou aires de vent. Son intensité est évaluée sur une échelle à huit degrés, 0 correspondant au calme et 7 à un ouragan ou typhon. Pour la nébulosité, l'échelle va de 0 à 4, et les types de nuages sont indiqués par les deux premières lettres de leur nom (tab. 1).

Tableau 1

Échelles d'évaluation du vent et de la nébulosité, et désignations des types de nuages dans l'«Instruction» de 1852

(0)	calme
1	fraîcheur, léger souffle
2	petite brise, faible brise, vent faible
3	jolie brise, vent modéré
4	brise fraîche, joli frais, belle brise, bonne brise, vent fort
5	grand frais, bon frais, vent très-fort
6	tempête
7	ouragan

0	ciel entièrement serein et pur
1	ciel au quart environ couvert de nuages
2	ciel à moitié couvert de nuages
3	ciel aux trois quarts
4	ciel entièrement couvert

Cirrus	Ci.
Cumulus	Cu.
Stratus	St.
Nimbus	Ni.
Cirro-cumulus	Ci-cu.
Cirro-stratus	Ci-st.
Cumulo-stratus	Cu-st.

6. Tableaux d'observations journalières, résumés du mois et synthèses annuelles. Métadonnées

Ni les tableaux des observations faites au Seigenji d'Ameku, restés sommaires et qui ne seront pas pris en compte ici, ni ceux des observations faites à Kumemura (Naha) — tableaux journaliers, résumés du mois, synthèses annuelles, tableaux annuels de la fréquence des vents — ne sont imprimés. Furet utilise de grandes feuilles quadrillées dont les colonnes et les lignes lui servent de cadre pour reproduire fidèlement la disposition des tableaux modèles figurant dans l'«Instruction» de 1852 pour les observations journalières et les résumés du mois (l'«Instruction» ne propose pas de modèle de synthèse annuelle).

Pour les données journalières, les tableaux sont au nombre de cinq par mois (soit cent dix au total), un pour chacune des cinq heures de relevés: 6 h et 10 h du matin, 1 h, 4 h et 10 h du soir. La période qu'ils couvrent va du 18 décembre 1856 au 30 septembre 1858 (fig. 4). Ils se composent de quatorze colonnes au total: 1. «Dates» (le jour dans le mois); 2. «Pression barométrique», subdivisée en «hauteur observée», «température du baromètre» et «hauteur corrigée»; 3. «Température», avec cinq sous-colonnes: «thermomètre sec», «thermomètre mouillé», «différence», «tension de la vapeur», «humidité relative»; 4. «État général de l'atmosphère», qui regroupe «force et direction du vent», «abondance des nuages», «forme des nuages», «orages-pluies» et «phénomènes particuliers».

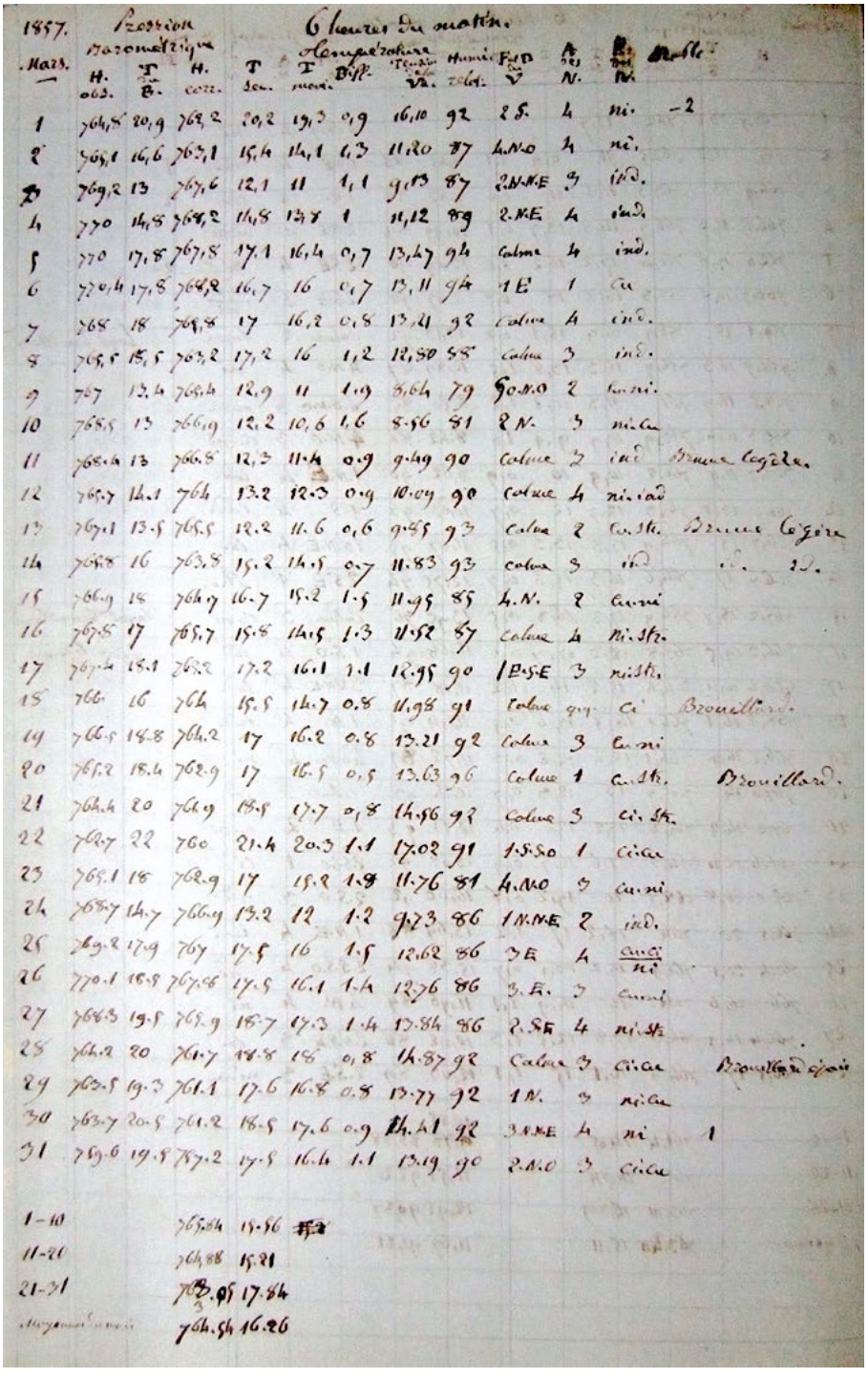


Fig. 4. — Tableau journalier des valeurs relevées à 6 heures du matin durant le mois de mars 1857 (source: AMF Furet).

Les tableaux d'observations journalières ne débutent à Kumemura que le 18 décembre 1856, plus d'un mois et demi après le retour de Furet à Okinawa, temps sans doute nécessaire pour s'adapter au nouvel environnement des missionnaires. Dans les tableaux journaliers des mois de décembre 1856 et janvier 1857, les données du thermomètre mouillé manquent, et avec elles les colonnes connexes de la tension de la vapeur et de l'humidité relative. Furet poursuit ses observations pour toutes les variables prescrites dans l'«Instruction» jusqu'au 23 septembre 1858. Survient alors un incident lourd de conséquences: le tube du baromètre se brise et Furet découvre que le tube de rechange qu'il gardait en réserve, sur les deux reçus du Dépôt de la Marine, était lui aussi brisé [45]. Dès lors, jusqu'à ce qu'il mette totalement fin à ses observations en octobre 1860, il ne pourra plus mesurer la pression atmosphérique ni calculer l'oscillation diurne. Les tableaux journaliers ne s'arrêtent cependant qu'au 30 septembre 1858, amputés de la pression atmosphérique et de la température du baromètre pour les sept derniers jours. Furet ne rédige plus ensuite de résumés mensuels et se contente, d'une part, de synthèses annuelles sans l'oscillation diurne et avec seulement les moyennes mensuelles de trois variables — température moyenne, tension de la vapeur, humidité relative —, d'autre part, de tableaux statistiques annuels indiquant en pourcentage, en regard de huit directions, la «fréquence relative des vents» pour chaque mois.

La comparaison des tableaux journaliers montre que l'assiduité de Furet à faire ses relevés varie sensiblement selon les heures. Du 18 décembre 1856 au 23 septembre 1858, le nombre total des valeurs pour la pression atmosphérique corrigée, pour chaque heure de relevé, devrait en théorie être de 645. Il serait de 652 pour la température de l'air, mesurée jusqu'au 30 septembre 1858, et de 607 pour l'humidité relative, dont la mesure ne débute qu'au 1er février 1857. Le tableau 2 donne le pourcentage des relevés effectifs notés par Furet pour ces trois variables à chacune des cinq heures prévues et pour l'ensemble de leur période d'observation respective. On voit ainsi que leur taux, qui est au minimum de 84 % et plus souvent entre 90 et 96 % à 6 h du matin et 10 h du soir, baisse d'environ dix points à 10 h du matin et qu'il n'est plus qu'entre 58 et 66 % à 1 h et 4 h du soir.

Tableau 2

Pourcentage des relevés quotidiens par heure d'observation pour trois variables

	6 h du matin	**10 h du matin**	**1 h du soir**	**4 h du soir**	**10 h du soir**
Pression corr.	94,33	83,13	64,11	63,96	96,32
Température	93,10	83,44	66,26	63,19	90,49
Humidité rel.	85,17	78,25	62,60	58,65	84,51

Les taux faibles de la mi-journée s'expliquent probablement par les absences de Furet qui aimait explorer la campagne à la recherche de fossiles, visiter des sites anciens ou étudier la flore et la faune de l'île, usant parfois d'une carabine pour tuer des oiseaux qu'il destinait au Muséum national d'Histoire naturelle (Furet, 1859a,b; Beillevaire, 2018; AMEP, vol. 569, p. 191). Sa correspondance n'indique pas qu'il ait jamais eu l'idée de se faire remplacer par ses confrères. La carence de données journalières est bien sûr préjudiciable au calcul des moyennes.

Comme les tableaux journaliers, les «résumés des observations du mois», ou «résumés du mois», couvrent la période allant du 18 décembre 1856 au 30 septembre 1858 (fig. 5). Ils se composent des colonnes et sous-colonnes suivantes: 1. Mois et quantièmes; 2. «Pression baro-

métrique», déclinée en «hauteur moyenne» (moyenne des valeurs corrigées pour la température à 6 h et 10 h du matin, 1 h et 4 h du soir) et «oscillation diurne» (différence entre les valeurs corrigées à 10 h du matin et 4 h du soir); 3. «Température», avec cinq sous-colonnes: «à minima», «à 6 h du matin», «à 1 h du soir», «moyenne» des deux précédentes mesures, «moyenne de 6 h et 10 h du matin, 4 h et 10 h du soir»; 4. «État hygrométrique», subdivisé en «tension moyenne de la vapeur» et «humidité relative moyenne» évaluée en centièmes; 5. «Pluie tombée», avec trois variables: «de 6 h du matin à 6 h du soir», «de 6 h du soir à 6 h du matin», «dans les 24 heures»; 6. «Phénomènes exceptionnels».

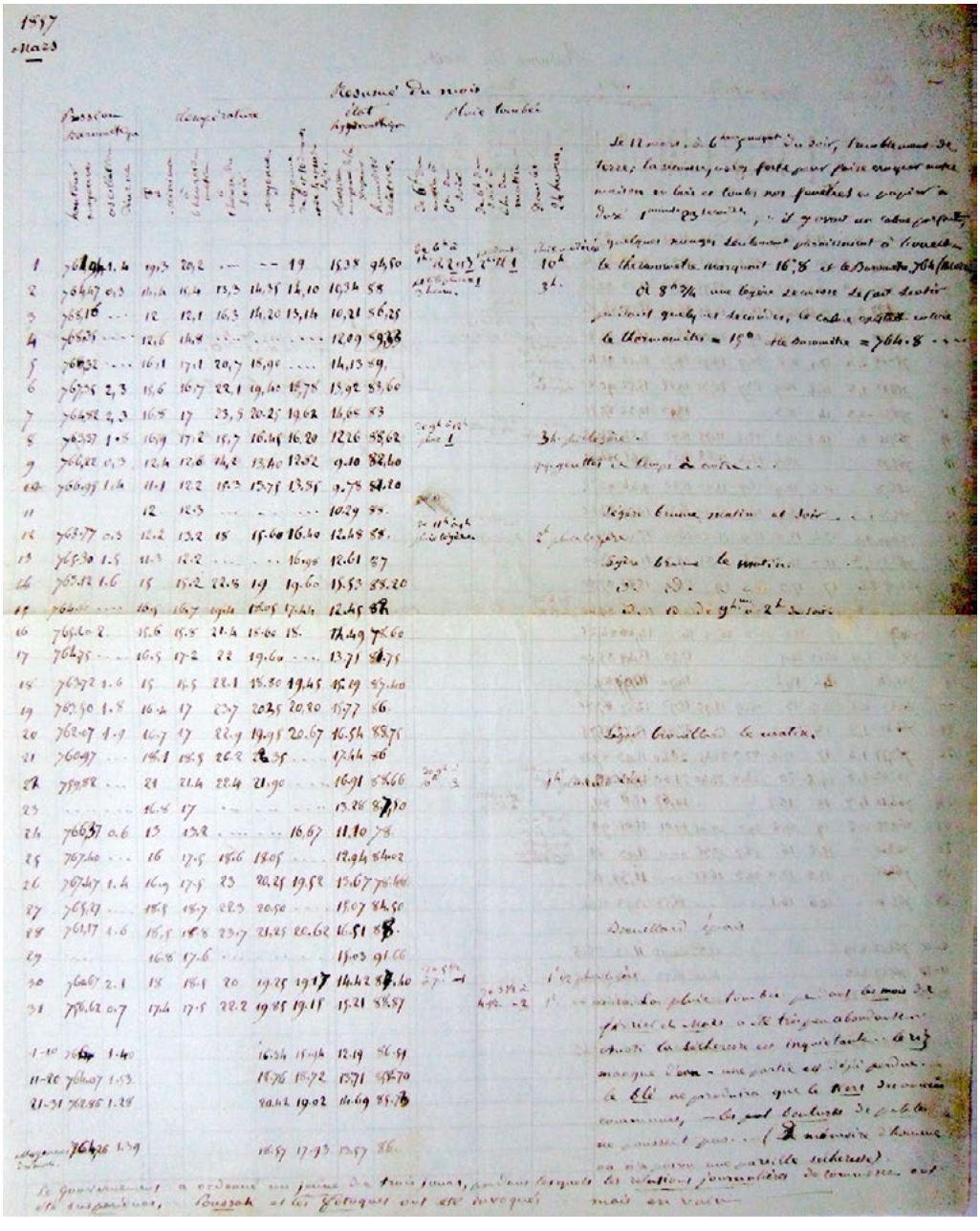


Fig. 5. — Résumé du mois de mars 1857 (source: AMF Furet).

La comparaison avec le «résumé du mois» modèle figurant dans l'«Instruction» de 1852 fait apparaître que les sous-colonnes de la «température à maxima» et de la moyenne entre «température à maxima» et «température à minima» sont ici absentes. Le Dépôt de la Marine n'avait en effet pas pu remettre à Furet de thermomètre à maxima, apparemment faute de temps, avant qu'il ne quitte Paris [46]. On note que la sous-colonne «température à minima» n'est présente dans ces résumés qu'à partir de février 1857.

Comme le recommande l'«Instruction» de 1852, au bas des tableaux mensuels de données journalières, pour chaque heure de relevé, Furet a noté les moyennes décadaires et la moyenne sur le mois pour la hauteur barométrique corrigée et la température sèche [47]. Il fait également un calcul des moyennes décadaires dans ses «résumés du mois» pour plusieurs variables: 1. La hauteur moyenne et l'oscillation diurne de la pression barométrique; 2. La moyenne des deux températures de l'air à 6 h du matin et 1 h du soir, et la moyenne des quatre températures de l'air à 6 h et 10 h du matin, 4 h et 10 h du soir; 3. La tension moyenne de la vapeur et l'humidité relative moyenne.

Les synthèses annuelles établies par Furet, au nombre de quatre, vont de janvier 1857 à octobre 1860. Jusqu'en août 1858, elles donnent les moyennes mensuelles, sauf carences, de cinq variables: «température moyenne», «tension de la vapeur», «humidité relative», «pression moyenne» et «oscillation». De septembre 1858 à juillet 1860, le baromètre étant hors usage, seules les trois premières variables continuent d'y figurer. D'août à octobre 1860, les moyennes de la tension de la vapeur et de l'humidité relative n'apparaissent plus et ne reste que celle de la température moyenne. Le calcul des moyennes jusqu'en juillet 1860, et même octobre 1860 pour la température, prouve que Furet a continué à mesurer, en principe chaque jour, ces trois variables après septembre 1858. Mais il ne subsiste pas trace de relevés quotidiens pour cette période.

Dans une lettre du 14 novembre 1860 à Jean Rousseille, ancien sous-procureur à Hong-Kong devenu directeur au séminaire des Missions étrangères à Paris, Furet fait savoir qu'il ne poursuit plus ses observations météorologiques et que ses instruments attendent d'être renvoyés au Dépôt de la Marine (AMEP, vol. 568, p. 1463). Ses arguments sont sans appel:

> Jusqu'à présent, M. l'abbé Chamaison avait eu la bonté de demander pour moi au Dépôt de la Marine la *Connaissance des temps* [48]. Non seulement je ne vous prie pas de continuer, mais je vous demande au contraire de ne pas m'en expédier si ces volumes venaient au séminaire d'une manière ou d'une autre. Je renonce aux observations qu'exigeraient ces livres. Faire ces observations dans ce pays et au Japon ne peut que nuire à notre œuvre. Je veux renvoyer au Dépôt de la Marine les instruments qui me furent confiés. Ils sont emballés depuis bientôt deux ans [49], mais il faut un navire.

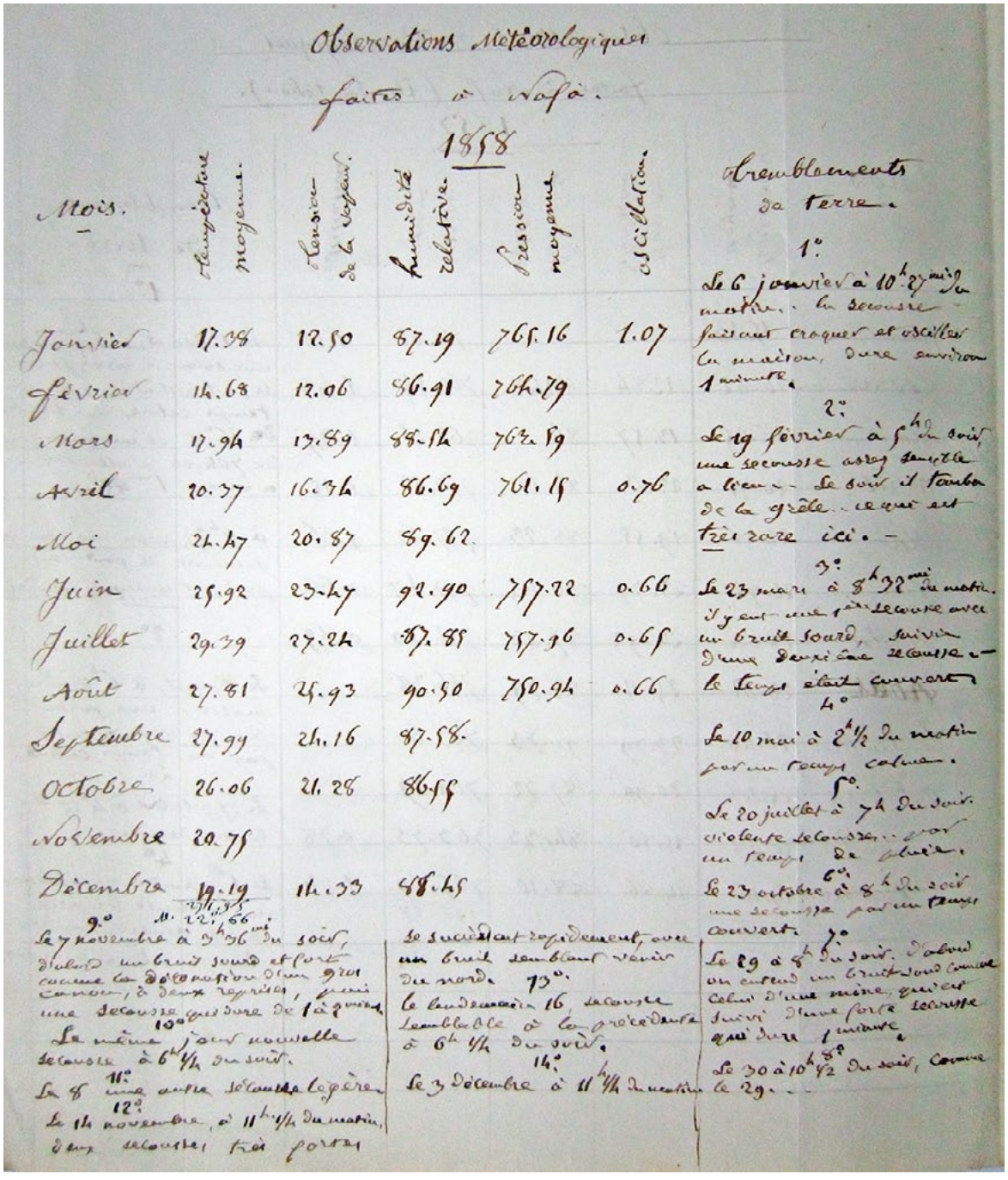
Il y a lieu de croire que les dernières observations de Furet, postérieures à septembre 1858, accompagnaient cette lettre et que, déposées à Fuzhou par un navire ryūkyū, elles sont parvenues à Hong-Kong début mai 1861. Comme noté plus haut, l'*Annuaire de la Société météorologique de France* signale dans sa correspondance de juillet 1861 la réception des observations faites par Furet de 1857 à 1860 (Furet, 1861). Deville, qui a vraisemblablement été l'intermédiaire dans cette donation, aura joint ce dernier envoi, sur lequel il n'a publié aucun commentaire, aux observations qui ont fait l'objet de sa communication de février 1859 et qui restaient en sa possession.

Il semble que Furet se soit peu à peu lassé d'une discipline quotidienne assez pesante et dont l'intérêt scientifique était devenu moindre sans les valeurs barométriques. Mais sa décision d'y mettre totalement fin, et le désintérêt qu'il exprime alors pour un exercice dans lequel il s'était engagé avec ardeur, attestent du tournant qui s'est opéré en lui [50]. Missionnaire sans fidèles, âgé maintenant de quarante-quatre ans, il a la douloureuse impression d'être oublié à Okinawa alors que ses anciens compagnons, tous plus jeunes, sont déjà installés au Japon à la faveur des traités de 1858. Dans le même temps, il rompt aussi avec l'orientaliste Léon de Rosny, spiritualiste athée et franc-maçon, et sa Société d'Ethnographie qui ont pourtant beaucoup contribué à le faire connaître.

Quinze jours avant qu'il n'écrive à Rousseille, le jeune Bernard Petitjean l'a rejoint à Naha pour remplacer Mounicou parti à Yokohama. Il s'investira alors beaucoup dans la formation de son cadet en s'attachant à lui transmettre les connaissances qu'il a acquises sur le Japon. Sans doute son engagement missionnaire s'en trouva-t-il aussi ravivé. Avec lui il passe encore deux ans à Okinawa durant lesquels aucune nouvelle de l'extérieur ne leur parvient. Il leur reste néanmoins la possibilité d'envoyer des lettres, et seulement des lettres, à Hong-Kong par les navires du royaume allant à Fuzhou, mais pas d'en recevoir. C'est ainsi que dans une lettre à Libois d'octobre 1861, Furet dit son regret d'avoir encore en attente la caisse «qui renferme les *instruments* du gouvernement [qu'il] désire renvoyer au Dépôt de la Marine parce qu'ils [lui] sont *plus qu'inutiles* dans ces pays» (AMEP, vol. 569, pp. 699-702) [51]. On ignore si ces instruments ont finalement été restitués au Dépôt de la Marine, ce qui n'a pu se faire qu'après le transfert de Furet au Japon en octobre 1862.

Furet s'est aussi beaucoup intéressé aux tremblements de terre, nombreux et intenses au Japon durant l'ère Ansei (1854-1860), bien que la sismicité de la région d'Okinawa soit faible comparée à celle des grandes îles du Japon. C'est dans ses synthèses annuelles qu'il en dresse la liste — on compte quarante-cinq secousses sismiques principales ressenties de 1857 à 1860 — et qu'il en décrit avec minutie les modalités (fig. 6) (Demarée *et al.*, 2016). Ses observations, antérieures de trente ans ou plus aux premiers sismogrammes, sont un apport précieux à l'histoire sismique d'Okinawa sur laquelle les sources locales offrent très peu d'informations. L'essaim de tremblements de terre qui s'est produit en 1858 a eu pour foyer le plus probable la fosse centrale d'Okinawa. La magnitude maximale estimée aurait atteint 6 à 7 sur l'échelle de Richter. Si, hypothèse seconde, le foyer s'est situé plus au nord, aux environs de l'île Amami, elle aurait pu être de 7 à 8. L'attention que Furet porte aux tremblements de terre n'est pas étrangère à la recherche de possibles corrélations entre la survenue de ces secousses et les phénomènes météorologiques, comme on le présumait assez banalement à l'époque. On relève, par exemple, qu'il marque par un signe «égal» le caractère concomitant d'un orage et d'une secousse sismique à la date du 20 dans son résumé du mois de juillet 1858 (voir en annexe le tableau des précipitations).

Enfin, Furet s'est appliqué à déterminer avec précision la direction du vent sans que l'on sache s'il utilisait quelque dispositif de son invention. Il en rend compte de janvier 1857 à octobre 1860 dans quatre tableaux annuels intitulés «fréquence relative des vents pour les divers mois à Nafa». Sur l'axe vertical figurent les mois et sur l'axe horizontal huit directions de la rose des vents. On y trouve indiqués, pour chaque direction, la fréquence du vent en pourcentage sur le mois ainsi que le «rapport de l'ouest à l'est» et «du sud au nord». Les tableaux de 1859 et 1860 ont une colonne supplémentaire consacrée à des observations et remarques concernant les vents forts et les typhons.



Observations météorologiques faites à Nossi-bé.

1858

Mois.	Température moyenne.	Tension de la vapeur.	Humidité relative.	Pression moyenne.	Oscillation.
Janvier	17.38	12.50	87.19	765.16	1.07
février	14.68	12.06	86.91	764.79	
Mars	17.94	13.89	88.54	762.89	
Avril	20.37	16.74	86.69	761.15	0.76
Mai	24.47	20.87	89.62		
Juin	25.92	23.47	92.90	757.22	0.66
Juillet	29.39	27.24	87.85	757.96	0.65
Août	27.81	25.93	90.50	750.94	0.66
Septembre	27.99	24.16	87.58		
Octobre	26.06	21.28	86.55		
Novembre	29.75				
Décembre	19.19	14.33	48.45		

Tremblements de terre.

1° Le 6 janvier à 10h 27mi du matin. La secousse faisant craquer et osciller la maison, dure environ 1 minute.

2° Le 19 février à 5h du soir, une secousse assez sensible a lieu. Le soir il tomba de la grêle, ce qui est très rare ici.

3° Le 23 mars à 8h 32mi du matin. Il y eut une 1re secousse avec un bruit sourd, suivie d'une deuxième secousse. Le temps était couvert.

4° Le 10 mai à 2h ½ du matin par un temps calme.

5° Le 20 juillet à 7h du soir, violente secousse par un temps de calme.

6° Le 23 octobre à 8h du soir une secousse par un temps couvert.

7° Le 29 à 4h du soir. D'abord on entend un bruit sourd comme celui d'une mine, puis cet bruit suivi d'une forte secousse qui dure 1 minute.

8° Le 30 à 10h ½ du soir, comme le 29.

9° Le 7 novembre à 3h 36mi du soir, d'abord un bruit sourd et fort comme la détonation d'un 9 ou canon, à deux reprises, puis une secousse qui dure de 1 à 2 minutes.

10° Le même jour nouvelle secousse à 6h ½ du soir.

11° Le 8 une autre secousse légère.

12° Le 14 novembre, à 11h ½ du matin, deux secousses très fortes

Le 3 précédent, précédemment avec un bruit semblant venir du nord. 13°.

Le lendemain 16, secousse semblable à la précédente à 6h ½ du soir.

14° Le 3 décembre à 11h ½ du matin

Fig. 6. — Synthèse pour l'année 1858 avec le relevé des tremblements de terre (source: AMF Furet).

7. La question du calcul des moyennes, de la température de l'air en particulier

L'article «Instruction sur les observations météorologiques à faire dans les hôpitaux coloniaux» de 1852 donne des directives détaillées pour calculer les moyennes journalières, puis les moyennes mensuelles, destinées aux «résumés des observations du mois». Au milieu du

XIX^{e} siècle, le calcul des moyennes journalières n'était pas encore standardisé. La façon de procéder la plus fréquente était de faire la moyenne arithmétique ou pondérée des valeurs relevées dans la journée. Pour la température de l'air, en particulier, le mode de calcul de la moyenne ne sera défini qu'au moment du premier Congrès météorologique international qui se tint à Vienne en septembre 1873 et qui est à l'origine de la création de l'Organisation météorologique internationale (OMI) [52]. Il fut alors convenu que la température moyenne journalière serait la moyenne arithmétique des valeurs minimales et maximales relevées à 8 h du matin (Anonyme, 1875).

Furet ne disposant pas de thermomètre à maxima, il ne pouvait calculer la température moyenne journalière de l'air sur la base des maxima et minima. Il procéda donc, pour ses résumés du mois, au calcul de deux moyennes journalières à partir des cinq relevés diurnes, comme cela est suggéré dans l'«Instruction» de 1852 (p. 20). La première, que nous appellerons *Moy2*, est la moyenne des valeurs relevées à 6 h du matin et 1 h du soir; la seconde, *Moy4*, est la moyenne des quatre valeurs relevées à 6 h et 10 h du matin, 4 h et 10 h du soir. Sur la période couverte par les résumés du mois, soit du 18 décembre 1856 à fin septembre 1858, on constate qu'en raison des relevés manquants Furet n'a calculé *Moy2* que pour 61,66 % des jours, pourcentage qui descend à 48,92 % pour *Moy4*. Dans ses tableaux annuels de synthèse, les températures mensuelles moyennes sont la moyenne de *Moy2* et *Moy4*; en cas d'absence de *Moy4*, *Moy2* seule est retenue. Il est à noter que les moyennes mensuelles *Moy2* et *Moy4* calculées par nous à partir des relevés journaliers ne sont pas toujours parfaitement identiques aux moyennes mensuelles rapportées par Furet dans ses résumés du mois. Les différences, qui ne sont que de quelques centièmes, plus rarement dixièmes, paraissent imputables à des erreurs commises par Furet.

Les températures mensuelles moyennes publiées par Deville dans les *Comptes rendus hebdomadaires des Séances de l'Académie des Sciences* pour la période de décembre 1856 à septembre 1858 sont *Moy4* quand elle est disponible, sinon *Moy2* (Furet, 1859b). Deville se trompe, du reste, en indiquant que les températures moyennes sont «calculées d'après trois observations diurnes (6 heures du matin, 1 h et 10 heures du soir)», alors qu'elles le sont, comme nous l'avons dit, à partir de deux ou quatre des cinq valeurs quotidiennes.

En ce qui concerne la pression atmosphérique corrigée, l'oscillation diurne, la température à minima et l'humidité relative, relevées en principe cinq fois par jour, les moyennes journalières des résumés du mois n'ont pu être calculées que sur la base, respectivement, de 35,58 %, 55,98 %, 87,31 % et 26,36 % de relevés effectifs (de janvier 1857 à septembre 1858 pour les deux premières variables, seulement à partir du 1er février 1857 pour les deux dernières). La fiabilité des moyennes mensuelles dans les synthèses annuelles est pareillement affectée par le manque de données journalières, lequel est plus accentué, on l'a vu, en milieu de journée.

En l'absence d'une définition standard de la température moyenne journalière de l'air, nous serons donc conduits à essayer d'appliquer aux valeurs observées aujourd'hui les mêmes calculs que ceux de Furet pour juger de l'évolution du climat à Naha depuis le milieu du XIX^{e} siècle.

8. Analyse des valeurs observées par Furet à Naha

L'analyse porte sur l'ensemble des relevés météorologiques effectués par Furet à Naha, dans le quartier de Kumemura, entre décembre 1856 et juillet 1860 — et même jusqu'à octobre 1860 pour la température. Elle repose en priorité sur les moyennes journalières calculées pour les résumés du mois à partir des cinq valeurs journalières. Les carences dans les relevés journaliers fausseraient par trop une analyse décadaire.

8.1. La température de l'air

Des deux moyennes journalières de la température de l'air, *Moy2* et *Moy4*, préconisées dans l'«Instruction» de 1852, la première est celle qui se rapproche structurellement le plus de la moyenne journalière dans sa définition actuelle. Elle repose en effet sur la valeur mesurée à 6 h du matin, qui dépasse en général légèrement celle du thermomètre à minima, et sur celle mesurée à 1 h du soir, laquelle tend au contraire à être un peu inférieure à celle du thermomètre à maxima. La moyenne arithmétique de ces deux valeurs, *Moy2*, peut donc en principe être considérée comme une approximation acceptable de la valeur moyenne de la température journalière de l'air obtenue selon la procédure standard des maxima et minima et elle peut y suppléer comme le suggère l'«Instruction» de 1852 (p. 4). Elle présente aussi un risque d'écart moins grand qu'avec *Moy4*, calculée avec les valeurs basses de 6 h du matin et 10 h du soir et les valeurs intermédiaires de 10 h du matin et 4 h du soir.

La figure 7 montre que *Moy2* et *Moy4* diffèrent assez peu, sauf pour le mois de février 1858 où l'on note un écart de 2° C. L'abaissement de *Moy4* ce mois-là semble dû à l'absence de relevés à 4 h du soir lors des jours les plus chauds. Dans ce qui suit, on privilégiera *Moy2* non seulement en raison de sa proximité avec la moyenne arithmétique des minima et maxima, mais aussi du fait de sa structure plus simple, de la plus grande régularité des relevés de 6 h du matin et 1 h du soir, et de l'adoption vraisemblable de cette moyenne par Furet dans ses synthèses annuelles.

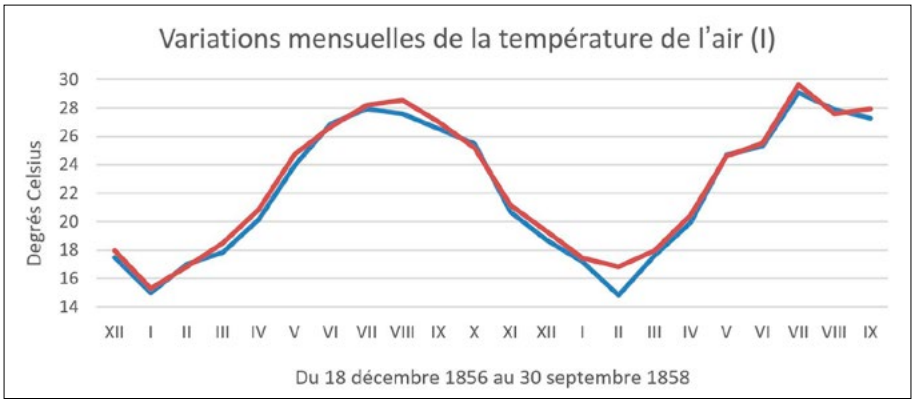


Fig. 7. — Comparaison des moyennes mensuelles, *Moy2* (en rouge) et *Moy4* (en bleu).

Sur la figure 8, on relève que la température de l'air en 1858 a été notablement supérieure à celle de 1857. Furet le confirme dans sa lettre à Deville du 10 octobre 1858: «Tous les Loutchouans conviennent que la chaleur de cette année est extraordinaire par l'intensité et la ténacité» (AMF Furet).

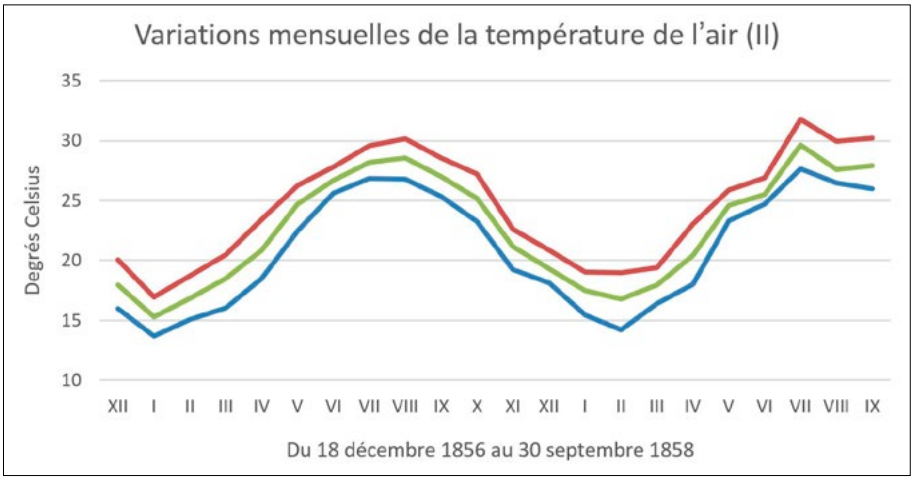


Fig. 8. — Comparaison des moyennes mensuelles des températures maximales (en rouge) et minimales (en bleu) et des moyennes mensuelles, *Moy2* (en vert).

La température maximale enregistrée par Furet s'élève à 33,7° C, le 18 juillet 1858 à 1 h du soir (Deville signale cette valeur, mais curieusement la situe au 17). La plus basse température a été observée le 23 février 1858: ce jour-là, le thermomètre à minima indique 8,8° C et la température relevée à 6 h du matin est de 9,1° C. Les valeurs relevées avec le thermomètre à minima n'apparaissent que dans les résumés du mois et seulement à partir du 1er février 1857, puis continûment jusqu'au 30 septembre 1858. Un rapide calcul sur ces vingt mois montre que le quotient entre les moyennes mensuelles des deux valeurs, température à minima et température à 6 h du matin, est en moyenne de 0,96, du même ordre, donc, que le quotient des températures relevées le 23 février 1858. On voit sur la figure 9 que l'écart maximum entre température à minima et température à 6 h du matin est de 1,88° C en novembre 1857.

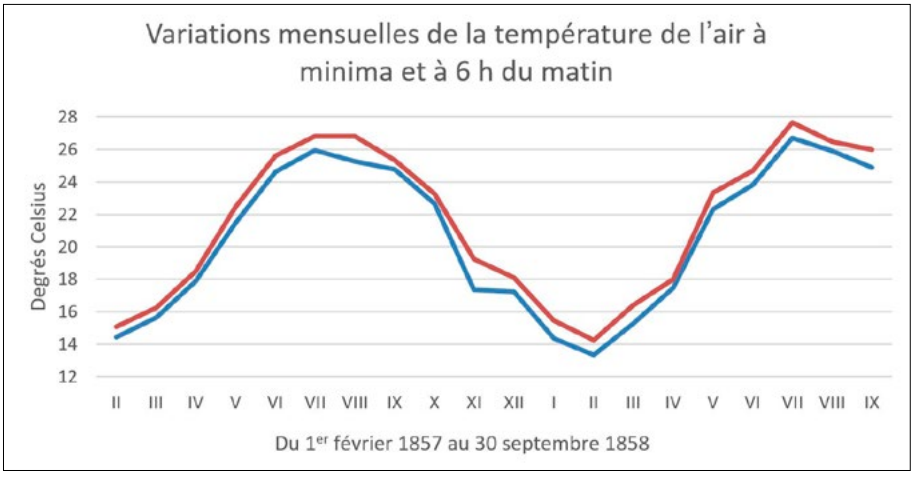


Fig. 9. — Comparaison entre les moyennes mensuelles des températures à minima (en bleu) et celles des températures relevées à 6 h du matin (en rouge).

8.2. Analyse des moyennes mensuelles de la pression atmosphérique

Rappelons que la pression atmosphérique moyenne est la moyenne arithmétique des quatre valeurs observées à 6 h et 10 h du matin, 1 h et 4 h du soir, et que l'oscillation diurne est la différence entre les valeurs à 10 h du matin et à 4 h du soir. Nous avons ici corrigé ces valeurs pour la température en appliquant la formule de Delcros & Haeghens (1853). L'altitude et la gravimétrie ne requièrent pas de correction puisque le lieu de résidence des missionnaires n'était situé qu'à une dizaine de mètres au-dessus du niveau de l'océan.

La figure 10 montre que la moyenne mensuelle de la pression atmosphérique est d'environ 755 mm Hg (1 007 hPa) en été et de 765 mm Hg (1 020 hPa) en hiver. La moyenne mensuelle la plus basse enregistrée, 750 mm Hg (1 000 hPa) en août 1858, correspond au passage de tempêtes tropicales les 6, 7 et 19 de ce mois-là. La valeur maximale de la pression atmosphérique, mesurée le 31 décembre 1857, est d'environ 773 mm Hg (1 030,6 hPa).

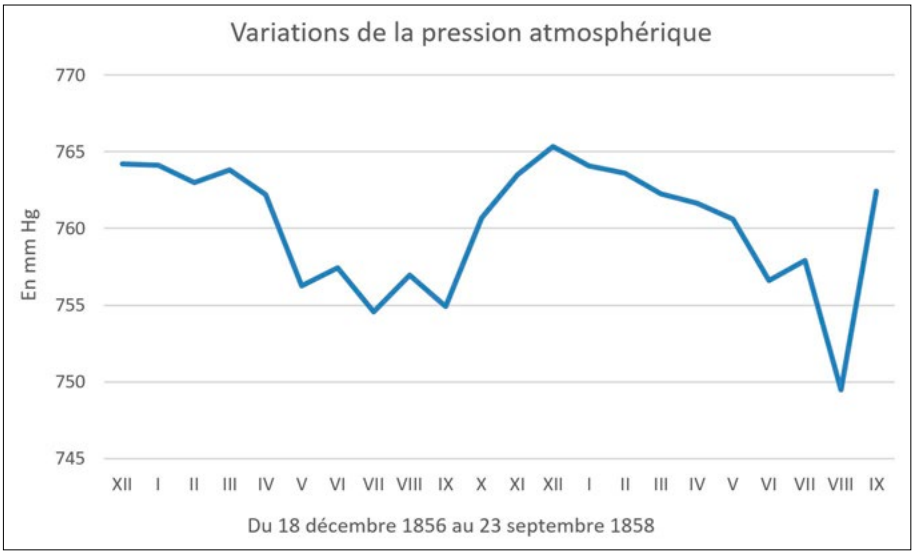


Fig. 10. — Moyennes mensuelles de la pression atmosphérique en mm Hg.

Le tableau 3 indique les dates et horaires auxquels ont été mesurées les plus basses pressions atmosphériques avec les moyennes journalières à ces dates, en mm Hg et en hPa, après correction pour la température (le signe - indique que l'absence d'au moins une valeur ne permet pas de calculer une moyenne).

Tableau 3

Pressions atmosphériques les plus basses enregistrées par Furet (après correction pour la température)

Année	Mois	Jour	Heure	mm Hg	hPa	Moyenne journalière mm Hg	Moyenne journalière hPa
1857	mai	18	4 h soir	721,6	962,1	734,18	978,8
	juillet	7	4 h soir	738,9	985,1	742,40	989,8
	septembre	3	6 h matin	740,2	986,9	742,18	989,5
		6	10 h soir	732,7	976,9	-	-

1858	août	6	10 h soir	734,2	978,9	742,28	989,6
		7	6 h matin	738,0	983,9	-	-
		19	10 h matin 1 h soir	737,0 737,0	982,6 982,6	737,45 -	983,2 -

Le typhon du 18 mai 1857 est évoqué par Furet dans son résumé du même mois:

> Typhon du 18 mai [1857]. Les typhons sont très rares à cette époque dans la grande Loutchou. Celui-ci d'ailleurs n'a pas été violent, au dire des habitants. Voici les hauteurs observées et corrigées, pendant la journée: à 6 h du matin 748,0, température de l'air 22,5° – 9 h ¾, 741,3 – 10 h, 738,8 t[empérature]. ext[érieure]. 23,8° – 11 h, 735,8 – 12 h, 731,6 t. ext. 25° – 1 h [soir], 728,3 t. ext. 24° – 2 h, 726,1 t. ext. 25° – 3 h, 722,3 t. ext. 25° – 4 h, 721,6 t. ext. 24,2° – 5 h, 724,1 t. ext. 25,5° – 6 h, 727,9 t. ext. 25° – 8 h, 735,4 – 10 h, 743,1 t. ext. 22,8°.

Sur la même feuille sont décrites les précipitations qui ont accompagné le typhon:

> Le 16 mai 1857: à 12 h et vers 2 h, pluie modérée (3) pendant 1 h 1/2; le 17 mai 1857: pluie légère (2), pluie modérée (3), fortes pluies (4) et pluies torrentielles (5) toute la journée; 18 mai 1857: pluies modérées (3), fortes pluies (4), pendant une partie de la journée (typhon); 19 mai 1857: pluie légère (2) vers 6 h jusqu'à 7 h ½ pendant 1 h 1/2.

Dans la nuit du 17 au 18 mai 1857, vers 3 h, le navire néerlandais *van Bosse* fit naufrage aux abords de la petite île de Tarama dans la partie sud de l'archipel des Ryūkyū, à environ 350 km au sud-ouest d'Okinawa [53]. L'incident, rapporté aussi par Furet, est bien documenté dans les chroniques d'Okinawa. La perte de ce navire a été causée par un typhon de faible intensité, plutôt une tempête tropicale (Demarée *et al.*, 2018; Beillevaire, 2018) [54].

8.3. Analyse des moyennes mensuelles de l'humidité relative

Dans l'«Instruction» de 1852 les variables «Température – État hygrométrique» occupent cinq colonnes des tableaux prévus pour recueillir les observations quotidiennes (Furet dissocie «température», trois colonnes, et «hygrométrie», deux colonnes). Leurs contenus respectifs se définissent ainsi: 1. Valeur *t* en° C donnée par le thermomètre sec exposé à l'air ambiant; 2. Valeur *t'* en° C donnée par le thermomètre à boule constamment humide; 3. Différence entre *t* et *t'* en dixièmes de° C; 4. Valeur de la tension de la vapeur (en mm); 5. Valeur de l'humidité relative en centièmes. Les deux dernières valeurs se déduisent des valeurs précédentes grâce aux tables psychrométriques. Celles-ci figurent dans cette «Instruction» (pp. 36-46) pour la différence $t - t'$, $t' > 0$, donnée de deux en deux dixièmes de degré, et pour les degrés du thermomètre mouillé de 0 à 25/30° C. Les mêmes tables psychrométriques sont présentées en complément par Renou dans ses *Instructions météorologiques* et dans l'*Instruction sur les observations météorologiques à recueillir dans les hôpitaux militaires* de 1864 (Renou, 1858; Anonyme, 1864).

Le calcul des moyennes journalières de l'humidité relative, comme de celles de la tension de la vapeur, oblige donc à lire, à chaque heure de relevé, les deux thermomètres et à consulter les tables psychrométriques. On constate, malheureusement, que le nombre de moyennes établies par Furet est assez faible. Cette relative paucité est cependant palliée en se reportant aux relevés journaliers eux-mêmes. Comme il s'agit d'une analyse de moyennes mensuelles,

nous avons choisi les valeurs relevées à 6 h du matin, au nombre de 517, et à 1 h du soir, au nombre de 380.

La figure 11 montre les moyennes mensuelles de l'humidité relative ainsi obtenues en pourcentage pour chacune des deux heures de relevés, de février 1857 à septembre 1858. La moyenne de l'humidité relative à 6 h du matin varie entre 90 et 95 %, et elle est significativement croissante durant les vingt mois d'observation. Celle de l'humidité relative à 1 h du soir est de 84,25 %. Comparativement, les deux moyennes sont élevées, mais elles peuvent avoir été influencées par la proximité du lieu de résidence des missionnaires avec la mer [55].

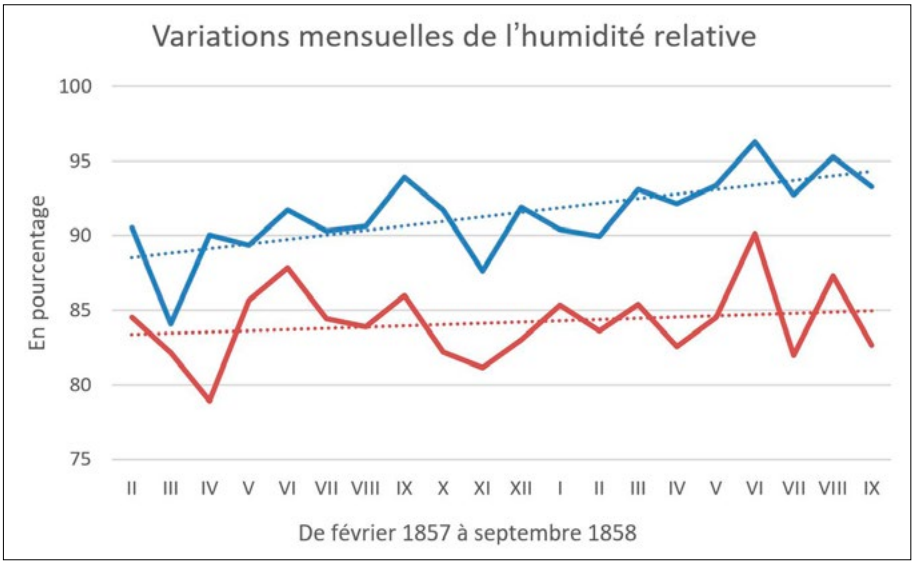


Fig. 11. — Moyennes mensuelles de l'humidité relative en pourcentage à 6 h du matin (ligne bleue) et à 1 h du soir (ligne rouge).

8.4. Précipitations et sécheresses

On trouvera en annexe un tableau regroupant la totalité des précipitations observées et évaluées, sur une échelle de 1 à 5, par Furet au Seigenji d'Ameku puis à Kumemura. Ces observations proviennent presque entièrement des résumés du mois. Dans sa correspondance, à côté des typhons ou tempêtes tropicales, Furet prête une grande attention aux sécheresses dont eurent à souffrir les habitants du sud d'Okinawa, région la plus densément peuplée, au cours des six années qu'il y a vécu. Il décrit ces situations avec d'intéressants détails sociographiques.

Pour l'année 1857:

> La pluie tombée pendant ce mois-ci et le mois précédent a été très peu abondante, aussi le riz n'est pas encore planté et le plant est presque sec dans beaucoup d'endroits, la récolte constante des patates ne souffre pas [56]…
>
> La pluie tombée pendant les mois de février et mars a été très peu abondante. Aussi la sécheresse est inquiétante. Le riz manque d'eau, une partie est déjà perdue. Le blé ne produira que le tiers des années communes, les boutures de patates ne poussent pas. (De mémoire d'homme on n'a pas vu une pareille sécheresse.) Le gouvernement a ordonné un jeûne de trois jours,

pendant lesquels les relations journalières de commerce ont été suspendues, Bussah et les fotoques ont été invoqués, mais en vain [57].

En passant une petite rivière de Nafa, on se trouve au pied d'une chaîne de collines qu'il faut traverser pour aller au village d'Oufou-mi [Ōmine] (à l'ouest). C'est là que quatre-vingts habitants venaient au-devant de nous, il y a quelques mois, pour nous engager à prier nos esprits de leur donner de l'eau. Il y avait une sécheresse très extraordinaire, et si on ne disait pas que nous, missionnaires, nous en étions la cause, au moins on disait que nous savions que la pluie ne viendrait que le quatrième mois, ce qui est arrivé sans prédiction [58].

Et pour les années 1860 et 1862:

Ah ! dans ce moment, il y a sécheresse, on fait des prières… De notre maison nous voyons les bannières et banderoles de la bonzerie où on fait la station de trois jours. Ces prières sont commandées par le gouvernement et le peuple, s'il veut. Dans des cas plus difficiles, le gouvernement ordonne même des jeûnes, et ces jours-là il y a défense de tuer cochons, chèvres, bœufs et poules. Aussi, au marché, on ne trouve que du poisson et des légumes [59].

La sécheresse m'a empêché jusqu'à présent de semer les graines que vous avez eu la bonté de m'envoyer, ce dont je vous suis bien reconnaissant [60].

Une sécheresse extraordinaire (les vieillards n'avaient pas souvenance d'en avoir vu une pareille) effraye et fait souffrir toute l'île. Il y a vraiment disette. Les vivres sont d'une cherté excessive. Les patates, qui sont la base de la nourriture, se vendent habituellement de 2 à 3 sapèques la livre, et maintenant elles se payent jusqu'à 20 sapèques la livre. Le riz se vend 97 sapèques le litre, la farine de blé se vend 120 sapèques la livre, l'huile à brûler se paye 370 sapèques la livre, la viande, le thé, la graisse, tout se vend en proportion. Il est vrai, je crois, que le changement opéré dans la monnaie est aussi en partie cause de cette cherté. Les mauvaises sapèques en fer du Japon ou de Lou-tchou n'ont que leur valeur d'une sapèque, mais les sapèques chinoises valent deux des autres.

Les bonzes, le gouvernement, le peuple, tout a remué pour avoir de l'eau. Et point d'eau… Il y a eu des jeûnes publics ordonnés par le gouvernement, beaucoup de prières publiques, avec tapage de tam-tam et force dépense de bâtonnets… Cependant, après toutes ces supplications à leurs fotoques ou à leurs esprits, il est venu quelques pluies d'orage (qu'ils n'ont pu attribuer à leurs prières, elles sont venues trop tard) qui ont permis de planter des patates. La joie est revenue parmi les gens du commun. Mais voici le temps de travailler les rizières et de faire les semis, et toutes sont sèches et fendues dans tous les sens. On dirait qu'elles ouvrent des milliers de bouches pour boire un coup, et l'eau ne vient pas [61].

8.5. Observations diverses, phénomènes extraordinaires

La dernière colonne des résumés mensuels et des synthèses annuelles est réservée à l'observation de phénomènes météorologiques qui ne figurent pas dans les autres colonnes et qui ne sont pas mesurables, ou non mesurés par Furet, et qui parfois offrent un caractère extraordinaire. Furet y note ainsi l'apparition de brume, de brouillard ou de halos, les bruits de tonnerre, la durée et l'évolution des précipitations ou les brusques changements de température. C'est principalement en marge de ses synthèses annuelles qu'il mentionne les secousses sismiques et qu'il s'applique à en caractériser l'intensité et le déroulement. Comme indiqué plus haut, c'est aussi dans la marge des tableaux sur la «fréquence relative des vents» qu'il a laissé des descriptions des typhons, appelés par lui «ouragans», survenus en 1859 et 1860.

Sur une feuille séparée, Furet a également rédigé une brève relation de l'apparition de la très brillante comète Donati (désignation officielle: C/1858 L1 et 1858 VI) dans le ciel de Naha entre le 20 septembre et le 22 octobre 1858. Au Japon, où elle fut très observée, elle a été surnommée *hōkiboshi*, «étoile balai», en raison de sa queue allongée. Furet date sa description du 25 octobre 1858 et l'adresse à Deville, jointe aux observations météorologiques qu'il a faites de novembre 1857 à septembre 1858 (AMF Furet).

> On nous a dit qu'elle paraissait vers le 20 septembre 1858. Le 29 à 6 h ½, elle était dans le nord à 45° environ au-dessus de l'horizon. À 7 h quelques minutes, l'extrémité de la queue était sous la première étoile de la Grande Ourse tandis que le noyau était dans la direction O.N.O. La queue était sensiblement parallèle à l'équateur et la convexité tournée vers le sud. À 7 h 40 min., le noyau disparaissait à l'horizon.
>
> Le 4 octobre, elle se couche tout près d'Arcturus et sa marche est bien marquée vers le sud.
>
> Le 22, elle était beaucoup plus au sud que les jours précédents et un peu à l'occident de Vénus.
>
> Les jours suivants, le temps est nuageux ou on ne la voit pas.
>
> Ce 25 octobre 1858. Le navire part demain et il vient d'arriver, je ne puis donner les explications que j'aurais voulu.

Furet a également décrit, beaucoup plus en détail, la progression et l'évolution morphologique d'une autre comète, non périodique, connue sous le nom de «Grande Comète de 1861» (C/1861 J1 et 1861 II) qui fut visible à Naha du 1er juillet au 13 août 1861 (AMEP, dossier Furet).

9. Le climat d'Okinawa: comparaison entre les années 1850 et aujourd'hui

Nous avons précédemment examiné les moyennes mensuelles de plusieurs variables établies sur la base des relevés quotidiens faits du 18 décembre 1856 à septembre 1858. Le bris de son instrument ne permet plus à Furet de mesurer la pression barométrique après le 23 septembre 1858. Il cesse alors, en octobre, de tenir des tableaux journaliers et des résumés du mois. Mais il n'en continue pas moins à faire des synthèses annuelles et poursuit donc ses observations quotidiennes pour calculer les moyennes mensuelles de la température de l'air, de la tension de la vapeur et de l'humidité relative qui y figurent. Ainsi, pour ces trois variables, nous disposons de moyennes mensuelles qui, débutant en janvier 1857 pour la température de l'air et en février 1857 pour la tension de la vapeur et l'humidité relative, vont jusqu'à juillet 1860 pour les deux dernières, et à octobre 1860 pour la première. Autrement dit, les synthèses annuelles nous permettent de suivre l'évolution mois par mois de la tension de la vapeur et de l'humidité relative sur une période continue de trois ans et demi, et pour la température de l'air sur une période de trois ans et neuf mois.

La figure 12 montre les variations de la moyenne mensuelle de la température de l'air sur près de quatre ans à partir des valeurs indiquées dans les synthèses annuelles (nous avons calculé et ajouté la moyenne pour la période du 18 au 31 décembre 1856). La température moyenne de l'air figurant dans les résumés du mois sous les deux formes *Moy2* et *Moy4*, leur comparaison avec les synthèses annuelles laisse entrevoir que Furet avait pour principe de calculer les moyennes mensuelles pour ses synthèses annuelles en faisant la moyenne de *Moy2* et *Moy4*

(comparaison bien sûr limitée à la période janvier 1857 – septembre 1858). Cependant, ses fréquentes absences en milieu de journée ne lui ont bien souvent pas permis de calculer *Moy4* et il ne lui restait alors que *Moy2* pour calculer la température mensuelle moyenne de ses synthèses annuelles. Sans doute en fut-il de même après septembre 1858, ce qui conférerait une certaine homogénéité à l'ensemble de cette série de valeurs, depuis janvier 1857, par la prédominance *de facto* de *Moy2*.

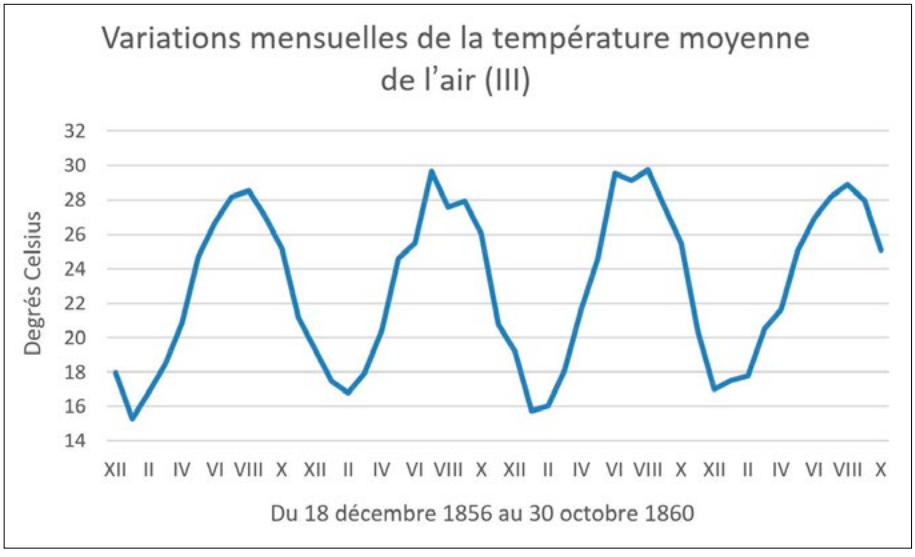


Fig. 12. — Température moyenne mensuelle de l'air sur la base des synthèses annuelles.

La figure 13 visualise la variation des moyennes mensuelles de la température de l'air, calculées par Furet pour ses synthèses annuelles, durant les années 1857, 1858, 1859 et 1860. Les maxima annuels oscillent entre 28,04° C en juillet 1857 et 29,75° C en août 1859, les minima entre 15,13° C en janvier 1857 et 16,98° C en décembre 1859.

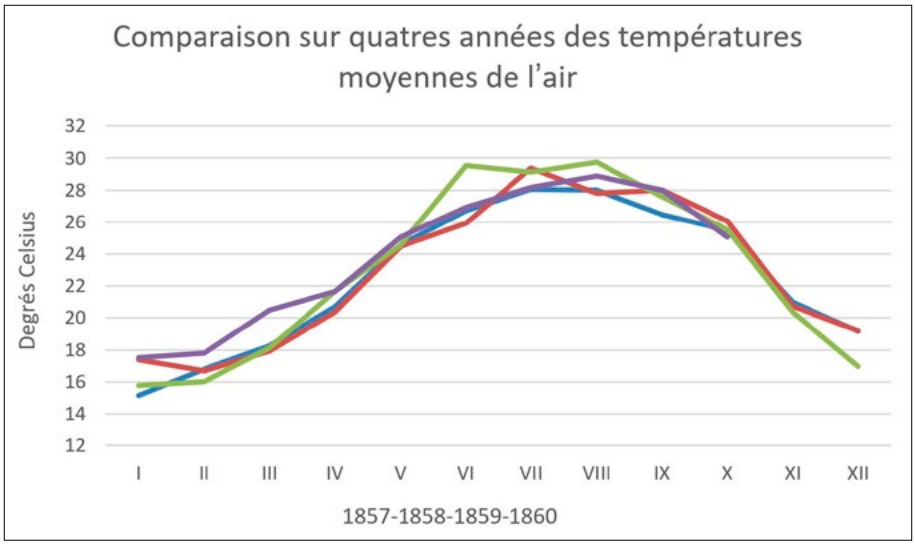


Fig. 13. — Variation des moyennes mensuelles de la température de l'air au cours des années 1857 (ligne bleue), 1858 (ligne rouge), 1859 (ligne verte) et 1860 (ligne pourpre).

Furet n'ayant pas disposé de thermomètre à maxima, il est impossible de faire une comparaison directe entre son époque et la nôtre qui reposerait, selon la procédure longtemps standard, sur la moyenne des maxima et minima journaliers. La comparaison reste cependant possible à condition que les températures actuelles prises comme termes de comparaison aient été relevées aux mêmes heures, heures locales dans le principe, que celles de Furet. La différence de longitude entre Naha et Tokyo représentant seulement un écart d'environ une demi-heure, se caler sur l'heure officielle japonaise n'entraîne qu'une légère approximation, admissible ici. Nous pouvons ainsi utiliser les moyennes mensuelles de la température à Naha de six années récentes, 1991, 2001, 2018, 2020, 2021 et 2022, données pour chaque heure de relevé sur le site de la *Japan Meteorological Agency* (JMA), et à partir de ces moyennes faire la moyenne arithmétique des températures relevées à 6 h du matin et à 1 h du soir, ce qui équivaut à *Moy2* dans les observations de Furet [62].

La figure 14 montre les moyennes mensuelles de la température de l'air calculées de cette manière pour chaque groupe d'années: 1857-1860, d'une part, 1991, 2001, 2018, 2020, 2021 et 2022, d'autre part. La comparaison, quoique limitée, montre une hausse appréciable de la température de l'air entre ces deux périodes, soit sur un siècle et demi. Pour l'ensemble de l'année, elle s'élève d'environ 0,85° C; plus encore pour les seuls mois d'hiver où elle atteint 1,40° C. Durant les mois d'été, la hausse est de 0,67° C, mais elle reste faible durant les mois intermédiaires.

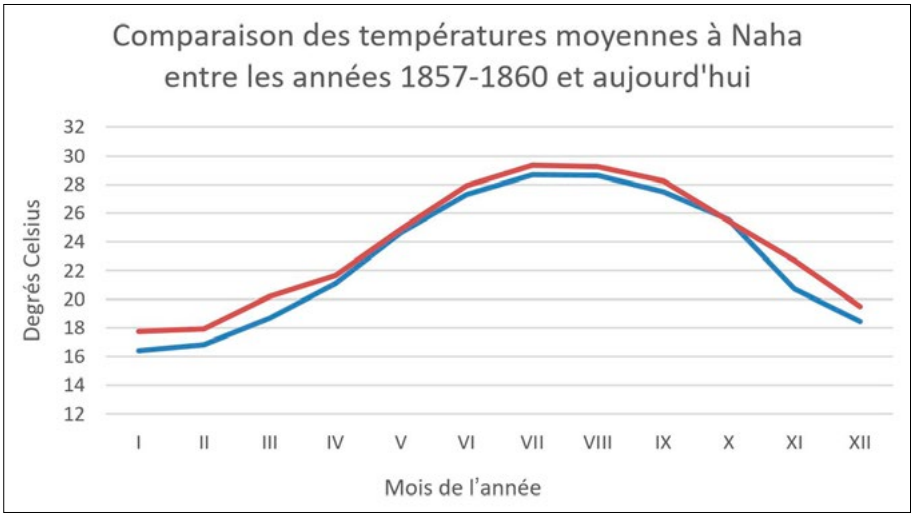


Fig. 14. — Moyennes mensuelles de la température de l'air, relevée à 6 h du matin et 1 h du soir pour les années 1857-1860 (ligne bleue) et 1991, 2001, 2018, 2020, 2021 et 2022 (ligne rouge).

Il est également permis de faire une comparaison reposant sur l'analyse séparée des températures de l'air à 6 h du matin et à 1 h du soir pour la même période de décembre 1856 à septembre 1858. L'évolution du climat apparaît alors plus manifeste pour les valeurs observées à 6 h du matin, surtout durant les mois d'hiver: l'écart des moyennes mensuelles de la température à 6 h du matin s'élève ainsi à 1,37° C sur l'année entière et à 1,88° C pour les seuls mois d'hiver, tandis qu'à 1 h du soir la différence n'est que de 0,77° C.

Cette comparaison entre les températures relevées au milieu du XIX^{e} siècle et celles de la période contemporaine est tributaire du mode de calcul de la température moyenne journalière

préconisé par l'«Instruction» de 1852. Quoique la valeur ainsi obtenue soit souvent très proche de la moyenne arithmétique des maxima et des minima, ce qui est la définition de la température moyenne journalière donnée par l'Organisation météorologique mondiale (OMM), les deux valeurs ne peuvent se confondre. Les résultats de la comparaison pourraient donc différer légèrement si on disposait aussi des maxima dans les observations de Furet. De plus, cette rapide comparaison peut évidemment pâtir de la disparité des instruments et du cadre environnemental des observations, ou également des conditions synoptiques pour les années 1857-1860.

Intéressons-nous maintenant au taux d'humidité dans l'air. Les figures 15 et 16 montrent les moyennes mensuelles de la tension de la vapeur en millimètres et celles des taux de l'humidité relative de février 1857 à juillet 1860 (la valeur manque pour novembre 1858), soit sur la période de trois ans et demi durant laquelle Furet a mesuré ces variables et calculé leurs moyennes mensuelles pour ses synthèses annuelles. Pour l'époque actuelle, les moyennes des taux d'humidité sur les vingt dernières années, calculées par nous à partir des valeurs moyennes mensuelles de l'humidité fournies par la JMA, sont d'environ 67 % en janvier et 70 % en février; elles montent à 83,5 % en juin et redescendent à 66 % en décembre. On voit que ces pourcentages sont nettement inférieurs à ceux trouvés par Furet au milieu du XIX^{e} siècle, respectivement 89 % (en février), 90,5 % et 89 %. Les tests que nous avons faits en soumettant les valeurs thermométriques et barométriques relevées par Furet à la formule thermodynamique utilisée par l'OMM attestent néanmoins de la fiabilité de ces pourcentages (Abbott & Tabony, 1985). Une mauvaise manipulation des thermomètres par Furet, observateur expérimenté et attaché à suivre les instructions, semble devoir être exclue. La différence entre les pourcentages qu'il a calculés et ceux mesurés de nos jours pourrait donc s'expliquer, mais ce n'est qu'hypothèse, par le changement des techniques de mesure ou par le fait que le lieu où Furet faisait ses observations était plus proche de la mer que le bureau de la JMA de Naha, ce dernier étant en outre situé en plein milieu urbain [63].

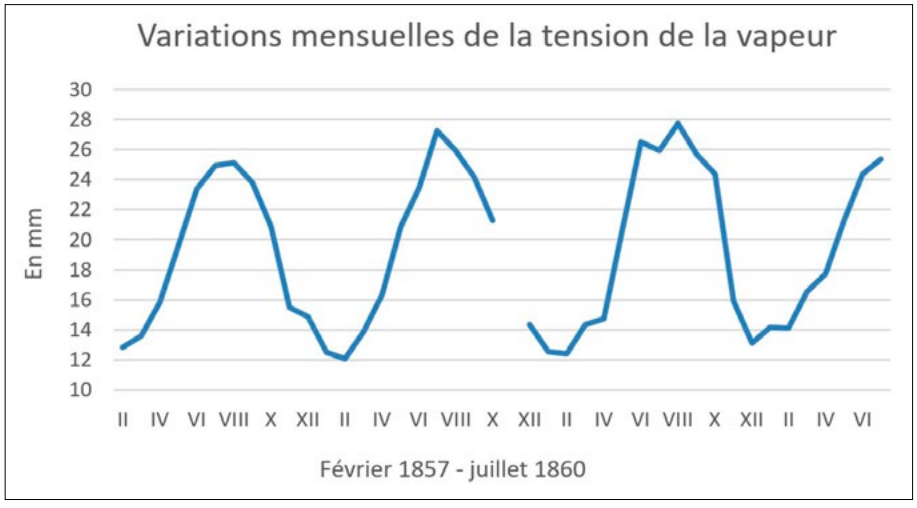


Fig. 15. — Moyennes mensuelles de la tension de la vapeur.

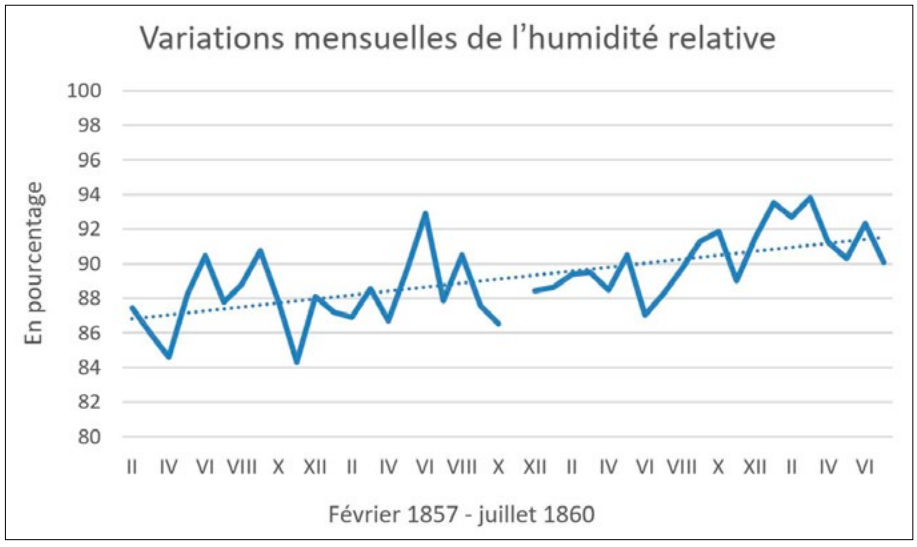


Fig. 16. — Moyennes mensuelles de l'humidité relative en pourcentage.

10. Conclusion

Les observations météorologiques de Furet bénéficient, on l'a vu, d'une publicité immédiate en France et même à l'étranger grâce à la notoriété de Charles Sainte-Claire Deville, leur destinataire, qui en fait lui-même la présentation à l'Académie des Sciences. Celui-ci n'en extrait cependant que quelques valeurs propres à souligner l'exemplarité d'un travail qui s'accomplit à l'autre bout du globe et répond aux attentes de la Société météorologique de France. L'intérêt pour les observations de Furet retombe ensuite très vite et elles connaissent l'oubli, comme tant d'autres, jusqu'à leur découverte, un peu inespérée, dans la bibliothèque de Météo-France. Cet établissement public est en effet l'héritier de la Société météorologique de France où elles avaient été déposées en juillet 1861. Héritier collatéral, à vrai dire, puisque la Société météorologique de France s'est dessaisie de ses activités de recherche et des données qu'elle archivait au profit du Bureau central de météorologie créé par le gouvernement en 1878 [64]. Son *Annuaire* continua à paraître, mais sans les tableaux météorologiques dont la publication fut dès lors assurée par ce nouvel organisme.

La Société météorologique de France elle-même n'a cependant pas cessé d'exister. Elle porte aujourd'hui le nom de «Météo et Climat. Société française de la Météorologie et du Climat» et a pour mission de faire connaître les recherches en ces domaines et de fédérer professionnels et amateurs concernés par celles-ci. Sa revue *La Météorologie. Revue de l'Atmosphère et du Climat* a succédé en 1925 à l'*Annuaire de la Société météorologique de France*, lui-même continuateur de l'*Annuaire météorologique de la France*, dont elle garda très longtemps la mention en sous-titre et auquel la rattache toujours sa numérotation par séries (Javelle, 1995). Quant à Météo-France, l'établissement naît en 1993 après les transformations du Bureau central de météorologie en un office national (1921), puis en une direction de la météorologie nationale (1945).

Le travail d'observation exigeant auquel Furet s'est livré participe du projet à long terme d'élaboration d'une science météorologique qui devait reposer, pour ses figures de proue — Haeghens, Deville ou Renou — sur une démarche inductive à l'instar des sciences naturelles

et sur une coopération bénévole transfrontière (Pyenson, 1993, pp. 24-25). Furet lui-même répondait indirectement — mais peut-être en avait-il eu connaissance en tant qu'enseignant — à l'appel adressé en 1847 par les trois fondateurs de l'*Annuaire météorologique de la France* avec lesquels, c'est à noter, il partageait une même inclination première pour les sciences naturelles. Abstraction faite de son statut de missionnaire, il est représentatif de cette génération d'observateurs qui s'adonnèrent, «sans d'autre but que celui d'être utile», à la patiente et indispensable accumulation de données chiffrées préalable aux généralisations et aux théories (Locher, 2009, p. 648; Walferdin & Bérigny, 1853).

Les applications pratiques que la météorologie recelait n'en étaient pas moins une motivation profonde partagée par tous ces premiers observateurs. «Si la Météorologie n'était qu'une science de pure curiosité, elle ne trouverait pas tant d'adeptes fidèles et persévérants» écrivait Martins dans l'introduction à l'*Annuaire météorologique de la France pour 1849*, avant de passer en revue toutes les améliorations que cette science en puissance, devenue «climatologie» [65], ambitionnait déjà d'apporter dans de très nombreux domaines: botanique, agriculture, sylviculture, prévention des fléaux atmosphériques, géologie, travaux publics, hygiène et médecine (Haeghens *et al.*, 1848, p. VI, *sq*.). Il reste que cette science paraissait «encore bien près de son berceau» et l'horizon de ses applications concrètes assurément lointain (Anonyme, 1852, p. 1).

Pourtant, moins de vingt ans après que Furet a arrêté ses observations, la création du Bureau central de météorologie consacre officiellement l'essor d'une météorologie prévisionnelle utile et fiable. Significativement, cette création arrive au lendemain de la mort de Deville, en 1876, et de celle, un an plus tard, du célèbre astronome Urbain Le Verrier qui avait obtenu de Napoléon III, en 1855, que fût institué à l'Observatoire astronomique de Paris un service météorologique dédié à la prévision, désormais concevable grâce au développement du télégraphe électrique [66]. Dès l'année suivante, ce service put fournir des avertissements de tempête et même un bulletin de presse quotidien; en 1857 il commençait à publier un bulletin international et en 1863 de véritables prévisions (Javelle & Rousseau, 2021; Locher, 2009). Ce progrès si rapide, qui s'accompagnait notamment d'une exigence de professionnalisation des observateurs, fit surgir des rivalités personnelles dont l'enjeu était la mainmise institutionnelle sur cette météorologie renouvelée. Celles-ci atteignirent un paroxysme avec la querelle mouvementée qui opposa l'observatoire météorologique du parc Montsouris à Paris, fondé en 1869 par Deville et Renou sous l'égide du ministère de l'Instruction publique et avec l'appui de la Société météorologique de France, au service météorologique de l'Observatoire de Paris dirigé par Le Verrier, imbroglio que la création du Bureau central de météorologie (1878) eut précisément pour effet de solder.

L'abolition complète du royaume des Ryūkyū décrétée par Tokyo le 4 avril 1879, onze ans après la fin du shogounat et le début de l'ère Meiji (1868-1912), a donné naissance au quarante-septième département japonais, ou département d'Okinawa [67]. À ce titre, les observations météorologiques conduites par Furet à Naha, devenue capitale du département, sont non seulement les premières observations instrumentales pour cette région, mis à part celles qui ont pu être faites sur des navires occidentaux de passage, mais elles constituent aussi la cinquième série la plus ancienne de données instrumentales pour tout le Japon [68]. Elles couvrent une période ininterrompue d'un peu plus de quarante-six mois pour la température, durée qui ne peut certes se comparer à celle des observations instrumentales accumulées depuis au moins 1819 à Nagasaki, bien que de façon discontinue, par le médecin et naturaliste bavarois Philipp

Franz von Siebold (1796-1866) et à sa suite d'autres agents de la *Vereenigde Oost-Indische Compagnie* (VOC), la Compagnie néerlandaise des Indes orientales (Mikami, 2023, pp. 85-119; Demarée *et al.*, 2000; Können *et al.*, 2003) [69]. Elles sont néanmoins plus conformes aux standards qui vont s'imposer dans la seconde moitié du XIX^{e} siècle, et aussi plus exhaustives pour les vingt et un mois allant de décembre 1856 à septembre 1858, avant le malencontreux bris du baromètre. Nous avons, par ailleurs, mentionné l'intérêt historique de la recension faite par Furet des tremblements de terre, phénomènes qui se sont ensuite complètement émancipés du domaine de la météorologie pour former une composante spécifique de la physique du globe.

La singularité historique et géographique de ces observations justifiait que l'on s'intéresse au détail de leur contenu, mais aussi au parcours personnel de celui qui les a conduites et au contexte institutionnel dans lequel s'inscrit sa contribution à une météorologie qui aspirait à devenir science. Nous avons examiné les protocoles et les modèles de tableaux auxquels il se référait, ses arrangements pratiques avec ceux-ci, les calculs et réductions auxquels il procédait pour ses synthèses mensuelles et annuelles, ainsi que ses observations des phénomènes atmosphériques ou telluriques non chiffrés. Sa correspondance renseigne aussi, de façon originale et sensible, sur les sécheresses et débuts de disette dont il a été le témoin. L'analyse des valeurs consignées dans ses tableaux, grâce à leur numérisation intégrale, nous a enfin permis, d'une part, de visualiser avec précision les conditions climatiques au sud de l'île d'Okinawa à l'époque de son séjour, d'autre part, d'esquisser une prudente comparaison avec les données thermométriques et hygrométriques contemporaines.

REMERCIEMENTS

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NOTES

[1] Sous le shogounat des Tokugawa, le gouvernement d'Edo n'avait en principe de commerce extérieur qu'à Nagasaki, dans un cadre très réglementé, et seulement avec les Pays-Bas, représentés par la *Vereenigde Oost-Indische Compagnie* (VOC), et des marchands privés chinois. Les îles Ryūkyū, mais aussi celles de Tsushima et d'Ezo, étaient d'autres voies d'échanges, par l'intermédiaire des seigneuries locales, avec la Chine, la Corée et les Aïnous. Royaume des Ryūkyū, Corée et Pays-Bas étaient chacun soumis à un régime diplomatique spécifique par le gouvernement shogounal.

[2] D'abord Augustin Forcade de 1844 à 1846, puis Pierre Le Turdu et Mathieu Adnet qui le remplacent. Ce dernier meurt à Okinawa en juillet 1848, et Le Turdu repart deux mois plus tard. Le missionnaire britannique, Bernard Jean Bettelheim, arrivé lui aussi en 1846, y reste jusqu'en 1854.

[3] Archives départementales de la Sarthe, fonds des cultes (série V, sous-série 1 V: clergé catholique séculier), «Livre des boursiers du séminaire du Mans (1808-1832)», cote 1 V 126 (auparavant VV 79).

[4] Furet s'initie au calcul intégral et différentiel avec Barthélémy Aoust, à la physique du globe avec Paul Desains, ancien élève de l'École normale supérieure, spécialiste du rayonnement thermique

et du magnétisme terrestre, qui sera nommé professeur à la faculté des sciences de Paris en 1854 et élu à l'Académie des Sciences en 1873. Ce dernier dirigeait l'école de mathématiques du collège Stanislas créée en 1842. Avec le Dr Jacques Lebaudy, Furet suit des cours d'anatomie et de médecine (Beillevaire, 1999, p. 3).

[5] Pour la région de la Sarthe en particulier, voir la remarquable étude de P. Foucault (2005).

[6] Dans sa correspondance avec son ancien collègue et proche ami de Précigné, l'abbé Charles Paumard, Furet fait allusion à ses contacts avec l'astronome François Arago (1786-1853), directeur de l'Observatoire de Paris (Beillevaire, 1999, p. 54).

[7] Il est à noter que Furet visite alors des fournisseurs d'instruments de laboratoire et se préoccupe notamment de l'achat d'un thermomètre à minima et à maxima pour le laboratoire de physique-chimie du petit séminaire de Précigné (Beillevaire, 1999, p. 65).

[8] La recherche de coquillages fossiles, très en vogue à l'époque, fut l'une de ses distractions favorites à Précigné et même durant son année rue du Bac aux alentours de la capitale (Beillevaire, 1999, pp. 49-65; 2018, p. 487).

[9] On trouve une utile présentation de l'organisation et des missions du Dépôt des cartes et plans de la Marine, institution créée en 1720, dans Foyot & Lanjalley, 1889.

[10] Alexandre Delamarche (1815-1884), diplômé de l'École polytechnique, membre de la Société de Géographie de Paris, fit en qualité de météorologue la campagne dans les mers de l'Inde et de la Chine à bord de la frégate *L'Érigone* de 1841 à 1844. Il représente la France à la conférence de météorologie maritime organisée à Bruxelles en 1853.

[11] Par l'intermédiaire du procureur des Missions étrangères à Hong-Kong, Furet adresse à P. Mathieu une carte manuscrite (AMEP, vol. 569, p. 432). Il demande au supérieur du séminaire de la rue du Bac d'obtenir de P. Daussy «une carte des mers du Japon ou de la Corée» (AMEP, vol. 139, p. 1307).

[12] Charles Sainte-Claire Deville (1814-1876), élève libre à l'École polytechnique, puis externe à l'École des Mines de Paris, géologue, volcanologue et météorologue. Ses recherches portent d'abord, et principalement sa vie durant, sur les phénomènes volcaniques. Durant les années 1840, il part les étudier à Ténériffe, aux îles du Cap-Vert et plusieurs fois aux Antilles (il était natif de Saint-Thomas dans les îles Vierges), puis dans les années 1850 et 1860, en Italie et aux Açores. Au cours de ses voyages océaniques, il conduit aussi des observations météorologiques, domaine d'activité auquel il accorde une part croissante de son temps, en particulier à son organisation et à son développement. Il est vice-président de la Société géologique de France lorsqu'il fonde en 1852 la Société météorologique de France avec Émilien Renou, entre autres. En 1857, il est élu à l'Académie des Sciences, et en 1861 à la présidence de la Société géologique de France. Ancien élève de Léonce Élie de Beaumont à l'École des Mines, il est son suppléant au Collège de France pendant vingt-trois ans avant de lui succéder en 1875 à la chaire d'histoire naturelle des corps inorganiques. En 1868-1869, associé à Renou et avec l'appui du ministère de l'Instruction publique, il fonde l'observatoire météorologique du parc Montsouris à Paris dont les attributions vont susciter une âpre rivalité avec le service météorologique de l'Observatoire de Paris dirigé par Urbain Le Verrier (voir plus bas). Dans les années 1870, le ministère de l'Instruction publique le nomme inspecteur général des établissements météorologiques, et, malgré une santé fragile, il se rend quatre fois en Algérie pour établir un service de climatologie et de prévision. Il se préoccupe aussi d'améliorer la coopération avec le service météorologique colonial (Renou, 1877; Dumas, 1888; Lacroix, 1929; Duvergé, 1995; Javelle & Rousseau, 2021).

[13] Lettres à Deville, Syncapour, 14 août 1853, et Hong-Kong, 27 octobre 1853 (AMF Furet).

[14] C'est sous la direction de Libois que la procure fut transférée de Macao à Hong-Kong en 1847. Les Missions étrangères se sont ainsi affranchies de l'emprise de l'Église portugaise pour profiter du libéralisme de la colonie britannique.

[15] Navire francisé à Bordeaux, appartenant à Dourdin aîné et Bonnet (registre de compte AR 1046, centre de documentation du Musée national des Douanes de Bordeaux).

[16] Le minimum de 14° C est observé le 10 avril 1855 et le maximum de 28,4° C le 29 avril à 2 h du soir.

[17] Souvent écrit *Sybille* par les auteurs français, y compris par des personnes embarquées à son bord.
[18] Louis Marie François Tardy de Montravel (1811-1864), nommé capitaine de vaisseau en 1852, fonde en 1854 la future Nouméa en Nouvelle-Calédonie. Sur la corvette *La Constantine*, il dirige la division navale française dans les opérations de 1855 en mer d'Okhotsk et à l'embouchure du fleuve Amour (Tagami *et al.*, 2019).
[19] Nicolas François Guérin (1796-1877), nommé contre-amiral en septembre 1854, succède à Adolphe Laguerre au commandement de la division navale de La Réunion et de l'Indochine dont dépend la station de la mer de Chine.
[20] Jean Barthe (1814-1866), qui a obtenu le titre de docteur en médecine en 1852 à Montpellier, participe aux dernières opérations franco-britanniques dans le Pacifique Nord en 1855 et 1856 à bord des frégates *La Virginie* et *La Sibylle*. Ses observations météorologiques, médicales et de sciences naturelles, accompagnées de lettres, ont été déposées par lui à l'Académie des Sciences en avril 1858 où elles font l'objet de plusieurs présentations. Elles sont conservées dans les archives de cette institution (Beillevaire *et al.*, 2018; Demarée *et al.*, 2019).
[21] Cette ignorance réciproque laisse imaginer une difficile entente entre le prêtre et le médecin, décrit par ses proches comme enjoué, mais vraisemblablement anticlérical et irréligieux.
[22] La convention conclue par Guérin n'eut pas l'assentiment du ministère des Affaires étrangères et ne fut jamais proposée à ratification.
[23] Bernard Thaddée Petitjean (1829-1884), du diocèse d'Autun, ordonné prêtre en mai 1853, entré au séminaire de la Société des Missions étrangères de Paris en juin 1859. Il sera nommé vicaire apostolique du Japon en mai 1866.
[24] Léonce Élie de Beaumont (1798-1874), géologue de grande renommée, professeur à l'École des Mines et au Collège de France, fait sénateur à vie en 1852, élu secrétaire perpétuel de l'Académie des Sciences en 1853. Jointe à sa «Notice sur les îles Lou-Tchou», Furet lui adresse une lettre en date du 5 juillet 1858, enregistrée le 7 février 1859 et conservée dans les archives de l'Académie des Sciences, Institut de France (Furet, 1859a).
[25] Claude Pouillet (1790-1868), physicien, ancien élève du Pensionnat normal (future École normale supérieure), élu à l'Académie des Sciences en 1837, professeur à la Faculté des Sciences de Paris, homme politique également, député de 1837 à 1848, partisan de la maison d'Orléans.
[26] Tableau des relevés à 6 h du matin de février 1858 (AMF Furet).
[27] C'est en fait à la date du 18 juillet 1858 qu'on lit 33,7° C, à la fois sur la feuille des relevés de 1 h du soir et dans le résumé du mois (AMF Furet).
[28] On lit 721,6 mm Hg à 4 h du soir le 18 mai 1857 (AMF Furet).
[29] Le tableau des relevés de décembre 1857 à 10 h du matin donne, à cette date, un maximum barométrique légèrement plus élevé, 773,3 mm Hg (AMF Furet).
[30] Résumé du mois de mai 1857 (AMF Furet).
[31] Synthèses annuelles de 1857 à 1860 (AMF Furet).
[32] Julien Haeghens (1808-1853), architecte de formation, élève de l'École des Beaux-Arts, promotion 1827 (Delaire, 1907, p. 288), s'initie à la météorologie et à la physique du globe durant son service militaire dans le Génie en Algérie. Natif de Paris, il vient se fixer à Versailles où il réside jusqu'à sa mort, à l'âge de 45 ans. Il y exerce le métier d'architecte-vérificateur. Membre de la Société des Sciences naturelles de Seine-et-Oise, il collabore au sein de celle-ci avec Jean Patrice Madden (1808-1889), professeur agrégé en poste au collège de Versailles, qui a entrepris des observations météorologiques en réponse à l'enquête lancée en 1841 par le Bureau de la statistique du ministère de l'Agriculture et du Commerce (Locher, 2009, p. 647). Mais c'est bientôt Haeghens qui poursuit seul ces observations et qui se fait remarquer pour sa rigueur et ses synthèses. En 1846, il instaure un protocole d'observations quotidiennes trihoraires avec Adolphe Bérigny (voir ci-après), également versaillais et membre de la Société des Sciences naturelles de Seine-et-Oise. Leur observatoire, lié à l'Institut agronomique de Versailles, est situé dans les mansardes de la Grande Écurie du château de Versailles (*Journal des Faits* du 18 novembre 1853, p. 6; Walferdin & Bérigny, 1853).
[33] Louis Adolphe de Deux-Ponts, dit Bérigny (1809-1885), né et mort à Versailles, docteur en médecine (Paris, 1834), longtemps médecin-chirurgien aux armées et dans la garde nationale, vice-pré-

sident de la Société météorologique de France et président de la Société des Sciences naturelles de Seine-et-Oise.

[34] Charles Fréderic Martins (1806-1889), docteur en médecine (Paris, 1834), botaniste, géologue et médecin français, d'une famille d'origine allemande. Traducteur d'ouvrages scientifiques, dont le manuel de climatologie de Ludwig Friedrich Kaëmtz, il entretint une correspondance avec Charles Darwin. Il fut membre de plusieurs expéditions scientifiques auxquelles il contribua notamment comme météorologue. En 1846, il fut nommé professeur de sciences naturelles à l'Université de Montpellier et devint peu après directeur du jardin des plantes de la ville. Il participa à la fondation de la Société météorologique de France en 1852. Il est possible que Bérigny et lui se soient connus durant leurs études de médecine à Paris puisqu'ils semblent avoir été diplômés la même année.

[35] L'année 1848 figure sur sa page de titre, mais il ne paraît qu'en 1849, chez Gaume frères à Paris, en raison de difficultés financières que connaîtront pareillement ses trois autres livraisons. C'est en effet avec leurs ressources personnelles que Haeghens, Bérigny et Martins assumaient le coût de sa fabrication.

[36] Il est notable que Martins mise déjà sur l'usage du télégraphe électrique qui n'est fonctionnel que depuis moins de dix ans. Six ans plus tard, il sera pour Urbain Le Verrier l'instrument primordial pour développer une météorologie prévisionnelle journalière.

[37] Fabien Locher (2009) indique que, dès mai 1851, devant les difficultés financières qui compromettaient la poursuite de l'*Annuaire*, Haeghens contacta le scientifique belge Adolphe Quetelet (voir ci-après), personnalité la plus renommée en matière de météorologie, pour trouver des fonds et qu'il entretint alors celui-ci du projet d'une association destinée à soutenir la revue.

[38] Émilien Jean Renou (1815-1902), géologue et météorologue, diplômé de l'École polytechnique et ingénieur du Corps des mines, de la même promotion qu'Urbain Le Verrier. Il renonce très tôt aux emplois publics pour vivre de l'exploitation d'un vaste domaine agricole. Il se fait alors «apôtre de l'observation météorologique ascétique» (Locher, 2009, p. 649). Fondateur avec Deville, en 1852, de la Société météorologique de France, dont il est longtemps le secrétaire et qu'il préside plusieurs fois, il est aussi à l'origine de l'observatoire du parc Montsouris où les observations débutent en 1869. Trois ans plus tard, à Saint-Maur-des-Fossés, où il réside, il crée une autre station météorologique qu'il dirige jusqu'à sa mort.

[39] Matthew Fontaine Maury (1806-1873), officier de la Marine américaine, pionnier de l'océanographie et de la météorologie marine modernes, il établit des statistiques à partir des informations contenues dans les journaux de bord de l'*US Navy*.

[40] Lambert Adolphe Quetelet (1796-1874), mathématicien, astronome, météorologue, statisticien, phénologue et fondateur de l'Observatoire royal de Bruxelles (Droesbeke, 2021).

[41] Robert FitzRoy (1805-1865), ancien commandant du HMS *Beagle* et ancien gouverneur de la Nouvelle-Zélande, membre de la *Royal Society*, élevé au grade de vice-amiral en 1863.

[42] Christoph Hendrik Diederik Buys Ballot (1817-1890), géologue, professeur de mathématiques et de physique, est le fondateur du KNMI qu'il dirige de 1854 jusqu'à sa mort. Il joua un grand rôle dans le développement de la coopération internationale et l'uniformisation des procédures d'observation.

[43] L'introduction de Charles Martins à l'*Annuaire météorologique de la France pour 1849* témoigne à la fois du caractère d'évidence qui s'attachait encore au néo-hippocratisme et des enjeux de santé cruciaux auxquels cette théorie confrontait la jeune science météorologique (pp. XXII-XXIV): «Toutes les maladies des organes respiratoires, et un grand nombre de celles des organes digestifs ont pour cause les vicissitudes atmosphériques». Par une connaissance précise des climats, la météorologie sert la médecine dont «la puissance sera pour ainsi dire doublée […] le jour où l'hygiène sera assez avancée pour indiquer à chacun le pays qu'il doit préférer». C'est aussi «la météorologie et la physique du globe qui doivent être interrogées en premier lieu [pour nous révéler] un jour le secret des grandes épidémies qui affligent l'humanité».

[44] Le baromètre portatif présenté en 1828 par Jean-François Bunten améliora celui conçu par Gay-Lussac en supprimant la gêne causée à l'observateur par la formation de bulles d'air (Savart & Arago, 1828; Saigey, 1828).

[45] Lettre à Deville, Nafa, le 10 octobre 1858: «Je pense qu'il avait été brisé pendant le déménagement de mes confrères. Je suis donc désarmé pour mesurer la pression atmosphérique et pour annoncer les typhons» (AMF Furet). Rappelons que Furet est à Hong-Kong lorsque ses confrères, début 1856, quittent le Seigenji pour prendre possession de la maison qu'ils ont fait construire à Kumemura. Un premier «tube de rechange pour le baromètre» avait été perdu durant la traversée du Havre à Hong-Kong (Lettre à Deville, Hong-Kong, 27 septembre 1853, AMF Furet).

[46] Lettre à Deville, Syncapour, 14 août 1853 (AMF Furet).

[47] On note qu'au bas des cinq tableaux des données journalières de février 1857, Furet mentionne les moyennes décadaires pour la tension de la vapeur et l'humidité relative, comme le recommande l'«Instruction» de 1852 (p. 20). Mais il ne continue pas les mois suivants.

[48] Jean Chamaison fut directeur au séminaire des Missions étrangères de 1847 à 1859. C'est par son intermédiaire que Furet rencontre en 1852 le secrétaire perpétuel de l'Académie des Sciences, Élie de Beaumont (lettre de Furet à Beaumont, Nafa, 5 juillet 1858, archives de l'Académie des Sciences). *Connaissance des Temps* est une publication annuelle créée en 1679 et destinée aux astronomes et aux navigateurs, le plus ancien périodique consacré à l'astronomie et à l'étude des phénomènes atmosphériques. Elle est à l'origine liée à l'Observatoire de Paris dont la construction s'achève vers 1672. À l'époque de Furet, elle a pris pour titre *Connaissance des Temps ou des Mouvements célestes à l'Usage des Astronomes et des Navigateurs* et c'est le Bureau des longitudes, créé en 1795, qui est responsable de sa rédaction.

[49] La lettre est bien de novembre 1860 et cet apparent anachronisme, puisque Furet a poursuivi ses relevés de température et autres observations jusqu'en octobre 1860, nous paraît devoir être interprété comme l'expression de sa détermination à ne plus se préoccuper de météorologie, à moins qu'il n'ait pensé au baromètre cassé deux ans plus tôt, en septembre 1858.

[50] En juillet 1855, après le retour imprévu de Furet à Hong-Kong, Libois confiait à Tesson, directeur au séminaire de Paris: «Le bon P. Furet est trop infatué de la science et il en parle trop souvent et trop volontiers» (AMEP, vol. 314, p. 1619).

[51] Les navires ryūkyū pour la Chine refusaient de transporter des caisses pour les missionnaires. Les mots en italique ont été soulignés par Furet.

[52] C'est le comité météorologique permanent institué par le congrès de Vienne et présidé par Buys Ballot qui forgea l'OMI, officiellement fondée lors du congrès de Rome en 1879. La France n'a pas eu de représentant au Congrès météorologique de Vienne en raison des querelles entre les météorologues de l'observatoire du parc Montsouris et ceux de l'Observatoire de Paris que venait alors de reprendre en main Urbain Le Verrier, démis de sa direction à la chute de l'Empire en 1870 (Javelle & Rousseau, 2021, p. 25; voir aussi plus bas). L'Organisation météorologique mondiale (OMM) a succédé à l'OMI en 1951.

[53] *Java-Bode, Nieuws, Handels- en Advertentieblad voor Nederlands-Indie*, A° 1857, zaterdag 5 december, n° 97; *De Oostpost: Letterkundig, Wetenschappelijk en Commercieel Nieuws- en Advertentieblad*, donderdag 10 december [1857].

[54] On trouve la liste des typhons et tempêtes tropicales enregistrés à Okinawa par Furet et par le missionnaire britannique Bernard Jean Bettelheim entre 1844 et 1862 dans Beillevaire, 2018, p. 497.

[55] Leur maison était située à environ 500 m du rivage et à une dizaine de mètres d'altitude.

[56] Résumé du mois de janvier 1857 (AMF Furet).

[57] Résumé du mois de mars 1857 (AMF Furet). Busa (de *bosatsu*), divinité protectrice amalgamant la figure de Maso, ou Tenpi sous son nom honorifique, déesse vénérée dans la province chinoise du Fujian (Mazu en chinois), avec la croyance dans le pouvoir protecteur de la sœur aînée (*onarigami*) centrale à la culture d'Okinawa; *fotoke*, *hotoke* au Japon, littéralement *buddha*, est ici synonyme d'ancêtre.

[58] Lettre à Gustave de Lorière à Asnières-sur-Vègre (Sarthe), Naha, 10 septembre 1857 (archives de la famille Bollée).

[59] Lettre à Henri Couillard, sous-procureur des Missions étrangères à Hong-Kong, Naha, 20 septembre 1860 (AMEP, vol. 569, p. 515).

[60] Lettre à Libois, Naha, 5-12 novembre 1860 (AMEP, vol. 569, p. 540).

[61] Lettre à Libois, Naha, 21 septembre 1862 (AMEP, vol. 569, p. 835).
[62] Le choix de ces trois années n'est pas totalement arbitraire: 1991 est la première année où figurent les heures des relevés pour Naha; avec 2001 débute le XIX^{e} siècle et 2018, 2020, 2021 et 2022, années plus récentes, reflètent sans doute mieux l'évolution climatique en cours.
[63] Les thermomètres à bulbe sec et bulbe humide utilisés par Furet ont aujourd'hui fait place à des senseurs électroniques. Son usage des tables psychrométriques de Delcros-Haeghens est correct, avec les approximations numériques de l'époque, mais leur validité pour le climat d'Okinawa pourrait faire question.
[64] La création de ce bureau coïncide avec celle de l'OMI avalisée officiellement l'année suivante lors du Congrès météorologique international qui se tint à Rome.
[65] Le terme est d'apparition toute récente. Il aurait été introduit par Alexander von Humboldt en 1843.
[66] Urbain Le Verrier (1811-1877), ancien élève de l'École polytechnique, astronome découvreur de Neptune par le calcul, partisan de Napoléon III qui le fait sénateur à vie. En 1854, il succède à François Arago à la direction de l'Observatoire de Paris. La guerre de Crimée, qui est à l'arrière-plan de l'interruption inopinée du séjour de Furet à Okinawa en mai 1855, est également à l'origine du service de météorologie créé à l'Observatoire de Paris. C'est en effet la destruction d'environ quarante navires de la flotte franco-anglo-turque par une tempête en mer Noire le 14 novembre 1854 qui amena Le Verrier à proposer à Napoléon III la création d'un service qui centraliserait et diffuserait rapidement les informations météorologiques afin de prévenir de telles catastrophes (Javelle, 2011).
[67] La première étape de l'annexion du royaume par Tokyo a été sa transformation en fief (*han*) dès 1872.
[68] Voir le tableau «Instrumental observations in nineteenth-century Japan» sur la page «Early Instrumental Data» du site web du *Japan-Asia Climate Data Program* (22 août 2023), tiré de l'article de Zaiki *et al.*, 2006; et aussi Mikami, 2023, p. 89.
[69] Les plus anciennes observations météorologiques instrumentales faites au Japon semblent être celles conduites sur l'îlot de Dejima, durant dix mois continus, par le Suédois Carl Peter Thunberg qui y fut en poste d'août 1775 à novembre 1776 en qualité d'employé de la VOC (Mikami, 2023, pp. 85, 88-90). Rappelons qu'après l'expulsion des Portugais en 1641, les Pays-Bas, représentés par cette compagnie, étaient le seul pays européen autorisé à venir commercer au Japon et à entretenir des relations diplomatiques avec le gouvernement shogounal.

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ANNEXE

Précipitations à Naha en avril et mai 1855, et de décembre 1856 à septembre1858.
(Échelle d'intensité: 1: bruine ou brouillard; 2: pluie légère; 3: pluie moyenne; 4: forte pluie; 5: pluie torrentielle)

			1855	**1855**
Année	**Mois**	**Jour**	**Matin (6 h et 10 h)**	**Soir (2 h et 6 h)**
1855	4	2	2	3
1855	4	6	2	2
1855	4	12		1
1855	4	13		1
1855	4	14	1	
1855	4	18		Petite pluie pendant la nuit
1855	4	19	Pluie pendant la matinée	
1855	5	2	Pluie fine	
1855	5	4	Pluie vers midi	Et le soir

			1856		**1856**	
Année	**Mois**	**Jour**	**6 h du matin – 6 h du soir**	**Int.**	**6 h du soir – 6 h du matin**	**Int.**
1856	12	19	Pluie légère de temps à autre	2	*Id.*	2
1856	12	20	*Id.*	2	*Id.*	2
1856	12	23			Pluie légère	2
1856	12	24	Pluie légère jusqu'à 3 h soir	2		
1856	12	31			Pluie légère de 4 h à 5 h ½ matin	2
			1857		**1857**	
Année	**Mois**	**Jour**	**6 h du matin – 6 h du soir**	**Int.**	**6 h du soir – 6 h du matin**	**Int.**
1857	1	2	De 6 à 10 h, quelques gouttes		De 6 à 8 h, *id*.	
1857	1	9			De 6 à 7 h, quelques gouttes	
1857	1	12			Dans la nuit, quelques gouttes	
1857	1	17		2		
1857	1	20	De 6 à 1 h, pluie très légère	2	De temps à autre	2
1857	1	21			Pluie légère	
1857	1	22	Un peu de pluie pendant la nuit			
1857	1	25			Pluie légère	

1857	1	26	De 11 h à 6 h, pluie modérée	2		
1857	1	30			De 4 h à 6 h, pluie modérée; orage, tonnerre dans tout l'O. dans la soirée	2-3
1857	1	31	Petite pluie par intervalles	2		
1857	2	2	Quelques gouttes	1-2	Plusieurs averses, pluie dans la nuit	3
1857	2	3		2		
1857	2	4		2	Pluie modérée, quelques gouttes	
1857	2	5	Jusqu'à 1 h, pluie modérée	2-3	De 8 à 10 h, pluie modérée	1
1857	2	6	De 9 h ½ à 11 h, pluie modérée	2		
1857	2	7	De 3 h ½ à 4 h, averse	3		2
1857	2	9	Vers 1 h, pluie modérée		À 10 h, quelques gouttes	1
1857	2	13			De 6 h ½ à 7 h, pluie légère	
1857	2	16	De 4 h à 5 h, pluie forte	4		
1857	2	23	Quelques gouttes à 10 h	1		
1857	2	24			Pluie légère de 6 h à 7 h	
1857	2	25	De 11 h à 12 h ½, pluie forte	3		
1857	2	26	Vers 9 h, quelques gouttes	1		
1857	3	1	De 6 à 1 h, pluie	2-3	Pluie modérée, pendant 2 h	1
1857	3	2	Petite pluie, quelques gouttes	1		
1857	3	8	De 9 h à 12 h, pluie légère	1		
1857	3	9	Qq. gouttes de temps à autre		Quelques gouttes de temps à autre	
1857	3	12	De 11 h à 1 h, pluie légère	2		
1857	3	22	De 9 h à 10 h, pluie modérée	2		
1857	3	30	De 5 h ½ mat. à 7 h, pluie légère	1		
1857	3	31			De 3 h ½ à 4 h ½, pluie modérée	2
1857	4	13			Quelques gouttes vers 9 h	
1857	4	17	De 11 h ½ à midi, pluie			
1857	4	18	De 1 h à 2 h, pluie légère	1		
1857	4	20	Vers 4 h, pluie	2		
1857	4	21	De 6 h à 8 h	2		
1857	4	22	De 12 h à 1 h	2		
1857	4	23	Pendant 2 h	2		
1857	4	26	De 8 h ½ à 11h ½	3	2 ou 3 h pendant la nuit	3
1857	4	27	Presque toute la journée	2-3	Presque toute la journée	
1857	4	28	Vers 1 h, ½ h de pluie	1		
1857	5	8	Vers 7 h ½ jusqu'à 8 h	1	De 11 h à 12 h, éclairs au nord	3
1857	5	9	De 7 h ½ à 9 h	3		
1857	5	12	À 3 h, grand vent, peu de pluie			
1857	5	13	De 1 h à 2 h	1	De 6 h ½ à 7 h ½	2
1857	5	16	À 12 h et vers 2 h	3		
1857	5	17	Pendant presque toute la journée	1-4		
1857	5	18	Une partie de la journée, typhon	2-3		
1857	5	19	Vers 6 h jusqu'à 7 h ½	2		

1857	5	25	Pendant la journée depuis 9 h	2-3	Et pendant la nuit	3
1857	5	26	De 6 h jusqu'à 8 h	2		
1857	5	29			Pluie pendant la nuit	1
1857	5	30	Depuis 3 h du soir	2	Jusqu'à 7 h du soir	2
1857	5	31		1-2		
1857	6	6	6 h ½-7 h et 4 h- 5 h, petite pluie	2		
1857	6	13	Le matin pendant 1 h ½	2		
1857	6	16			De 8 h à 10 h, éclairs et tonnerre à l'O.	2
1857	6	17	De 4 h ½ à 6 h	2		
1857	6	18	Pendant 4 ou 5 h	3		
1857	6	20		2		
1857	6	22	De 6 ½ à 7 h, et de 9 ½ à 11 h	2-3		
1857	6	30			¼ d'heure	3
1857	7	7	De temps en temps	2-3		
1857	7	8	*Id.*	3		
1857	7	22	Pluie pendant 1 heure	3		
1857	7	27	De 4 h ½ soir à 5 h ½	3		
1857	7	28	¾ d'heure	2		
1857	7	31	½ heure	2		
1857	8	1	De 10 h à 11 h ½	2		
1857	8	3	De 3 à 4 h (tonnerre)	2		
1857	8	4	De 2 h ½ à 4 h (tonnerre)	3		
1857	8	6	De 2 h à 3 h	2		
1857	8	7	½ heure	2		
1857	8	10	1 heure	3		
1857	8	18	Vers 4 h, 1 h ½	3	Entre 4 et 5 h	3
1857	8	19	De 9 h à 10 h	3	Vers 5 h, ½ heure	2
1857	8	22			Vers 10 h, ½ heure environ	3
1857	8	23	Averses de temps en temps	[2]	Averses de temps en temps	[2]
1857	8	24	Quelques averses	[2]	Quelques averses	[2]
1857	8	25	*Id.* le matin	[2]		
1857	8	26	Pluie le matin (de 4 h à 6 h)	3		
1857	8	27	*Id.*	3	Le soir, tonnerre dans le nord	
1857	8	29			½ heure la nuit, orage, averses	3
1857	9	2	Pluie pendant 2 heures	3		
1857	9	3	Averses pendant la journée	3		
1857	9	5	Pendant 1 heure	2		
1857	9	6	Pluie presque continue	3	Pluie presque continue	3
1857	9	7	À 7 h et à 4 h, quelques averses	3		
1857	9	18			Vers 7 à 8 h du soir	1
1857	9	19				2
1857	9	22	De 9 h ½ à 4 h ¼	2		

1857	9	23	De 2 h à 3 h ½	3		
1857	9	28			Quelques averses dans la soirée	
1857	10	6	Entre 3 et 4 h, averse	3	À 7 h éclairs, après 12 h tonnerre pluie	
1857	10	11	De 5 à 6 h, éclairs vers le N.	3	Pluie 1 h ½ le soir	3
1857	10	15	De 6 h à 7 h, petite pluie	2		
1857	10	20	Vers 4 h, petite pluie	2		
1857	10	22	Pluie et tonnerre pendant presque toute la journée	3		
1857	10	23	Pluie pendant toute la journée	3		3
1857	10	24	Pluie le matin	3		
1857	11	1	De 4 h à 5 h	3		
1857	11	13	Pendant 2 h environ	2		
1857	11	19			De 10 h à 11 h	3
1857	11	24	Pendant ½ h	2		
1857	12	2	Vers 1 h, pendant ½ h	3		
1857	12	10			Vers 7 h, pendant ½ h, et la nuit	2-3
1857	12	11	Vers 6 h, pendant 1 h environ	2		
1857	12	19			Vers 7 h, 1 heure environ	2
1857	12	20	De 10 h à 12 h	2	Pluie dans la nuit	2
1857	12	21	Pluie dans la matinée	2	Pluie pendant la nuit	2
1857	12	22	Pluie dans la soirée	3	De 9 h à 10 h	3
1857	12	25	À 6 h, pluie pendant 2 ou 3 h	2	À 10 h	2
1857	12	26	À 10 h, à 1 h, 2 h environ	2-1		
1857	12	27	De 4 h à 5 h	3	De 9 h ½ à 10 h ½	2
1857	12	28	De 6 h, 1 h à 1 h ½ h de pluie	2		
1857	12	29	De 6 h, averses sporadiques	2		
			1858		**1858**	
Année	Mois	Jour	6 h du matin – 6 h du soir	Int.	6 h du soir – 6 h du matin	Int.
1858	1	2	Vers 6 h, une averse d'½ h	2		
1858	1	3	À 10 h et à 4 h, pendant 2 h ½	3-2		
1858	1	5	Vers 2 h, brouillard pendant 3 h	3		
1858	1	7	De 6 à 8 h, pendant 2 h environ	2		
1858	1	9	Vers 6 h ½, brouillard ½ heure	3		
1858	1	11	Vers 4 h, pendant 1 h ½	3	Tonnerre au N.O. et N. entre 10 h-11 h	
1858	1	13	À 10 h et à 4 h, pendant 2-3 h	2		
1858	1	19			Vers 8 h, pendant 1 h, léger brouillard	2
1858	1	24	Pluie pendant toute la journée	2-3	Pluie pendant toute la journée	2-3
1858	1	26			Pluie pendant la nuit	
1858	1	30	De 1 h à 4 h	1		
1858	2	7	Petite pluie ½ h, brouillard	1		
1858	2	15	À 6 h et à 8 h, tonnerre lointain	3		

1858	2	18	À 10 h, pendant 1 heure, brume	1		
1858	2	19			Le soir vers 9 h ½, un peu de grêle	
1858	3	1			Vers 4 h, pendant 1 heure	3
1858	3	3	De 8 à 10 h, tonnerre	3		
1858	3	5	Pluie grande partie de la journée	2	Pluie grande partie de la journée	2
1858	3	8			3 à 4 h, grande pluie, éclairs, tonnerre	4
1858	3	11	De 6 h à 1 h	2		
1858	3	14	De 3 h ½ à 5 h	2		
1858	3	15			De 9 h ½ à…	2
1858	3	16	De 1 h à 5 h	2		
1858	3	17	De 6 h à 7 h	1		
1858	3	19			De 9 h ½ à…	2
1858	3	20	De 6 h à 2 h	2		
1858	3	21	De 6 h à 7 h ½	2		
1858	4	1			Le soir, tonnerre dans le lointain	
1858	4	2			Brouillard le soir, éclairs et tonnerre	
1858	4	3	Pluie une partie de la journée			
1858	4	6	De 6 h à 2 h, tonnerre à 11 h ½	2-3		
1858	4	9			À 10 h, léger brouillard	2
1858	4	13			De 10 h à…	1
1858	4	14	De 4 h à 6 h	2	De 7 h ½ à…	3
1858	4	15	Pluie dans la journée			
1858	4	23	De 10 h à 5 h	2-3		
1858	4	27	4 h, qq. instants, léger brouillard	1		
1858	4	29	Bruine pendant la journée			
1858	5	11	De 5 h à 3 h, éclairs, tonnerre	2	Le soir, brouillard	
1858	5	18	De 9 h ½ à 11 h	2		
1858	5	20	De 6 h à 11 h	1		
1858	5	21	De 12 h à 2 h	1		
1858	5	22	Une partie de la journée	1		
1858	5	28			Le soir, tonnerre et éclairs lointains	
1858	5	30			Éclairs et tonnerre	
1858	5	31	De 10 h à 5 h, éclairs	2		
1858	6	1	De 3 h à 5 h	3		
1858	6	2	Pendant presque toute la journée	3		
1858	6	3	Pendant la journée, éclairs à l'O.	3		
1858	6	4			De 4 h à 5 h ½, pluie torrentielle	4
1858	6	5	Pendant presque tout le jour	3-4		
1858	6	6	De 6 h à 7 h ½	2		
1858	6	8			De 4 h à 6 h	2
1858	6	9			De 4 h à 5 h	2
1858	6	10	Pendant tout le jour et la nuit	2	De 4 h ½ à 6 h	3

1858	6	11	De 9 h à 11 h	2	Une partie de la nuit	2
1858	6	12	De 9 h à 6 h	3-2	De 4 h à 5 h ½	2
1858	6	15			De 7 h à 5 h, presque toute la nuit	2-3
1858	6	16	De 6 h à 7 ½	2	Toute la nuit	3
1858	6	17	Pendant toute la journée	3	Jusqu'à 10 h du soir	3
1858	6	18	De 9 h à 5 h	3		
1858	6	19	De 1 h ½ à 6 h	2	Dans la nuit	3
1858	6	23			À 10 h, pendant ½ h	3
1858	7	1	De 7 h à 8 h	3		
1858	7	5	De 5 h à 5 h ½	3		
1858	7	6			De 4 h ½ à 6 h	2
1858	7	11	Le matin et de 4 h à 6 h	1-3	Tonnerre au N.E. dans la soirée	
1858	7	12			Orage sans pluie	
1858	7	19			Le soir, orage à l'E. sans pluie	
1858	7	20			Orage à l'ouest = Tr. de terre à 6 h 54	
1858	7	21	Pendant une partie de la journée	2-3		
1858	7	25	Brume le matin		Éclairs et tonnerre lointains au N.E.	
1858	7	26			Éclairs et tonnerre le soir	
1858	7	27	De 3 h ½ à 4 h ½	2		
1858	7	28	De 11 h à 12 h, tonnerre	3	Tonnerre lointain dans le N.	
1858	7	30	De 10 h à 10 h ½, tonnerre	2		
1858	8	3	De 1 h à 2 h	3		
1858	8	4	De 2 h à 4 h, léger brouillard	3		
1858	8	5	De 7 h ½ à 8 h ½	2		
1858	8	6	De 3 h ½ à 10 h, averses	3	Le soir, éclairs dans le S.	3
1858	8	7	Éclairs et tonnerre dans le S.		Éclairs et tonnerre dans le S.	
1858	8	8	De 9 h ½ à 10 h	3		
1858	8	9	De 10 h à 11 h ½, éclairs au S.	3	De 4 h ½ à 5 h ½, éclairs au N.	3
1858	8	10	Pluie dans la nuit, la matinée	3	Et le soir	3
1858	8	18	De 1 h à 10 h	2-3	Pendant toute la soirée et la nuit	2-3
1858	8	19	Une grande partie de la journée	2-3	Pendant la nuit	2-3
1858	8	20	Et jusque vers midi	3		
1858	8	27			Très fort orage, grande pluie la nuit	[5]
1858	9	3			De 9 h ½ à 10 h	3
1858	9	7	De 3 h à 4 h	2		
1858	9	9	De 11 h à 12 h, de 5 h à 6 h ½	1-3		
1858	9	11	Une grande partie de la journée	2-3		
1858	9	13	De 5 h à 6 h	3		
1858	9	18	De 10 à 11h ½, éclairs au N.E.	2-3		
1858	9	20			¾ h, orage le soir au N. et N.O.-N.E.	2
1858	9	27	Le matin, orage au N.-N.O, ½ h	3	Soir, 7 h à 10 h, pluie, éclairs, tonnerre	

In memoriam

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Chéibane Coulibaly

(Bamako, Mali, 12 juillet 1950 – Bamako, 22 septembre 2021)

Chéibane Coulibaly est un des grands intellectuels maliens ayant marqué tant le monde intellectuel que politique de son pays. Très impliqué dans les questions de développement du Mali, il a axé ses recherches sur le monde rural africain et les problèmes fonciers.

Il obtient tout d'abord une maîtrise en philosophie à l'École normale supérieure de Bamako, en 1973, puis un master en sociologie et un doctorat en socio-économie du développement à l'Université de Paris I, Panthéon-Sorbonne, en 1985. Dès lors, il mène de nombreuses recherches, en tant que consultant pour le compte du Mali, pour la FAO, la Banque mondiale, l'Union africaine, l'Union Européenne, ou encore la CEDEAO (Communauté économique des États de l'Afrique de l'Ouest).

De 1998 à 1999, il est chercheur associé et enseignant à l'Université d'Indiana et à l'Université de Harvard. Il a également été professeur invité à l'Université libre de Bruxelles.

Très actif dans la mise en place de journaux scientifiques, il sera directeur de publication de *Kolonkise*, journal édité en bambara de 1997 à 1999, et de *Cauris*, hebdomadaire édité en français à partir de 1990.

En 1987, il fonde l'Institut malien de Recherches appliquées au Développement qu'il dirigera jusqu'en 1999, créant finalement la même année l'Université Mandé Bukari à Bamako.

Politiquement très actif pendant une période de sa vie, il est conseiller spécial du président de l'Assemblée nationale du Mali de 2003 à 2006. Il est nommé conseiller technique, chef de la cellule «Développement agricole et Environnement» auprès du Premier ministre en 2014 et directeur de la «Mission de restructuration du secteur coton» rattachée au ministère du Développement rural. C'est là qu'il œuvre pour la restructuration du coton malien. En particulier, il conseille d'impliquer les producteurs de coton dans le capital de la Compagnie malienne pour le Développement des Textiles afin de les inciter à produire plus et de mettre en place un fonds d'appui pour amortir les variations du cours mondial du coton. Comme le Mali ne transforme que moins de 2 % de son coton, il tente de convaincre le gouvernement d'investir dans des usines de filature.

Outre les engagements et les batailles politiques, Chéibane Coulibaly est surtout connu pour son rôle dans la création et la promotion de l'Université Mandé Bukari (UMB), créée en 1999 et reconnue par les autorités publiques en 2008. Il y sera promu à l'honorariat en 2015.

L'Université se profile progressivement comme une référence dans l'enseignement supérieur et la recherche scientifique au Mali. C'est à cette période que commencent les collaborations

avec l'Université libre de Bruxelles par des recherches menées sur les questions foncières au Mali.

L'Université devient un des partenaires importants du projet européen Edulink. Dans ce cadre, elle lance pour l'année académique 2009-2010 un centre d'excellence avec l'ouverture d'une filière «Politiques agricoles et économies paysannes». Cette dernière consiste en la mise en place d'un «master en politiques agricoles et économies paysannes» dont les meilleurs étudiants pourront préparer une thèse de doctorat en cotutelle avec l'Université libre de Bruxelles. La formation des doctorants inclut des séjours d'études à l'ULB. Edulink, outre sa prise en charge par l'Union européenne, bénéficie de l'appui de l'Union économique et monétaire ouest-africaine et aussi de ceux du ministère malien de l'Agriculture et de l'Institut d'Économie rurale. L'objectif est également de fonder un vaste réseau d'expertise et un pôle d'excellence de promotion des politiques de développement rural. L'Université Mandé Bukari crée alors un cadre de collaboration avec les universités de Bamako, Ouagadougou et Conakry pour l'exécution de son master en politiques agricoles et économies paysannes. Les professeurs viennent d'Europe et des universités partenaires. Le programme comporte un volet recherche avec l'installation d'un observatoire des politiques agricoles dans chacune des universités africaines partenaires. Les responsables de l'UMB s'engagent à la publication des résultats dans la revue trimestrielle *Les Cahiers de Mandé Bukari* qui est renforcée pour l'occasion. Malheureusement, pour des raisons liées à la complexité des financements, le projet s'arrêtera après deux ans.

Chéibane Coulibaly est également un auteur prolixe dont les écrits ont une grande répercussion dans son pays. Il a publié de nombreux rapports d'étude sur les politiques rurales et les questions foncières mais aussi sur la politique globale de son pays dans laquelle la décentralisation, un de ses combats, tient une place privilégiée. Outre de nombreux articles scientifiques, on lui doit les ouvrages suivants: (en coll. avec Maxime Haubert *et al*.), *Politiques alimentaires et structures sociales en Afrique noire* (Paris, PUF/IEDES, 1985); *Problématique foncière et gestion des conflits en Afrique noire* (Bamako, Le Cauri d'Or, 1997); *Politiques agricoles et stratégies paysannes au Mali: le règne des mythes à l'Office du Niger* (Bamako, Le Cauri d'Or, 1998); *Comme un petit air de démocratie bananière!* Recueil de pamphlets sur la vie politique ouest-africaine des dix dernières années (Bamako, Le Cauri d'Or, 2000).

Ses dernières recherches seront publiées aux éditions l'Harmattan à Paris. En 2014, sort *Politiques agricoles et stratégies paysannes au Mali de 1910 à 2010: mythes et réalités à l'Office du Niger* et, en 2015, *Problématique foncière et gestion des conflits en Afrique noire: des indépendances à la faillite des dictatures, 1960-1990.* Ce livre prévu en deux tomes n'en verra que le premier, le second ayant été probablement interrompu par le décès de Coulibaly.

L'un de ses derniers écrits, publié en 2016, toujours à l'Harmattan, est *Crise politico-institutionnelle au Mali. Essai de philosophie politique Mandingue*, dans lequel il fait le procès de la III^{e} République malienne. En particulier, il l'accuse d'avoir négligé les questions de développement.

Avec la disparition de Chéibane Coulibaly, l'Afrique perd l'un de ses plus grands spécialistes du monde rural et l'ARSOM l'un de ses brillants correspondants étrangers.

Firouzeh Nahavandi

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Paul Antun

(Luxembourg, 8 septembre 1920 – Tandel, Grand-Duché de Luxemboug, 28 décembre 2012)

Paul, Théodore, Albert Antun est né à Luxembourg-ville, Grand-Duché de Luxemboug, le 8 septembre 1920. Il est le fils de Jean (Johannes) Antun (1885-1974) et d'Anne Van der Vekene (1887-1962) et possède la nationalité luxembourgeoise par filiation. Il a épousé Suerdna Gupffert qui ne lui a pas donné de descendance. Il est décédé le 28 décembre 2012 à Houschterhaff (Hoscheidterhof en allemand) appartenant à la commune de Tandel, Grand-Duché de Luxembourg.

Après des études primaires à Luxembourg-Clausen, de 1926 à 1932, il effectue sept années d'humanités à l'Athénée grand-ducal, de 1932 à 1939, en section latine, avec un complément en mathématiques spéciales, et obtient le certificat de maturité en 1939. Visant une carrière d'ingénieur des eaux et forêts, il entame ensuite une première année aux Cours supérieurs de l'État à Luxembourg, en section sciences naturelles et mathématiques qui correspond à l'épreuve de première candidature ou de bachelier des universités belges. Mais cette orientation ne pourra pas être poursuivie à cause de l'invasion allemande de la Seconde Guerre mondiale.

Il s'oriente alors vers la géologie. De 1940 et jusqu'à septembre 1942, il étudie à l'Université de Bonn sous la direction du professeur H. Cloos et obtient à la fin du quatrième semestre un prédiplôme de géologue avec la plus grande distinction (diplôme équivalant à celui de la deuxième année de candidature belge). Mais, en septembre 1942, il est enrôlé de force dans la *Wehrmacht* et sera envoyé sur le front de l'Est, n'ayant pas réussi à se faire enrôler dans une unité militaire s'occupant de géologie. La guerre terminée, il reprend des études de géologie à l'Université de Liège sous la direction de Paul Fourmarier et obtient le grade de licencié en sciences géologiques et minéralogiques le 28 novembre 1948 avec la plus grande distinction. Son travail de fin d'études portait sur l'analyse des joints dans l'éodévonien luxembourgeois et de leurs relations avec les déformations majeures.

Sa carrière de géologue débute en 1948 à l'Université de Liège, comme assistant à temps plein au laboratoire de pétrographie du professeur Paul Michot, période qu'il mettra à profit jusqu'en 1955 pour la réalisation d'un doctorat. Le 3 octobre 1955, il décroche le grade de docteur en sciences géologiques et minéralogiques avec grande distinction. Son mémoire avait pour sujet la géologie et la pétrographie des dykes de dolérite de la région d'Egersund (Norvège méridionale). Dans une thèse annexe, il démontrait que les roches dites maclifères de Libramont ne sont pas des microdiorites saussuritisées. Pendant son séjour à l'Université de Liège, il rédige aussi plusieurs rapports d'expertise pour le compte de l'industrie minière qui lui donnent l'occasion de se familiariser avec la détermination des minéraux opaques par microscopie en lumière réfléchie.

De 1955 à 1958, il est employé au Congo belge à Kalima (Maniema) par la Société belge de Recherches minières en Afrique (Remina) comme géologue et minéralogiste en charge du contrôle de la composition détaillée des gisements exploités par la société Symétain. Ce travail devait faciliter la récupération des métaux dans les laveries et usines d'épuration de la société. En outre, il s'occupe des sondages effectués en vue de l'évaluation des gisements à Sn-W-Nb-Ta de Symétain. Enfin, il étudie des échantillons de prospections réalisées par Remina pour le compte de tiers en Afrique et en Amérique centrale.

C'est comme pétrographe au bureau de Léopoldville du service géologique du gouvernement du Congo belge et du Ruanda-Urundi qu'il travaille de 1958 à 1959. Son activité principale porte sur l'étude de terrain et de laboratoire du substrat doléritique des bauxites ferrugineuses du Bas-Congo et du Mayumi ainsi que des séries précambriennes encaissantes.

Un nouvel épisode de sa carrière universitaire débute le 22 septembre 1959 à l'Université officielle du Congo belge et du Ruanda-Urundi, comme chargé de cours à la faculté d'agronomie d'Astrida (Butare), puis d'Usumbura (Bujumbura). Il durera jusque fin 1961, moment où il sera mis un terme aux activités de la faculté d'agronomie (la tutelle belge prend fin avec l'indépendance du Ruanda-Urundi en juillet 1962). Pendant cette période, il effectue le levé géologique du complexe alcalin de la Haute Ruvuvu en Urundi en s'appuyant sur une prospection par monazite-zircon réalisée par la société Somiki. Il lève également le domaine volcanique des Virunga au Ruanda et en Ouganda pour le compte du Centre national de Volcanologie belge (en 1962, ce centre de recherche sera dissous par la Belgique qui ne voyait plus de raison de le conserver du fait de l'accession du Congo belge à l'indépendance le 30 juin 1960).

Bénéficiant d'une bourse *postdoctoral fellowship*, octroyée par le Conseil royal norvégien pour la recherche scientifique et technique, il séjourne de 1962 à 1963 en Norvège à l'invitation du professeur T. Barth de l'Université d'Oslo. Le but était de retravailler le sujet de sa thèse de 1955. L'exemplaire confié à un jeune docteur anglophone pour traduction a hélas été égaré par ce dernier.

Antun revient en Belgique en mars 1963 où il travaille comme collaborateur au Musée royal de l'Afrique centrale à Tervuren jusqu'en septembre 1963. Il y mène des recherches sur le précambrien de la crête Congo-Nil et les formations correspondantes du Kivu ainsi que sur les massifs alcalins de Fizi au sud de Beni dans le nord. Cet intermède en Belgique lui permet d'attendre que la chaire de géologie à l'Université Lovanium à Kinshasa soit vacante. La place était alors occupée par le professeur Paul Bartholomé qui la libérera lorsqu'il décidera de réintégrer l'Université de Liège.

Vers la fin de l'année, il retourne au Congo et, de 1963 à 1971, occupe un poste de professeur à Kinshasa, d'abord comme chargé de cours, puis comme professeur ordinaire et chef de département. En fait, d'octobre 1963 à octobre 1967, il est intégré au sein de la Coopération technique belge (CTB). Mais en 1967, suite à un changement de statut de la CTB, l'Agence de la Coopération au Développement (AGCD) met fin à son contrat en justifiant que ce type de poste est réservé à des Belges. Pourtant, l'Union économique belgo-luxembourgeoise mettait sur le même pied les ressortissants des deux pays. Antun a alors bénéficié des «Lois de Garantie» et a continué d'être rémunéré par la Fondation de l'Université Lovanium alimentée par des fonds de la Communauté économique européenne.

À la fin de l'année 1971, l'intégration de l'Université de Kinshasa à l'Université nationale du Zaïre (UNAZA) contraint Antun à déménager son département sur le campus de Lubum-

bashi. Grâce à l'appui de professeurs de l'Université de Liège (J. Frenkel, P. Michot et J. Bellière), il réussit à se faire admettre comme professeur ordinaire par la Coopération technique universitaire belge (CTU) nouvellement créée. C'est ainsi que du 1er janvier 1972 au 31 octobre 1978, il réorganise la coopération géologique et minéralogique belge au Département des Mines de la Faculté polytechnique. Cette coopération s'effectuait sous la houlette de l'Université de Liège, gestionnaire du projet CTU n° 4 (mines, géologie minière).

Entre 1963 et 1978, Antun a donc souvent été obligé d'assurer seul l'enseignement des cours de géologie générale, cristallographie, minéralogie, pétrographie, géologie appliquée, compléments de géologie, étude des gisements africains et prospection minière aux futurs licenciés en sciences géologiques et minéralogiques, puis à partir de 1972, également aux futurs ingénieurs des mines. Sa charge d'enseignement universitaire a dès lors freiné ses recherches scientifiques personnelles. Il a néanmoins réussi à maintenir une présence belge dans le domaine de la géologie et des mines au Congo (dénommé Zaïre entre 1971 et 1997) où il a été confronté à de nombreux obstacles. Les géologues zaïrois occupant des postes à responsabilités étaient, à l'époque, pour la plupart, ses anciens élèves.

À partir du 1er novembre 1978, et pour deux ans, il réintègre le laboratoire de géologie, pétrographie et géochimie de l'Université de Liège, comme professeur hors cadre en vertu de son contrat CTU/AGCD, tout en effectuant encore des missions en tant que professeur visiteur à la faculté polytechnique de l'UNAZA (Lubumbashi en février – avril et novembre – décembre 1979). Il accède à la retraite en 1980.

En résumé, sa carrière comportait alors sept années d'assistanat en pétrographie à l'Université de Liège et dix-sept années d'enseignement universitaire comme chargé de cours, puis comme professeur ordinaire au Congo belge-Zaïre. En outre, il avait consacré quatre années au Congo belge comme chercheur dans les laboratoires de la société Remina, entre un et deux ans au Service géologique du Congo belge et du Ruanda-Urundi, un peu moins d'un an comme boursier post-doctorat à l'Université d'Oslo et environ six mois comme collaborateur au Musée royal de l'Afrique centrale.

Ses secteurs de recherche s'étendent de la géologie générale aux problèmes de minéralogenèse et de pétrogenèse, ou encore à des questions variées de géologie et de minéralogie appliquée. On peut ranger ses travaux dans plusieurs domaines:

— Géologie générale:

- Les météorites (en Afrique centrale);
- Le volcanisme (dans le secteur des Virungas au Ruanda et en Ouganda);
- Les dolérites de la Norvège méridionale;
- Les massifs intrusifs anorthosito-monzonitiques d'Egersund en Norvège;
- Les complexes alcalins de syénites à néphéline nordmarkites;
- Les granites stannifères et leur cortège filonien au Burundi;
- Les sills subsidiairement à laves basaltiques du Burundi et de l'ouest congolais.

— Sédimentologie:

- En Belgique, les dépôts mésozoïques au bord sud de l'Ardenne et les déformations synsédimentaires;
- En Afrique, la sédimentologie des arkoses du Système de l'Inkisi ainsi que la tillite inférieure de l'ouest congolais et diverses questions relatives au Katanguien.

— Tectonique et métamorphisme:

- En Belgique, les déformations macro et microtectoniques du dévonien inférieur du sud de l'Ardenne et le métamorphisme de la région de Bastogne-Libramont;
- En Afrique, la structure du précambrien de part et d'autre du fossé tectonique du Kivu.

— Géologie appliquée:

- L'étude de concentrés naturels divers au point de vue de leur dérivation, de leur composition quantitative, de leur épuration et de leur valorisation. La plupart de ces travaux seront finalisés par des rapports inédits à des sociétés privées comme Remina, Symétain, Bumifom et Somuki.
- Les campagnes de sondages sur des gisements primaires de cassitérite et accompagnateurs économiquement intéressants.
- La prospection des bauxites dans le Bas-Zaïre.
- Les gisements de fer sédimentaires (thuringite oolithique de Tachila au Maroc) et magmatiques (fer titané de la région de Gambos et de Pocolo en Angola) pour la société Ougrée-Marihaye.
- Les gisements sulfurés de fer-cuivre-nickel de serpentinites chromifères de Chypre (société Hellenic Mining).
- Les gisements aurifères (Bumifom, Remina).
- Les gisements de cuivre, cobalt, plomb-zinc et vanadium (Shaba, Bas-Zaïre, Kasaï, Panama, Luxembourg).

Paul Antun a été collaborateur scientifique du Musée national d'Histoire naturelle de Luxembourg (MNHNL), statut obtenu en 1982 lors de la création officielle de ce titre par règlement grand-ducal du 10 novembre 1982. Dans ce cadre, il a installé un laboratoire de minéralogie en 1985 à Dommeldange (en luxembourgeois: Dummeldeng, un des vingt-quatre quartiers de Luxembourg-ville où le MNHNL disposait alors de locaux supplémentaires).

Les collections de minéralogie africaine du MNHNL sont très riches tant du point de vue scientifique que des spécimens muséologiques. Ces collections proviennent de plusieurs sources, la plus importante en volume étant celle de Paul Antun. Le MNHNL a hérité de tous ses échantillons du Congo et des pays limitrophes (Rwanda, Ouganda, Burundi), des lames minces et de toute la bibliographie qui s'y rapporte. En plus de sa collection africaine, Antun a fait don au MNHNL d'un ensemble d'échantillons de pétrologie collectés et répertoriés au Luxembourg et dans les régions voisines (plus de quatre mille échantillons généralement accompagnés des lames minces correspondantes).

C'est d'ailleurs à partir d'un échantillon identifié dans le catalogue du MNHNL, sous le numéro WPA504, collecté par Paul Antun en 1977 dans la mine de tungstène de Nyakabingo (Kigali, Rwanda – latitude 1°51'47'' S, longitude 29°58'40'' E), que les scientifiques du MNHNL et leurs collaborateurs internationaux (Hatert *et al.*, 2023) ont identifié une nouvelle espèce minérale, l'yttrotungstite-(Nd), qui est l'équivalent de l'yttrotungstite-(Ce) et de l'yttrotungstite-(Y). Cette nouvelle espèce a été validée par la *Commission on New Minerals, Nomenclature and Classification* de l'*International Mineralogical Association.*

Paul Antun a été nommé membre associé de la Classe des Sciences techniques de l'Académie royale des Sciences d'Outre-Mer le 31 mars 1982 et promu à l'honorariat le 20 février 1986.

Ceux qui l'ont connu se souviennent de ses fréquentes et longues communications téléphoniques où il débattait de ses expériences africaines et de diverses questions de géologie à l'aide d'une voix chantante très caractéristique.

Léon Dejonghe & Simon Philippo*

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L'ensemble de ses rapports non publiés est conservé au MNHNL.

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Looking for Maps in the King's Library: Leopold II's Maps of the Congo Basin

by

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Keywords. — Congo; Central Africa; Leopold II; Berlin Conference; Mapping; Library Studies; Royal Archives; Colonialism.

Summary. — King Leopold II considered his personal library as an essential instrument in the development of his colonial policy. However, scholars have hardly paid any attention to its content. In this paper the library's importance as a historical source will be illustrated by focusing on the cartographical component. More specifically this paper lists and deals with the maps of Africa and in particular of Central Africa and Congo the King and his staff had at their disposal during the years of intensive exploration of the Congo Basin which would ultimately lead to the Berlin Conference (1884-1885) and the creation of the Congo Free State. As the library is not (yet) accessible to the general public, its inventory published in 1909 in the *Moniteur belge* is the only source to study its composition. After a general description of the inventory's origins and structure, the paper will concentrate on a description of the library's geographical content, identifying books, booklets and journals mentioned in the inventory that contain maps of (Central) Africa, and more specifically of the Congo Basin. Additionally, maps kept as loose sheets in the archives of the Royal Palace, which date from 1885 or before and therefore presumably belonged to king Leopold II, are taken into account when discussing the library's cartographical content.

Introduction

On 8 August 1884 Leopold wrote to Otto von Bismarck (1815-1898), chancellor of Germany from 1871 to 1890, asking him to recognize the *Association internationale du Congo* (AIC). The letter was accompanied by the following map on which the King roughly outlined the borders of the AIC: *Karte von Central-Afrika. Nach den neuesten Forschungen bearbeitet von Dr. Joseph Chavanne* (Wien/Pest/Leipzig: A. Hartleben's Verlag). In 1884, Joseph Chavanne (1846-1902) had been sent on an exploration journey of the Congo river by the *Institut national de Géographie* (ING), a private company founded in 1882 in Brussels by Merzbach and Falk. Three months later, on 8 November 1884, Otto von Bismarck and the AIC signed a convention in which Germany recognized the association. For its borders, once again reference was made to a map. This time it was a manuscript map: *Croquis des stations fondées ou en cours de fondation dans les bassins du Congo et du Kwilu-Niadi et formant les chefs-lieux des territoires acquis en toute souveraineté par l'Association Internationale du Cong*o. This map was printed the same month by the ING under a slightly modified title: *Croquis de l'Afrique équatoriale contenant les derniers renseignements recueillis par les agents de l'Association Internationale du Congo* (fig. 1). The printed map was used by the AIC during the Berlin Conference [1]**.

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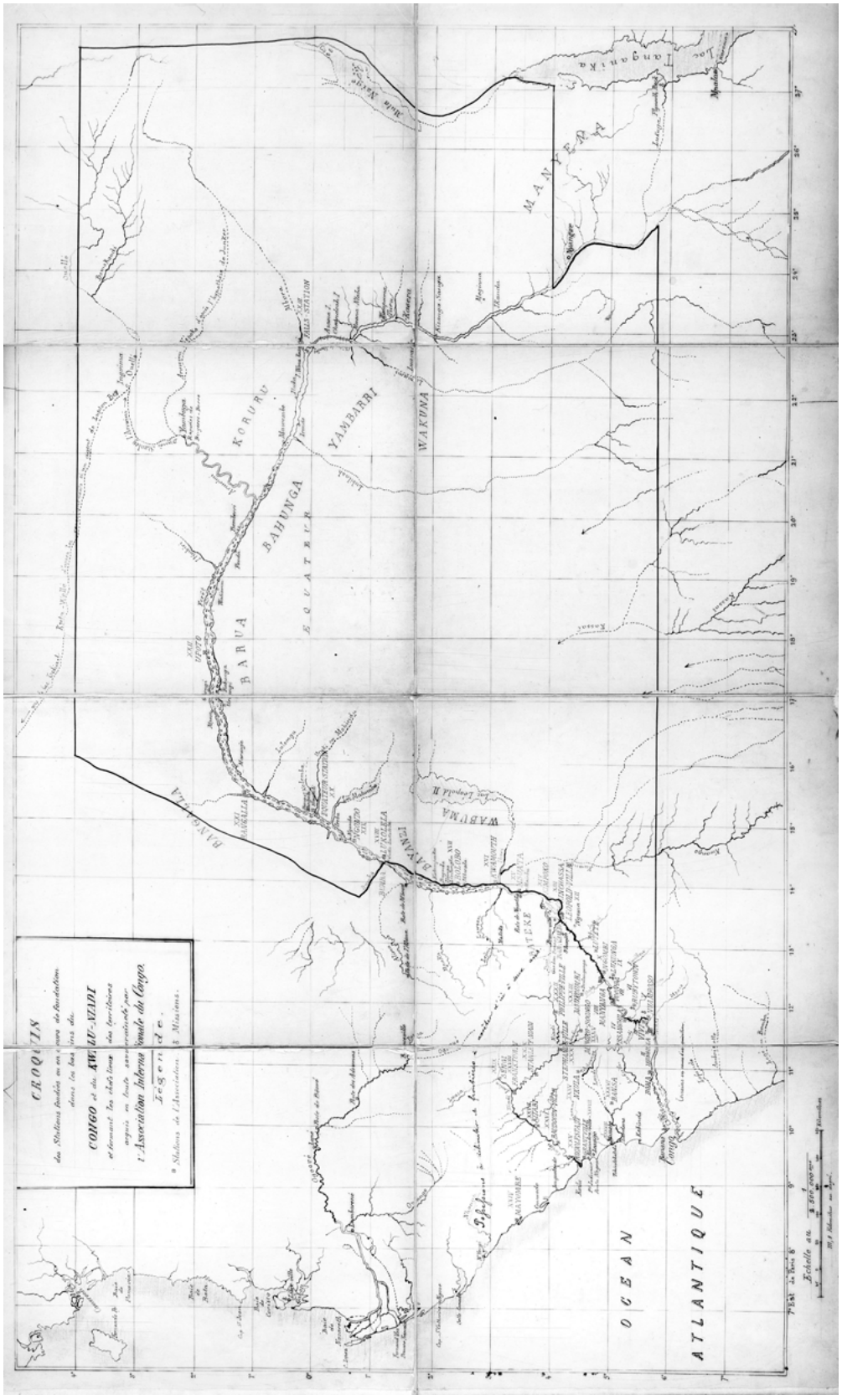
** Numbers in brackets [ ] refer to the notes, pp. 165-167.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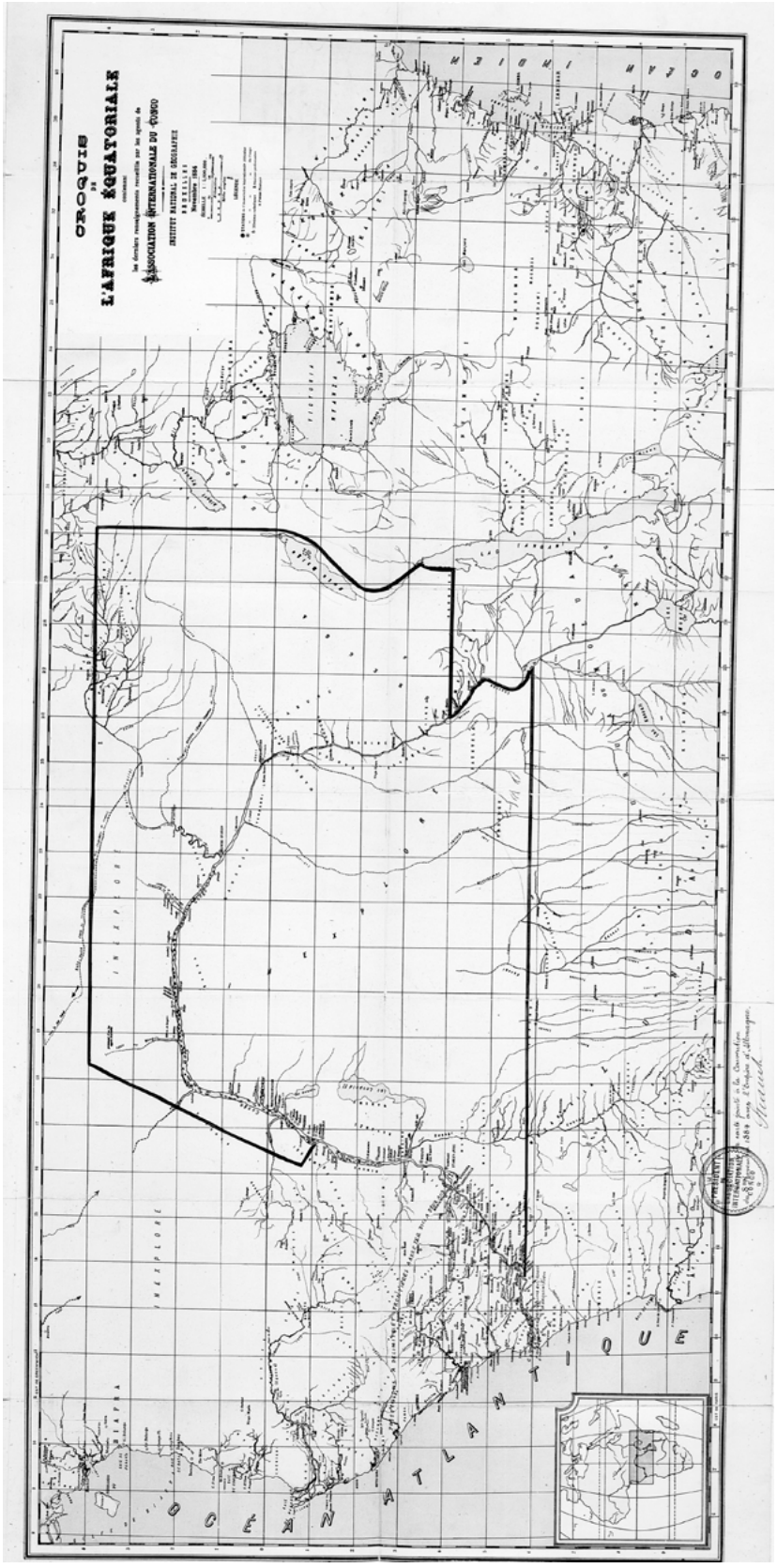

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Fig. 1. — Manuscript (a) and printed (b) map with the tracing of the borders according to the convention signed between the AIC and Germany on 8 november 1884 (© Berlin, Bundesarchiv).

The *Institut national de Géographie* was an important player in the dissemination of geographical knowledge in Belgium in the last quarter of the 19th century. From 1884 onwards the Institute published a bimonthly magazine titled *Le Mouvement Géographique* to inform the larger public on exploring activities going on all over the world. In its first years, though, the main focus was on the exploration of the Congo river (Henry, 2008). In those years the journal's editor-in-chief, Alphonse-Jules Wauters (1845-1916), was close to the Royal Court, which explains the speed with which the ING received the latest news on the explorations of the Congo Basin, largely financed by the King. It thus became a partner in the strategy developed by the Crown to convince the public, especially in Belgium, of the importance of the King's colonial aspirations.

What becomes clear from this close, albeit informal, collaboration between the Court and the ING, is that maps played an important role in the King's colonial policy. It also raises the question of how the King informed himself about his future colony and more particularly which maps he and his staff had at their disposal to get an idea of the territory the King wanted to claim for himself. In the following it will be shown that the King's personal library is a good place to start looking for an answer to these questions. As the library has never been thoroughly studied before, I will first give a general description of its content on the basis of its inventory, with a focus on its African component. Then, I will deal with the maps of the Congo Basin and its neighbouring countries that have been found in the Royal Archives, most of which as I will show are taken out of books the King (must have) possessed. Finally, I will identify the books and journals mentioned in the inventory of the King's library that are somehow related to the geography of the African continent, pointing out in what way they could have been of interest to the King and his staff in their search for information about the Congo Basin. In my analysis I will concentrate on the maps present in these works.

The King's Library and its Inventory

The library of Leopold II is preserved in the Royal Palace at Laeken but is not accessible today. Negotiations are currently conducted to have the library moved to the Royal Library of Belgium and thus make it accessible to the general public. Moreover, an inventory of the library was drawn up a few days before the King's demise in December 1909 and was published the same month in the *Moniteur belge*, the official journal of the kingdom of Belgium (*Moniteur belge*, 1909) [2]. The library's inventory consists of almost nine thousand items. Some items contain more than one publication. The presence of a book or another publication, be it a booklet, a fascicle, a report, or a journal, in a given library does not prove its owner has actually read the work. Especially in the case of a king's library, one has to keep in mind that many books were probably offered to him as gifts from authors or publishers well aware of the king's interests, or looking for some patronage. In the case of King Leopold's library, though, its content, as reflected in the inventory, clearly shows that it was not a ceremonial library, a *bibliothèque d'apparat*. On the contrary, as the description of its inventory will show, it has all the characteristics of what one would call a personal work tool. Its origins, as far as can be ascertained on the basis of accessible documents, should be traced back to a personal initiative of the King which is also traditionally marked as the starting point of the Africa library of the Belgian Ministry for Foreign Affairs. In a letter to his close collaborator Henri-Alexis Brialmont (1821-1903), dated 1861, the future King wrote he wanted to create his own library,

which would allow him to obtain the necessary ‘arsenal’ with which to attack Belgian critics of his colonial ideas (Geeraerts, 1972, p. 5; Bils-Lambert, De Spiegeleer-Lamiroy & Van Hemelrijck, 1991, p. 5; Périer, 1935, pp. 222-223; Crokaert, 1925, p. 409). The correspondence with Brialmont in the early 1860s shows a Leopold eagerly looking for all sorts of information on existing colonies, especially from London and (in a lesser degree) Paris. A book that often comes up in the King’s letters to Brialmont is *Money’s on Dutch colonialism* (see *infra*), which really forms the basis of the colonial doctrine he was developing in those years (Crokaert, 1925, pp. 409-427).

The library’s inventory, prepared under the direction of Louis Paris (1864-1934), private librarian of the King and from 1919 to 1929 director of the Royal Library of Belgium, was part of a larger inventory of the King’s personal belongings that would merge into a private foundation created according to the King’s wishes. In that way the King wanted to avoid that the royal patrimony be divided amongst the families to which two of his three daughters had married. The fact that it was hastily drawn up tells us something about what the library must have looked like at the time of the King’s demise.

The inventory lists books, maps, booklets and journals. Maps and booklets are mingled with the books, although item 8894 of the inventory mentions “Maps and plans, about 250 rolls” without further detail. Journals, on the contrary, are grouped together, with annuaries and all sorts of reports, at the very end of the inventory. Overall the inventory follows an alphabetical order — the order is repeated over and over again as if it were describing contents of individual bookcases. There is also a sort of chronological order within the alphabetical order and in general the most recent items appear towards the end of the inventory. Clearly books were displaced or reordered according to changing interests. There are many thematical clusters on all kinds of subjects, interrupting the alphabetical order, which show Leopold’s personal interests and reflect his work as a prince and king: medical works, dictionaries, catalogues of exhibitions and museums, books on the history of typography, publications related to official visits, books on music, on politics, biographies, books in Greek, contemporary literature, etc. Nos. 2225-2320 include an important geographical corpus, in random order: about a hundred works, mostly from before 1870, thirty-seven of which on Africa, while the others are mainly about the Far East, China, India and the Dutch colonies, countries which had played a prominent role in Leopold’s search for a colony outside Europe in the 1860s. Books published after 1870 are almost all about Africa, which shows the King’s shift of interest in matters of international expansion.

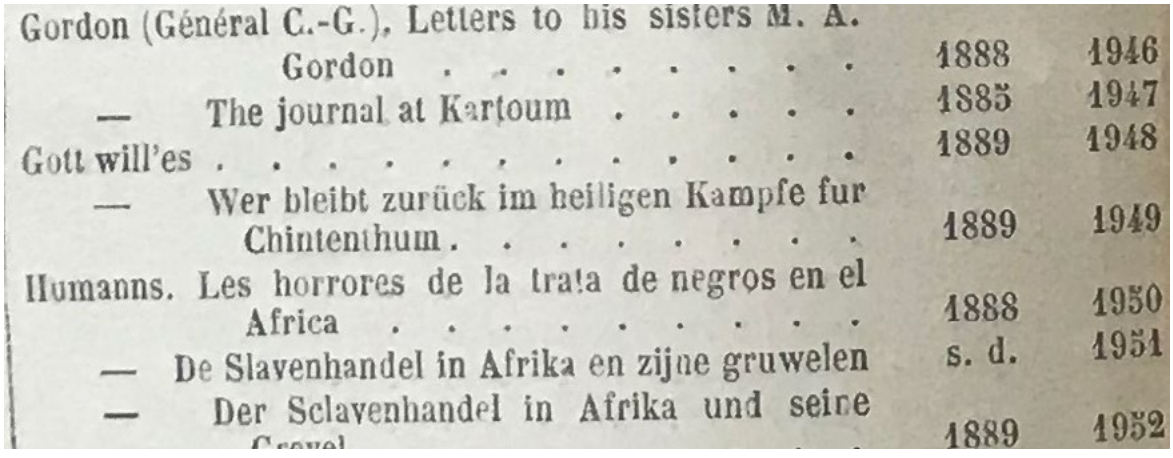
That the King and his staff used the library professionally also becomes apparent from the study of the correspondence related to the library, which is preserved in the archives of the Royal Palace in Brussels [3]. The letters deal with acquisitions, donations, loans and restitutions of books and journals, and often the King’s name is mentioned. Some letters in particular show the King’s (direct) involvement with the geographical content of his library. In early August 1875, the royal military house wrote to the King’s librarian, August Scheler (1819-1890), that Leopold wanted to know the whereabouts in the library of *Petermanns Mitteilungen*, of the journals of the Royal Geographical Society (RGS) and the *Société de Géographie de Paris*. The King also asked for a complete list of the works on geography in his possession. A couple of days later, on 7 August, the military house asked access to the library on a Sunday morning, to do research in the journals of the RGS and the *Société de Géographie de Paris*. On 20 September, several issues of the latter journal were sent to Scheler because the King didn’t need them anymore. The King had them bought directly from the Brussels librarian and

publishing house Muquardt. On 2 January 1877, the librarian was informed by John C. d'Oultremont (1848-1917) that the King wished to create a special office where he would bring together all maps and works regarding Africa and the Far East. Scheler was asked to put the books in two boxes, one for each continent, but it was emphasized that it would be the King who would order the books and assign them their proper place (AKP/Bib K 1-3). Perhaps the aforementioned geographical corpus is still a remainder of this initiative.

In the inventory, I counted over six hundred books on Africa or related affairs that could be of interest for the exploration and administration of the Congo Basin. More than a third of them date from 1885 or before. They are spread all over the inventory, but one also finds clusters, for instance over seventy works (nos. 5850-5924) which mostly deal with Congo or West Africa. The most recent publications on the Congo, from the early 20th century, are grouped together at the end of the list of books. Not all books on Africa are about geography, of course. There are poetry books, books on music, medical books, works of a political or commercial nature, and also a number of works on slavery.

It has not always been easy to identify these works, nor has it been evident to determine, on the sole basis of a title or name, if a work has or had a colonial interest, let alone a specific importance for the study of the Congo. Here are some examples.

Nos. 1948-1949 of the inventory (fig. 2) mention the following author and title: *Gott will'es Wer bleibt zurück im heiligen Kampfe fur Chintenthum*, 1889. It can be identified with the anonymously published work of Walter Helmes, *Gott will es! Wer bleibt zurück im heiligen Kampf für Christentum und Menschenrechten?*, published in Münster in 1889. It is the human rights' aspect of the work that probably was decisive in putting the book in the library amongst the works on slave trade. The items that are next on the list (nos. 1950-1952) are again by the same Helmes: two of them are translations of the third, titled *Der sclavenhandel in Afrika und seine Grevel, beleuchtet nach den Vorträgen des Kardinals Lavigerie und Berichten des Missionaren und Forschern*, Münster, 1888.



Gordon (Général C.-G.), Letters to his sisters M. A. Gordon		1888	1946
—	The journal at Kartoum	1885	1947
Gott will'es		1889	1948
—	Wer bleibt zurück im heiligen Kampfe fur Chintenthum	1889	1949
Humanns.	Les horrores de la trata de negros en el Africa	1888	1950
—	De Slavenhandel in Afrika en zijne gruwelen	s. d.	1951
—	Der Sclavenhandel in Afrika und seine Grevel	1889	1952

Fig. 2. — Excerpt from the inventory of the King's library (*Moniteur belge*, 1909).

No. 2152 is a book by Léon de Thier (1825-1903), founder of the journal *La Meuse*, on the free navigation of the Danube, a topic of great importance in the debate on the juridical status of the Congo river during the Berlin Conference (1885). It should thus be considered complementary to the writings by sir Travers Twiss (1809-1897) (nos. 5907 and 5920) on Africa and

the Congo river in which he dealt with questions of navigation and free trade. Twiss argued against the proposal of the economist and expert on primitive property Émile de Laveleye (1822-1892) (Vandersmissen, 2011), published in the journal's same issue, to declare the Congo neutral (Sylvest, 2008). Twiss, instead, referred to the Danube and argued in favour of the creation of an international commission that would control free navigation for at least the lower Congo river (Twiss, 1883a,b; Vandersmissen, 2011) [4].

For similar reasons, because they were deemed important to the King's colonial doctrine, one should include in the Congo collection the works by Jules Duval (1813-1870) on European emigration and on the French colonies in North Africa (1862 and 1877, nos. 2307 and 4478), *Java or how to manage a colony* by James William Money (1819-1890, no. 2278), or the conference by Ferdinand de Lesseps (1805-1894) on the scientific and civilizing character of large industrial enterprises (1883, no. 6423) [5].

The Loose Sheet Maps

The inventory gives a short description of a variety of single and multiple sheet maps and plans, but none of them depicts Central Africa [6].This seems to indicate that the maps of Africa were kept separately. From one of the letters from the archives of the Royal Palace mentioned before we know that in 1875, the King had indeed the intention to bring together in one room his books and maps related to Africa. Furthermore, the inventory of the archives of the former Ministry of Colonies informs us that a collection of maps, mostly of Africa, belonging to King Leopold II, had disappeared from the archives. The archives were originally created in the 1920s by a historical committee established with the idea of writing a history of Congo (Van Grieken & Van Grieken-Taverniers, 1958, p. 59). So far no traces of this collection have been found.

However, if the African map collection has indeed disappeared, several maps that were part of the collection at some stage or of which we may assume they must have belonged to the collection, have survived in the archives of King Albert I, Leopold's successor, and his wife, Queen Elisabeth I. For the region and period that are of interest here, thirty maps could be identified. A list of these is annexed to this article. It is worth notifying that most maps were originally part of a book or were published in journals which are listed in the library's inventory [7].The map by John Arrowsmith (no. 25 of our list published in the appendix) was actually part of the book by David and Charles Livingstone on their expedition to the Zambezi river (1865, no. 2247 of the King's library's inventory), and 27 is from Henry Morton Stanley's book *Through the Dark Continent* which recounts his first trans-African expedition of 1874-77 (1878, no. 5235). No. 4 is from the travel account by Lyons McLeod (†1893), at the time consul in Mozambique (1860, no. 2272). No. 10 is from Émile Banning's report of the Brussels Geographical Conference on Africa of 1876 (nos. 2229-2230; see *infra*). The conference can be considered as the starting point of Leopold's active Congo policy which would eventually lead to the creation of the Congo Free State (Académie royale des Sciences d'Outre-Mer, 1976). No. 18 comes from Chaillé-Long's account of his journeys to Lake Victoria and the Niam-Niam (1876, no. 819; see *infra*) [8].

Other maps were published in journals such as *L'Afrique Explorée et Civilisée* (8, 13, no. 8434), the journal founded in Geneva in 1879 by Gustave Moynier (1826-1910) and ideologically close to Leopold II (Rossinelli 2021; Vandersmissen, 2011), the *Bulletin de la*

Société Belge de Géographie (11, no. 8436), *Petermanns Mitteilungen* (14, no. 8452; see *infra*), the *Bulletin de la Société Khédiviale de Géographie* (19, no. 8435), and the *Proceedings of the Royal Geographical Society* (29, no. 8127a). Several maps were published by the already mentioned *Institut national de Géographie* (21-22, and 30) as was 28, a map by captain Boyé published in *Le Mouvement Géographique* on 18 June 1888 (no. 8185). Others were published by the *Institut cartographique militaire*, forerunner of the current Belgian Geographical Institute and another partner in the King's colonial policy (12, 23) [9]. Nos. 5, 7, 17 (and 13) are by Keith Johnston (1844-1879), fellow of the Royal Geographical Society, and its map curator responsible for the verification, interpretation and drawing of maps from the exploration surveys of famous explorers of Africa of the day, in particular the mapping of the source of the Nile. He died in 1879 in East Africa where he had just started his expedition towards the Great Lakes (McCarthy, 2004). To these we must add of course Rutherford Alcock's map of Africa, which the president of the Royal Geographical Society offered to the King when he participated in the aforementioned Brussels Geographical Conference of 1876 and which was used as a reference at the conference itself (Denis, 1976, p. 39). Two reproductions were produced of this map: a facsimile, of which the archives of the Royal Palace hold several copies, which shows the explorations that took place on the whole continent with the explorers' names written on the itineraries, and a photographic reproduction which only indicates the itineraries (without the explorers' names) of the Congo area. On this copy (fig. 3) the exploration of the Ogooué by Savorgnan de Brazza (1852-1905) is drawn as partly accomplished, partly projected (1876/78). The first expedition by Paul Pogge (1838-1884), from Loanda to Cassange (which he continued afterwards into Mussumba) (1874-1876), is still in progress. Amongst the accomplished explorations we have the Welle river discovered in 1870 by Georg Schweinfurth (1836-1925), Livingstone's explorations of Lakes Nyassa, Moero and Banguelo (1868-1869), the travels by Verney Lovett Cameron (1844-1894) from Nyangwé to the north of Benguela (1873-1875), and finally Stanley's travels to Lake Victoria, Tanganyika and Nyangwé (1870s), following the travels of Richard Burton (1821-1890), John Speke and James Grant to the Great Lakes (1857-1863). The map of Egypt and Equatorial Africa (20) is authored by the engineer John Fowler (1817-1898) who devoted his life to the construction of railways. This copy of the map, which was published for the first time in 1876 (Mackay, 1900), once belonged to Gordon Pasha (1833-1885), governor-general of Sudan between 1877 and 1879, who must be the author of the manuscript tracings and notes in English and in Arabic [10]. Finally, no. 9 includes sheets of the first general map of Africa on scale 1:2,000,000 by Richard de Régnauld de Lannoy de Bissy (1844-1906), member of the French Geographical Society and in close contact with the AIC at a time when France opposed the King regarding the valley of the Kwilu-Niari. His map is a product of the 19th-century colonial expansion and was considered by contemporaries as an indispensable guide for travellers in Africa (Loiseaux, 2004) [11].

I would like to add to this list the wall map of Africa by Jean-Baptiste Louis Clouet (c. 1730-1790) (fig. 4) [12]. It is not mentioned anywhere in the inventory, nor in the archives of the King's successor, but it was donated to the Royal Library in 2022 by the Royal household. Since the death of King Albert I, it has been stored in the attic of the Royal Palace in Laeken. A manuscript subscription says it was bought in November 1876, ten days after the closure of the Universal Exhibition of Philadelphia, by a certain Müllender. The latter, from Eupen (which was not yet part of Belgium at the time), could be identified as Alphons Maria Hubert Müllender (1853-1932) who would be naturalized in 1884, an engineer with aspirational ideas, whose many projects — a metro in Brussels, an electric train between Antwerp and Brussels,

a tunnel connecting Antwerp with its left bank — have never been carried out, but his publications found their way into the King's library (nos. 1434, 1638, 3550, 5056, 5058, 5197, 6246, 7832-3, 7874, 7905, 7906; Müllender, 1994). He participated in the Universal Exhibition as a representative of the industries in Verviers (Liège). The Court's interest in antiquarian maps is (again) demonstrated in the maps by Jacob Meursius (born 1618), Guillaume Delisle (1675-1726), and Robert de Vaugondy (1688-1766) mentioned in our list (1-3). In the library's inventory, other antiquarian maps, or reproductions of them, can be found. In fact, the map by Meursius (1) was published in the French edition of Olfert Dapper's work, of which the King owned a copy (1686, no. 1516). A reproduction of Dapper's map of 1676 can also be found in Stanley's *Through the Dark Continent* (1878). Another ancient source to which contemporary authors, like Stanley and Banning, liked to refer to is the work of Filippo Pigafetta (1533-1604), of which we find an English and French edition in the inventory (1881 and 1883, nos. 2005 and 2105; Périer, 1939, 1955, pp. 135-140) [13]. As we will see, there may have been other reasons than purely cartographic ones to explain their presence in the King's library.

Fig. 3. — *Reproduction photographique d'un croquis des explorations en Afrique offert à Sa Majesté le Roi des Belges par Sir R. Alcock K.C.B., P.R.G.S., etc. le 11 septembre 1876* (© Brussels, Royal Library of Belgium).

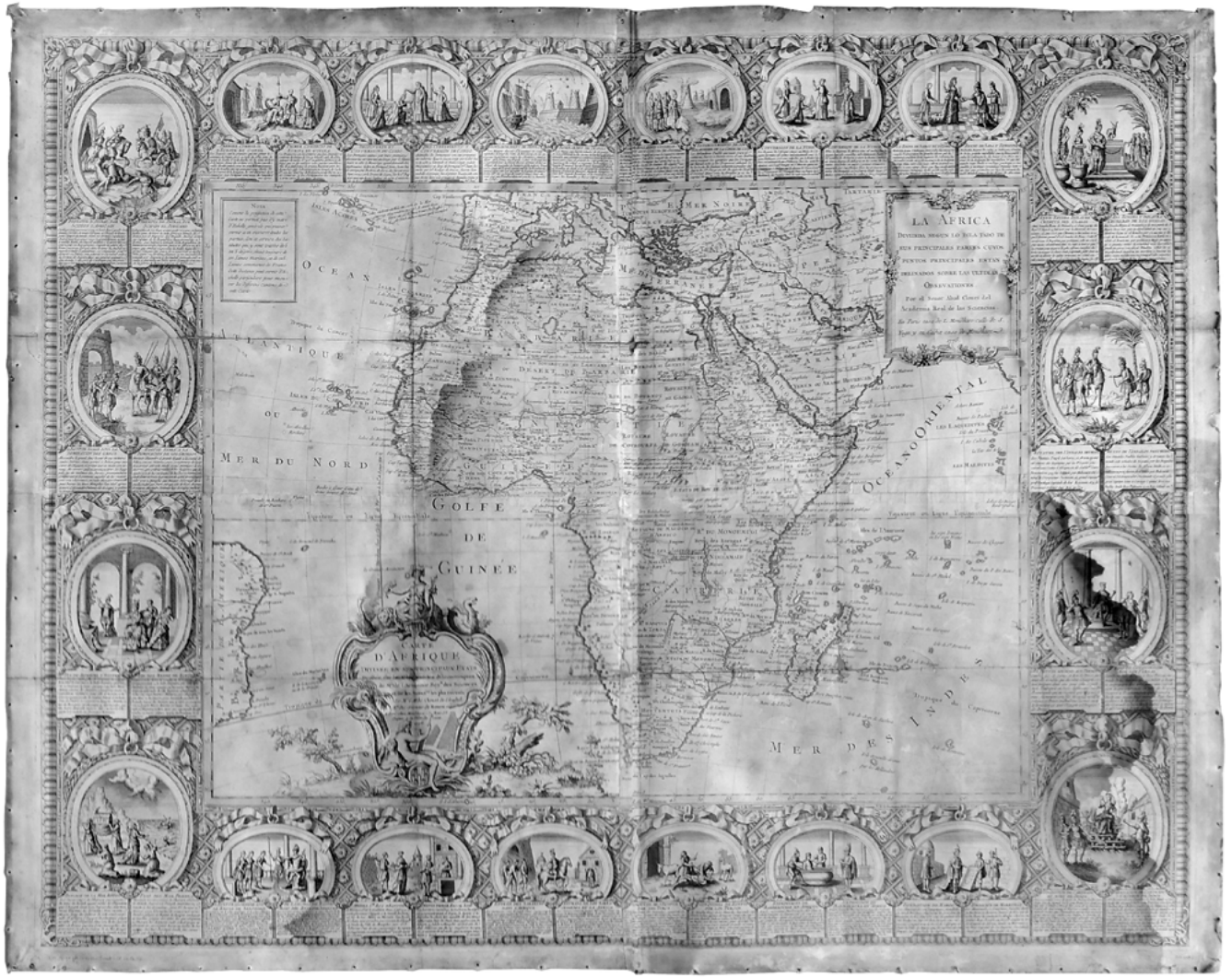


Fig. 4. — *Carte d'Afrique divisée en ses principaux Etats dressée sur les observations astronomiques de Mrs de l'Academie roy[a]le des Sciences, et sur les memoires les plus récents. Par Mr l'abbé Clouet de l'Academie r[oya]le des Sciences de Rouen. A Paris: chez Mondhare rue St Jaques a la Ville de Caen, 1782* [...] (© Brussels, Royal Library of Belgium).

Maps in Books

The fact that many of the maps found in the archives of King Albert I and Queen Elisabeth I come from books and journals, is a convincing enough argument to have another closer look at the books and journals in the library. In fact, most of the books or travel accounts written by the explorers themselves include maps, large-scale and small-scale maps, either inserted in the text, published at the very beginning or the end of the book, or added as a loose sheet to the book's binding. These maps were effectively consulted by the King's collaborators, if not the King himself, as illustrated by a letter from Lambermont to the King's *chef de cabinet* (chief of staff) of 26 August 1876: in preparation of the Geographical Conference of September that year, Lambermont sent several notes based on his readings to the chief of staff. He advised his correspondent to consult the appropriate maps while reading his notes: for a general approach of the African continent, he recommended the maps by Stanford and Kiepert. For more detailed maps, he referred to those in the books and reports written by explorers like Schweinfurth. Lastly, he suggested to subscribe to the journal *Le Tour du Monde* [14]. We will come across the names mentioned by Lambermont in the following paragraphs.

The African Continent

First of all, there are the publications relating the explorations mentioned on the map Alcock gave to the King in 1876, although some important travel accounts, as we will see, are missing. Besides Livingstone's narrative on the expedition to the Zambezi already mentioned (no. 2247), the inventory lists *A popular account of missionary travels in South Africa* by David Livingstone (1873, no. 2249) as well as *The last journals on Central Africa* (1874, no. 2248). Cameron's *Letters detailing the journey of the Livingstone east coast expedition from Lake Tanganyika to the west coast of Africa,* published in the *Proceedings of the Royal Geographical Society*, is also found in the inventory (20, 2, 1875-6, 117-134; no. 6459). Absent, however, is Cameron's own *Across Africa* (New York: Harper & Brothers, 1877). This absence is difficult to explain, for the King was very much interested in Cameron's expedition, to the point that when the news reached his ears that the explorer was unable to continue his travels for lack of money, he even offered to pay for the expenses of bringing him back to England (Stengers, 1955, pp. 13-15). On the other hand, Cameron's route from Zanzibar to Lake Tanganyika is the subject of a map published in the account of the opportunities for the Church Missionary Society in the lake regions by its secretary Edward Hutchinson (1834-1897) (1876, no. 2243). Equally missing is Speke's *Journal of the discovery of the source of the Nile* (Edinburgh and London: William Blackwood and Sons, 1863). This lack is compensated by the presence of the French edition of the report by his travel companion Richard Burton. This edition includes maps showing their itinerary from Zanzibar to Lake Tanganyika (1862, no. 2302) as well as a copy of Beke's 1863 map in the aforementioned work by Hutchinson (1876). Furthermore, we find Paul Güssfeldt's report of the 1873-1876 Loango expedition (1879, nos. 1541 and 3485) and the account of the Ogooué exploration in 1872-1873 by the naturalist Antoine Marche (1844-1898), companion to the explorer Victor de Compiègne (1846-1877) (Marche, 1879).

The account of the expeditions to Lake Victoria and the Niam-Niam by the American Charles Chaillé-Long (1842-1917) already mentioned, is only of minor interest for the history of the mapping of Central Africa. But the book, in which the author developed the analysis he had presented in 1875 at a meeting of the *Société de Géographie de Paris*, must have held a special

place in the King's library. It is mentioned twice in the inventory, in its English and French edition (1876 and 1877, nos. 819 and 2235). In the introduction Chaillé-Long pays tribute to "the character of the enlightened Sovereign, under whose auspices the work of Central African regeneration is being carried forward" (1876, p. VI). The reference is not to Leopold, for sure, but to the Khedive of Egypt, Isma'il Pasha (1830-1895), who modernized Egypt and Sudan during his reign (1863-1879), a man whose government Leopold also much approved of (Vandersmissen, 2009, p. 343). The book's map with Chaillé-Long's itinerary shows Lake Albert, the northern part of Lake Victoria, and Lake Ibrahim (Kyoga) which he discovered. Other maps of the region were published in Gerard Rohlfs (1874-1875, no. 2255). Those in Rohlfs' work are based on the maps published in *Petermanns Mitteilungen*.

Central Africa

Exploration accounts (with maps) other than those related to itineraries drawn on Alcock's map can be grouped geographically, according to the regions of Central Africa the explorers' accounts describe. First, there is the translation by Richard Burton of the mission to Cazembe in southeastern Congo by Francisco de Lacerda e Almeida (1753-1798), to which are added the journeys from Angola to Zambezi by the so-called Pombeiros in 1805-1811, and of José Moneiro and Antonio Gamitto in 1831-1832, the latter in an abridged form by the aforementioned Beke (1873, no. 774). All three missions were organized by the Portuguese with the dual aim of establishing trade relations in the region and opening up a transcontinental trade route between Portuguese territories in the East and West (Cunnison, 1961). On the map of southeastern Africa, we still see the large central lake called Zembre, or Zambre, whose discovery was claimed by the Portuguese, according to Wauters (1879b) with no reason (see *infra*) [15]. Gebhard Schneider's account has a map of the Swahili coast showing the itinerary of the Spiritan Antoine Horner (1827-1880), superior of the Zanzibar mission, and a plan of that city (1877, no. 2254). Harry Johnston's description of the Congo river from its mouth to Bolobo brings us to the west coast (1884, no. 745). Johnston (1858-1927) became involved in the early 1890s in the dispute between Great Britain and Leopold over the inclusion of Katanga in the Congo Free State. He was held responsible for circulating a map of Leopold's colony without Katanga. His map of the Congo river was published for the *Proceedings of the Royal Geographical Society* where he had first shared the results of his sojourn (Johnston, 1883b). His book of 1884, dedicated to Stanley, offers a detailed description of the Congo from the west coast to Bolobo, where the Baptist Missionary Society had a mission station. The author presents his work as a "guide-book […] which may convey to intending travellers or stay-at-home folks a fairly just impression of the main features of the great river" (Johnston, 1884, p. VI).

The King's Collaborators

Several close collaborators of the King published descriptions and critical studies on Africa. Most of their works can be found in his library. Stanley's work is abundantly present in the inventory; he was employed by the King from 1879 onwards. *Through the Dark Continent* (1878, nos. 1143-7, 5115, 5235) and *The Congo and the founding of its Free State* (1885, nos. 1148-9 and 1690) are listed in the inventory in different languages and editions. However, his book *How I found Livingstone* (1872), of which a French translation had already been published in Paris by Hachette in 1874, could not be found.

We have already mentioned Émile Banning's report on the Geographical Conference held in Brussels in 1876. Both the French and English editions are listed. The Africa map in the French edition is authored by Friedrich von Stülpnagel (1786-1865) who worked in Gotha at Stieler's *Handatlas*. The map was published for the first time in 1855 but Banning's copy stems from the 1875 edition of the *Handatlas* (though no. 68 of the atlas is left out in Banning's copy). It is also one of the maps that Josef Chavanne recommended to his readers in the print of his conference on Central Africa of 1876 (no. 6456). For the English version of Banning's work a new map was produced. An important difference between both maps is the orientation of Lake Tanganyika, oriented north-south by Stülpnagel, and corrected in the English map, in north-west/south-east direction. Through Banning's works the King had access to literature and maps, which were not present in his personal library. Banning, who had started his professional career first as a journalist, and afterwards as the archivist and librarian of the Royal Library of Belgium before entering the Ministry for Foreign Affairs, laid the basis, according to his own words, for what would be known later as the African Library (Stengers, 1955, p. 23). His passion for Africa went back to his childhood. He particularly recalled the episode when he received the first volume of Karl Ritter's *Compared geography* dedicated to Africa, in its French translation (Ritter, 1836; Stengers, 1955, p. 31). For Banning, this work ushered in a new era for geography. He referred to this work in the first part of his report of the Brussels Geographical Conference, which was dedicated to a detailed description of Africa and its exploration. He argued that Ritter's innovating theories must have been suggested by his study of Africa which "physical conformation has exercised a preponderating influence on the history and civilization of the races that inhabit it" (p. 59 of the English version). Another source for Banning, and again not mentioned in the library's inventory nor found in the archives of Leopold's successor — at least not for the period and the region we are concerned with here — is Heinrich Kiepert (1818-1899). Again his starting point was Ritter, but this time he wanted to show the enormous progress geography had made over the past two decades in comparing Ritter's geographical knowledge of Africa to a map of the continent published by Kiepert in 1874 in the *Journal of the Geographical Society* in Berlin (Kiepert, 1873). Kiepert — or was it his son Richard (1846-1915)? or both? — was the author of the wall map that ornated the conference room in Berlin in 1884-1885 (Coret, 2019; *Le Patriote*, 1884) [16]. His son Richard Kiepert was the cartographer of colonial Germany: he prepared maps from data collected by German explorers of Africa that included Friedrich Gerhard Rohlfs (1831-1896), Johan M. Hildebrandt (1847-1881) and Gustav Nachtigal (1834-1885), and drew the first map of the Congo Basin showing the results of the Berlin Conference. Two important geographic works on Africa were his *Deutscher Kolonial-Atlas* (1893) and the *Spezialkarte von Deutsch-Ostafrika* (scale 1:300,000), which was finished by his colleagues Paul Sprigade (1863-1928) and Max Moisel (1869-1920) in 1911 (Bodenstein, 2015; Demhardt, 2000, pp. 66-67, 149). Heinrich Kiepert's 1874 article was also Banning's reference when he looked for antiquarian maps, as when he referred to the map by Olfert Dapper of 1676 already mentioned and celebrated the quality of its representation of the continent's profile which "seems even to have out-stepped in many respects the progress of modern geography" (Banning, 1877b, p. 5).

Émile Adan (1830-1882) is yet another of the King's collaborators whose work is found in the library. He acted as head of the *Institut cartographique militaire*, and in 1877 taught a course on astronomy for Belgian explorers of Africa at the *École royale militaire* (Adan, 1877b, no. 508). In the late 1870s he also gave conferences on the subject in Brussels, which were published in the *Communications de l'Institut cartographique militaire* (Adan, 1879). He made

a map of Africa that accompanied a long detailed overview of the continent's past explorations. The article was published in the first issue of the journal of the newly-created Belgian geographical society and ended with a handy index of all explorers' names (Adan, 1877a; Vandersmissen, 2009, pp. 237-238).

Finally, a special mention amongst the King's collaborators goes to Alphonse-Jules Wauters, not so much as the editor-in-chief of *Le Mouvement Géographique*, but as an 'independent' writer who became a specialist on Africa and published in 1895 a bibliography on Africa containing no less than three thousand eight hundred items (Wauters, 1895; no. 5104). Several of his publications are mentioned in the library's inventory. His historical study on the source of the Nile and more specifically on Lake Sachaf, *i.e.* the aforementioned Zembre, was as much an answer to a public question from the *Société de Géographie de Lyon* as a reaction to Portugal's answer to that same question by Luciano Cordeiro (1844-1900), secretary-general of the Geographical Society of Lisbon, who claimed Portuguese primacy in exploring the interior of Central Africa (Wauters, 1879a, no. 1345; Cordeiro, 1878). The question was politically interesting because the Portuguese strongly opposed Belgian (and French) explorations of the Congo Basin. In 1883, they would sign a treaty with Great Britain confirming their rights in the area. A memorandum by the Portuguese Geographical Society was published to sustain their claim for Portuguese sovereignty over the interior of the Congo by using ancient maps and travel accounts (no. 5918). Wauters reacted again along the same lines with an article in the *Bulletin de la Société Belge de Géographie* (1883). The aforementioned 1881 English translation of Pigafetta's description of Congo, one of the sources used by the Portuguese, often referred in its notes to Cordeiro's study (1879) on Africa's hydrography in the 16th century. Therefore, the presence of Pigafetta's book in the King's library is perhaps more due to political reasons than to a purely cartographic interest. The same year, Wauters published a work on the Zambezi, explored by the Livingstone brothers in 1865 (Wauters, 1879b; no. 1344). The work gave a general picture of the river, including a chapter on the river's political and social geography. In a *post-scriptum* the author mentioned the exploration of 1877 by the Portuguese Alexandre de Serpa Pinto (1846-1900), the results of which were not yet known to him. They would indeed be published two years later; its publication can be found in the King's library (Serpa Pinto, 1881, no. 1007). The last publication by Wauters I would like to mention here is on the Welle river, it also includes a map (Wauters, 1885; no. 4452). The author described the hydrography on both sides of the higher Congo river and came to the conclusion that the Ubangi river must be considered as the lower Welle. Wauters' theory, purely hypothetical at the time, is based on exploration reports and published maps of German and Belgian explorers. The identification of the Ubangi as the lower Welle had an impact on how the hydrography of this region was perceived. The region became consequently part of the Congo Basin and it moved the colony's northern border far up north well beyond 4° N latitude. The inclusion of the Ubangi watershed in the King's future personal possessions was thought of great commercial importance. As Wauters explained in his article, the Ubangi could open these fertile lands to trade with the western coast of Central Africa and, more importantly, the Congo could eventually replace the Nile as the most direct way to the Momboutous and Niam-Niam merchants. The land's richness was now no longer only accessible through the long road to Alexandria, situated at eight hundred leagues from this region, but also through the road to Banana, situated at only five hundred leagues. Belgian exploration of the area in the years following the signature of the Berlin protocol would confirm Wauters' identification of the Ubangi as the lower Welle but not his ideas about the Congo as an alternative for the Nile.

Maps in Journals

As mentioned before, at the end of the inventory there is a long list of journals, annuaries, reports and catalogues, classified more or less by subject (from no. 8175 onwards). The inventory does not give any details about the issues of the journals present in the library. Therefore, we don't know if the King possessed complete series or only certain issues of these journals. A letter from the archives suggests that there was at least an intention to have these series completed [17]. Even more impressive than the long list of journals is the number of European geographical societies represented in the inventory, the most important of which being Paris (8413), Berlin (8427), London (8127a), Madrid (8429), Lisbon (8431), St. Petersburg (7432), Geneva (8433), Vienna (8428), Budapest (8420), Rome (8405), New York (8407), Brussels (8438), Antwerp (8437). The presence of their journals in the library testifies to the King's general interest in matters of geography. To which extent they also served the King's African policy we cannot tell with certainty, although for some at least there are indications they must have.

Geographical Societies

The *Società africana d'Italia* founded in Naples in 1880 as the *Club Africano*, had been created within the context of the country's colonial policy. Its journal (8406) was of course of direct interest to the King's own colonial aspirations. Journals like the *Journal of the Manchester Geographical Society* and the *Scottish Geographical Magazine* (8408-8409), both published for the first time in 1885, and thus somewhat out of the scope of this contribution, featured nevertheless in their first issue an article by Stanley and a map of Africa. The journals of the three oldest geographical societies, of which Leopold was a member, the *Société de Géographie de Paris*, the *Gesellschaft für Erdkunde zu Berlin* and the Royal Geographical Society, relate extensively, and on a very regular basis, on national and foreign expeditions, publishing maps and sketches sent to them by the explorers themselves together with their reports and letters. The same is true for *Le Mouvement Géographique*, the journal of the *Institut national de Géographie* (8185), as well as for the journals of the two Belgian geographical societies, both created in 1876, the year of the Geographical Conference on Africa organized by the King in Brussels (Vandersmissen, 2009). The American Geographical Society in New York published in the 1884 issue of its journal a long, well-documented report delivered by its president Charles P. Daly (1816-1899) on *Recent developments in Central Africa and the valley of the Congo*. It deals with the treaty signed between Portugal and Great Britain on 26 February 1884 and the recognition by the United States of the *Association internationale du Congo* on 22 April 1884. Daly had been a partisan of the King's colonial ideas from the creation of the AIA onwards (Bontinck, 1976).

Local French Societies and Others

Local French societies are very well represented in the inventory. The King was an honorary member of some of them: Lyon founded in 1873 (8414), Bordeaux in 1874 (8415), Marseilles in 1877 (8416), Rochefort in 1878 (8417), Rouen in 1879 (8553) and Nancy in 1887 (8419). In the last quarter of the 19th century, many cities in France founded their own geographical society. Their journals, important for the dissemination of popular geography at a time when

academic geography was not yet fully established, often focused on commercial opportunities offered by national and other colonies (Clout, 2008). They are followed in the inventory by other French journals, explicitly dedicated to exploration and expedition accounts. *L'Exploration* (8418) bears the revealing subtitle *Journal des conquêtes de la civilisation sur tous les points du globe*, which was changed in 1884 into *Revue hebdomadaire des découvertes géographiques et de la politique coloniale*. It was published for the first time in 1876 under the direction of Charles Hertz (†1879), secretary-general and founder of the *Société de Géographie commerciale* in Paris, whose journal can also be found in the inventory (8413) [18]. Amongst the German journals, one should mention the *Correspondenzblatt der Afrikanischen Gesellschaft* that published in its first issues letters, reports and maps by the members of the Güssfeldt expedition (1877, no. 8340).

Petermanns Mitteilungen

A crucial role in the dissemination of the latest updates on exploration was played by *Petermanns Mitteilungen* [19]. August Petermann (1822-1878), after whom the monthly journal was named, had stressed in his foreword the excellent quality of the maps published in the journal, which distinguished the latter from other similar initiatives (Demhardt, 2000, p. 22). The impact of these highly successful maps cannot be overestimated. The maps were copied by other journals and were used to make other maps. They provided explorers with first-hand information they couldn't find elsewhere, information whose sustainability was sometimes longer than one might expect in those years of intensive exploration and mapping. To give but one example: the RGS published in 1884 the letters by Frank Lupton (1854-1888), dated 1882, on his geographical observations with regard to the Bahr-el-Ghazal region (South Soudan) read and discussed by its members at their evening meeting of 10 March 1884 (Lupton & Lupton, 1884). In his letters, Lupton referred to the maps he had with him at the time. He suggested several corrections to the map of equatorial Africa published in *Petermanns Mitteilungen* in 1877, which shows the then-latest results of the explorations in Central Africa, including Stanley's in 1876/77 (fig. 5). In 1882, this was still Lupton's most recent map! The latter went on criticizing another map, *i.e.* Schweinfurth's from the account of his travels in Central Africa between 1868 and 1871 (Schweinfurth, 1874), and finished with a request for the latest published maps, for his "are all old ones, not worth anything" (Lupton & Lupton, 1884, p. 252). Between 1877 and 1882, when Lupton explored the northern Congo region, the Congo Basin had been intensively explored, but the only recent map then available to him was, so he said, a small map the Russian explorer Wilhelm Junker (1840-1892) sent to him about his discoveries in the region while he was investigating the Nile-Congo watershed. From time to time, there are physical traces of the journal's use by the King or his collaborators. For instance, the account by Clemens Denhardt (1852-1928) of his travels in East Africa and the discovery of the Tana river (Kenya), published in *Petermanns Mitteilungen*, was preserved as a separate fascicle in the library (Denhardt, 1881, no. 6458). Its accompanying map, on the other hand, was probably taken out and kept aside, as it is now in the archives of the King's successor (fourteen of the maps described in the appendix).

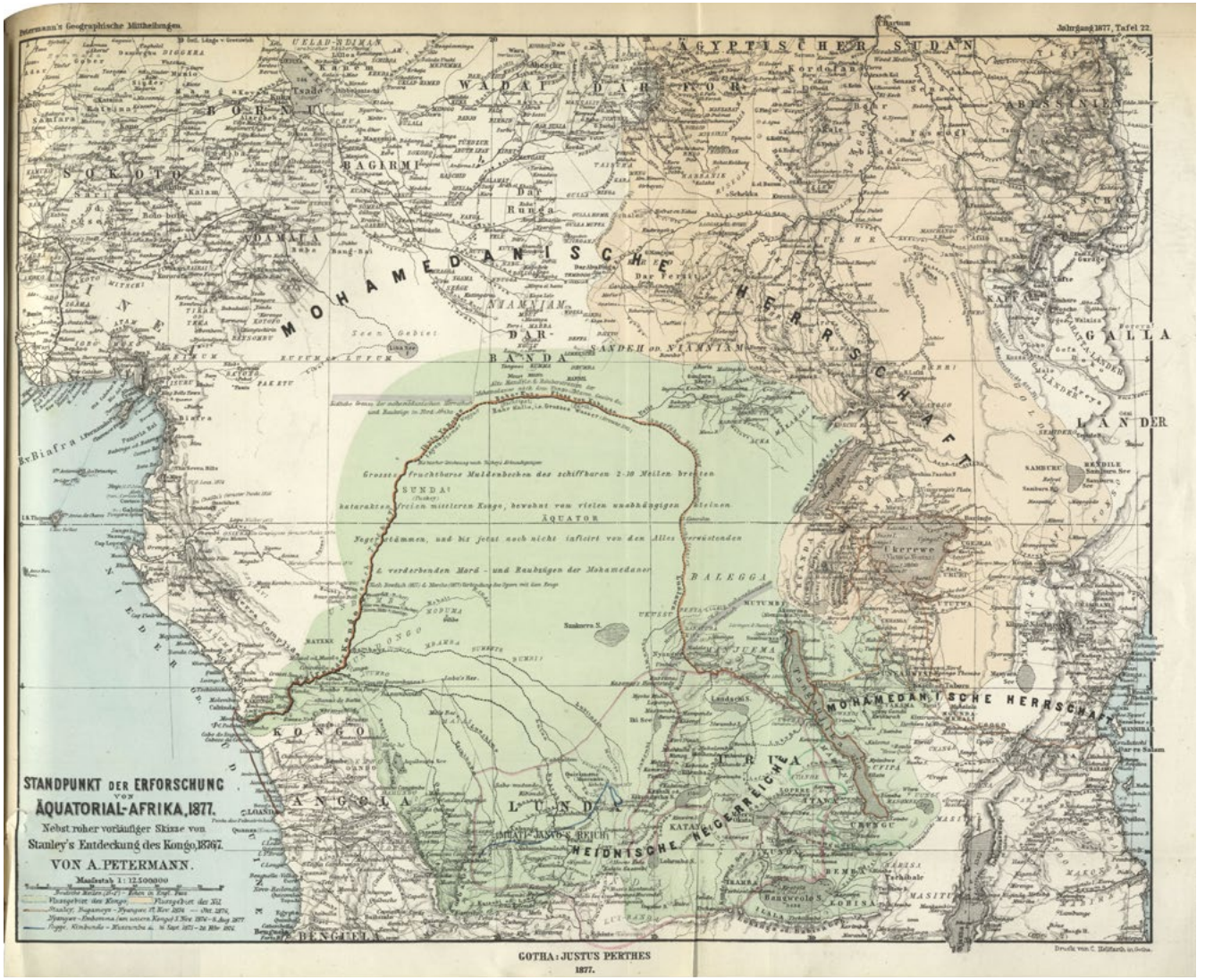


Fig. 5. — *Standpunkt der Erforschung von Äquatorial-Afrika, 1887 [...] von A. Petermann, Petermanns Mitteilungen, 1877, tafel 22* (© Brussels, Royal Library of Belgium).

Conclusion

The King's library contained so to say all the contemporary literature on Central Africa and the Congo Basin that a potential reader at the time could wish for. Most of the literature also offered maps, large- and small-scale maps, particular maps of itineraries, lakes and other specific areas of interest. Even old maps were present in the library, some in contemporary facsimile editions. The library's structure at the King's demise, which is reflected in the inventory drawn up at the time, is that of a working tool. It shows the library was not just a ceremonial one. The preserved correspondence on acquisitions, loans and restitutions, on the library's accessibility, confirms this. Furthermore, the letters referred to in this paper are testimony to the library's practical use for the King and his staff in establishing the former's colonial policy. The few maps that have been preserved in the archives of the King's successor and that have been taken out of books and journals, are proof of the particular interest their owner took in that sort of items. The library (and its inventory) thus becomes a privileged testimony of the King's colonial policy, a testimony that should be heard by scholars of Belgium's colonial past and, more generally, of 19th-century colonialism.

APPENDIX

List of maps of Africa, and particularly Central Africa, which have or may have belonged to the King's library and are now in the archives of King Albert I and Queen Elisabeth [20].

1. 538/A. *Africae accurata tabula ex-officina Jacobum Meursium*.
2. 1482/B. *Carte d'Afrique. Dressée pour l'instruction*. Par Guillaume Delisle […] Revue et augmentée par Dezauche […] À Paris, Chez l'Auteur, Rue des Noyers, 1819.
3. 944/A. *Afrique divisée en ses principaux Empires et Royaumes*. Par Robert de Vaugondy, Géographe à Paris. Chez Delamarche, Géographe, Rue du Jardinet, n° 13.
4. 562/A. *Map of East Africa* by Lyons McLeod F.R.G.S., etc. Late H.B.M.'s Consul Mozambique 1859. Day & Son Lith.rs to the Queen, London, Hurst & Blackett, Great Marlborough Street, 1860.
5. 461/ *Stanford's Library Map of Africa* constructed by A. Keith Johnston, F.R.S.E. F.R.G.S., etc. London, Edward Stanford, 55 Charing Cross, July 2nd 1866.
6. 361/B. *Fac Simile d'un croquis des explorations en Afrique offert à Sa Majesté le Roi des Belges par Sir R. Alcock K.C.B., P.R.G.S., etc. le 11 septembre 1876*.
7. 589/A. *General Map of Africa constructed from the most recent coast surveys and embodying the results of all explorations to the present time*. By Keith Johnston, F.R.G.S., 1879. Engraved, printed and published by W. & A.K. Johnston, Edinburgh & London.
8. 626/A. *Afrique*. Wm. Rosier del.; Aut. Hoverraz, Genève, L'Afrique Explorée et Civilisée, n° 11, mai 1880.
9. 454/A, 1170/A (1625/A). *Afrique*. Carte dressée et dessinée par le Chef de Bon du Génie Régnauld de Lannoye de Bissy (étant chef du Service Géographique le général Perrier), Paris, Dépôt de la Guerre, Service Géographique de l'Armée, 1881.
10. 565/A. *Africa shewing the routes of the Leading Explorers to accompany M. Banning's Africa and the Brussels Conference*. Stanford's Geographical Establishment, Sharing Cross. London, Sampson Low, Marston, Searle & Rivingston [1877].
11. 633/A. *Croquis des explorations dans le sud de l'Afrique, dans les territoires équatoriaux de l'ouest et dans le Soudan*.
12. 624/A. *Itinéraires suivis par les principaux explorateurs de l'Afrique*, par E. Adan, Lt col. d'État-Major. Bruxelles, Institut Cartographique Militaire de Belgique, 1879.
13. 625/A. *Carte de l'Ousambara Méridional avec l'itinéraire de Keith Johnston en 1879*. Wm. Rosier del.; autogr. Noverraz, Genève. L'Afrique explorée et civilisée, 1re année, o. 6.

14. 575/A. *Originalkarte des Äquatorialen Ost-Afrika zwischen Mombasa und Nijansa. Mit Zugrundelegung der Tana-Fluss-Aufnahme nach den eigenen Erkundigungen über die Handelswege des Innern construirt und gezeichnet* von Clemens Denhardt. Red. von B. Hassenstein, aut. von B. Domann, C. Schmidt; Drück von C. Hellfarth i. Gotha. Gotha, Justus Perthes, 1881.
15. 597/A. Manuscript map of German East Africa: region of Lake Kigarama, Bugarura, Bugesera and Buhoma.
16. 598/A. Manuscript map of German East Africa: region between Lakes Kivu and Tanganyika and Lake Victoria.
17. 556/A. *Map of the Route adopted by Captains Speke & Grant, on their Journey across Africa from Zanzibar to the Mediterranean*, by A. Keith Johnston F.R.S.E. W. & A. K. Johnston, Edinburgh. Edinburgh and London, William Blackwood & Sons, 1864.
18. 353/A. *Map of Expeditions made to the Lake Victoria Nyanza and West of the White Nile to Makraka-Niam-Niam 1874 and 1875 by Col. C. Chaillé Long [...] Adding notes of Stanley & Linant who have since visited the Lake*. E. Weller, Lith. London, Sampson Low, et Co.
19. 632/A. *Carte d'une reconnaissance faite par feu M.E. Linant de Bellefonds (février-juin?1875) entre Regaf et le Lac d'Ukerewe*. Dressé d'après les notes et croquis du voyageur par G. Schweinfurth. Autogr. par Schweinfurth; Imp. lith. V. Penasson, Alexandrie. *Bulletin de la Société Khédiviale de Géographie*, Année 1876, n° 2.
20. 590/ *Egypt and Equatorial Africa compiled from original surveys and the best authenticated sources* by John Fowler, 1877. London, Thomas Kell Lith.
21. 380/B, 853/B. *Croquis de l'Afrique Équatoriale contenant les derniers renseignements recueillis par les agents de l'Association Internationale du Congo*. Bruxelles, Institut National de Géographie, novembre 1884.
22. 854/A. *Carte politique de l'Afrique centrale. A Messieurs les Membres de la Chambre des Représentants. Hommage du Mouvement Géographique*. Bruxelles, Institut National de Géographie, 10 mars 1885.
23. 635/A. *Le Tanganyika*. Institut Cartographique Militaire, 1880.
24. 622/A. Association Internationale Africaine. *Croquis de l'itinéraire suivi de la côte au lac Tanganyka par Mr. Cambier chef de la 1re expédition*. Litho Verhavert Frères et Sœurs, rue du Cornet, 131. Etterbeek-Bruxelles.
25. 563/ *South Eastern Africa. Map of the River Shire, the Lakes Nyassa & Shirwa, the Lower Courses of the Rivers Zambesia & Rovuma. Based on the Astronomical Observations & Sketches of Dr. Livingstone*. Constructed by John Arrowsmith, 1865. London, John Murray, [1865].
26. 937/ *Carte Partielle des missions de l'Afrique Équatoriale* dressée par le R.P. Fx. Charmetant, Missionnaire Apostolique d'Alger. Gravée par R. Hausermann, 27, Rue St. André des Arts. Paris, Imp. Becquet, 1879.
27. 586/A. *Survey of the Livingstone Falls (32 in Number) of the Lower Livingstone River from Stanley's Pool to Boma*, by Henry M. Stanley. Stanford's Geographical Establishment, 55 Charing Cross. London, Sampson Low, Marston, Searle & Rivington.
28. 358/A. *Le Congo de Boma à Matadi. Les chiffres indiquent les profondeurs en brasses*.
29. 535/A. *The Congo River from its Mouth to Bolobo to illustrate the journeys of Mr H.H. Johnston*. Edward Weller, Red Lion Square; H. Sharbau, R.G.S. del. From the *Proceedings of the Royal Geographical Society*, 1883.
30. 808/B. *Le Congo depuis l'Équateur jusqu'à l'Océan et la Vallée du Niadi-Kwilu*. Bruxelles, Institut National de Géographie, novembre 1883.

NOTES

[1] Copies of the printed map published by the ING, signed by Maximilien Strauch (1829-1911), president of the AIC, are found in the documents of the Berlin Conference kept in the National Archives in Berlin. One bears the tracing of the borders as they appear on the map added to the convention of 8 November 1884; the other shows the borders as they appear on the map added to the declaration signed by the Belgian government and the AIC on 23 February 1885 (R 1001/4170). The

original manuscript map together with the text of the convention of 8 November 1884 can be found in the same archives (R 1001/9047). For an introduction to the political history of the Congo colony, see Stengers (2020); for a study of Leopold's interest in matters of geography, see Vandersmissen (2009).

[2] Jan Vandersmissen (2009, pp. 409-412) has been the first to offer a short description of the library, underlining its importance for the study of the King's colonial doctrine. I am grateful for his precious help in studying the King's library.

[3] *Archives du Palais Royal* (ARP), Bib K 1-3.

[4] Noteworthy in this respect is the absence of Laveley's writings on Congo in the library, except for his article of 1891 on the partition of Africa (no. 5904).

[5] James William Money was a British lawyer based in India, who defended the Dutch colonial Cultivation System, the so-called *Cultuurstelsel*, requiring that 20 % of village land had to be devoted to government crops for export or that, alternatively, peasants had to work in government-owned plantations for sixty days each year. On 25 October 1883, Ferdinand Marie, comte de Lesseps, developer of the Suez Canal (1869), held a public lecture which was titled: *Sur le caractère scientifique et civilisateur des grandes entreprises industrielles ayant pour but de faciliter les relations entre les peuples*.

[6] In order of appearance in the inventory: the topographical map of Russia, 1860 (no. 2945), a detailed map of the surroundings of Hernstein castle in Austria drawn by Joseph Wanka von Lenzenheim (no. 3898), a plan of the Gileppe dam published in 1880 by the city of Verviers (no. 3976), different editions of the *Carte de Belgique, indiquant toutes les voies de communication. Dressée au Dépôt de la Guerre*, 1875 (scale 1:160,000, nos. 4037-4041 and 5527), the *Carte hydrographique et routière de la Belgique* (scale 1:100,000) by the Belgian cartographer Philippe Vandermaelen (1795-1869, no. 4084), *The Original Map of South Africa* (scale 1: 2,500,000) by Alexander Merensky, 1837-1918 (no. 4538), a *Plan topographique des environs d'Anvers au 1/20 000* by the *Dépôt de la Guerre*, 1859 (no. 5200), a map for cyclists by E. Hennequin and published by the Ministry of War, 1898 (no. 5279), a map of Southern Germany by Carl Arends (no. 5522), Joseph Schlacher's *Orohydrographische Karte von Mittel-Europa* (no. 5529), the 1882 reproduction of the large map of Flanders by Gérard Mercator of 1540 (no. 5530), the map of the battle in the Royal Parc in Brussels in 1830 by Léon Teusch (no. 5535), the *Carte de la production, de la circulation et de la consommation des charbons belges en 1877*, 1879 by Max Goebel (no. 5653), the *Carte militaire de la Crimée et de la côte de Kinburn* engraved by J. Claes (no. 6469), J.N. Fritschi's *Topographische Karte der Umgebungen von Baden*, ca. 1880 (scale 1:37,500, no. 6470), a city plan of The Hague by M. Couvée (?) (no. 6471), *This is the first map of the world ever constructed on the variation of the needle* (by Midleton [*sic*]), (= Middleton's *Pioneer map of the world*?, no. 6472), E. Higginson's map of the Republic of Peru, 1903 (no. 7580), and finally Jules Hansens' *Carte topographique du Grand Duché de Luxembourg*, 1905-1907 (scale 1: 50,000, no. 8169). As we have seen, one item of the inventory (8894) assembles a collection of two hundred and fifty enrolled maps; possibly, this collection held maps of Africa.

[7] It is true that for long it was common practice among archivists to separate maps from the fascicles in which they were found and the stamps with their stack number were put on the maps by the first archivist of the royal palace in the early 1960s. Still, the fact remains that in this case most maps were taken out of books and journals, which is not, nor was, a current practice amongst librarians or archivists.

[8] No. 17 was published in the account by James Augustus Grant (1827-1892) of his journey with John Hanning Speke (1827-1864) searching for the source of the Nile (1864). I didn't find this book in the inventory. On the other hand, Grant's study of the botany described during this expedition is present in the library (1878, no. 5745).

[9] For no. 23 see also the *Bulletin de la Société Belge de Géographie* (Adan, 1880).

[10] The date of 14 July 1879 added to the map near Tasha (?) must refer to the battle between Romolo Gessi (1831-1881), serving under Gordon, and the slave trader and rebel leader Suleiman Zobeir, which led to the latter's capture and execution on 15 July (Gessi Pasha, 1892, p. 329).

[11] We can try to complete these results by going through the archives of the Ministry of Foreign Affairs, whose secretary-general from 1859 onwards was Auguste, later Baron, Lambermont (1819-1905), one of the key figures in the Belgian preparation of the Berlin conference and its joint reporter with Baron Alphonse Chodron de Courcel (1835-1919), or by looking for maps in the family archives of the Goffinet family, three male members of which were at the royal court in the period under consideration and one, Constant, served as secretary to the Belgian delegation in Berlin. In both cases, the results are equally meagre, most maps being of later dates. On the other hand, the catalogues of the so-called Africa Library of the Ministry of Foreign Affairs are more promising. There are two of them for the 19th century and their comparison is quite illuminating: the first one published in 1878 mentions only eight maps of Africa and a few works on Congo. The second catalogue, published in 1889, gives a quite different image. We have more than five pages of monographies and eight with travel reports — most of them we will also find in the inventory of the King's library — and sixty-three maps of Africa. This is basically thanks to its librarian Émile Banning (1836-1898) who had become an expert on Africa and would as such participate in the Berlin Conference (see *infra*).

[12] *Carte d'Afrique divisée en ses principaux Etats dressée sur les observations astronomiques de Mrs de l'Academie roy[a]le des Sciences, et sur les memoires les plus récents. Par Mr l'abbé Clouet de l'Academie r[oya]le des Sciences de Rouen = La África dividida según lo dilatado de sus principales partes cuyos puntos principales están delinados sobre las últimas obsevationes [sic]: por el Señor abad Clouet del Academia real de las Sciencias.* A Paris: chez Mondhare rue St Jaques a la Ville de Caen, 1782; [...] en Cádix: casa de Mondhare, 1782.

[13] In chapter II of his book *The Congo and the founding of its Free State,* Stanley inserted an English version of Pigafetta's map of the Congo kingdom (1885, p. 10).

[14] "Je vous envoie quelques notes, dont quelques-unes étaient déjà préparées. Il va de soi qu'il faut suivre sur les cartes. Vous avez Stanford et Kiepert pour l'ensemble. Il y a ensuite les cartes spéciales jointes aux ouvrages ou rapports de Schweinfurth, etc. Je ne sais si vous avez le 'Tour du Monde'. Il y a là des notices, des résumés, des cartes. Le premier libraire venu vous fera venir la collection de Paris en 4 heures" (Vandewoude, 1976, p. 436). For Lambermont's notes see file G.M. 439 of the Archives of the Royal Palace (*ibidem*, n. 26). The journal *Le Tour du Monde* is not mentioned in the inventory, but from the correspondence related to the library in the Archives of the Royal Palace we know it was regularly consulted by the Royal household (Bib K 1-3).

[15] According to Pigafetta, the Congo river found its origin in this central lake, which in the 1870s was sometimes identified as Lake Tanganyika (Duveyrier, 1876, p. 125).

[16] According to J.-L. Vellut (*Congo: ambitions et désenchantements, 1880-1960*. Karhala, 2017, p. 41), the author of the wall map was the Prussian geographer Ludwig Friederichsen (1841-1915), who drew the map of Central Africa added to the protocols of the Berlin Conference.

[17] Letter from the *Direction de la liste civile* to the King's librarian, dated 19 March 1877: "J'ai l'honneur de vous prier, d'après les ordres du Roi, de faire relier les collections de publications périodiques dont vous avez pris note samedi dernier, et de tâcher de vous procurer les numéros qui pourraient manquer pour compléter ces collections" (APR Bib K 1-3).

[18] In 1885, it was continued by the industrialist and politician Édouard Marbeau (1847-1940), under the title *La Gazette géographique et l'Exploration*, and in 1888, under the same Marbeau, merged into the *Revue française de l'Étranger et des Colonies et Exploration* (8423).

[19] Its full title read at first as follows: *Mittheilungen aus Justus Perthes' Geographischer Anstalt über wichtige neue Erforschungen auf dem Gesammtgebiet der Geographie*. From 1879 onwards, after Petermann's demise in 1878, it became *Dr. A. Petermanns Mittheilungen aus Justus Perthes' Geographischer Anstalt*, and in 1938 this was changed into *Petermanns Geographische Mitteilungen*.

[20] References are copied from the provisional map inventory of the archives of the Royal Palace drawn up by Baudouin D'Hoore. We have added to this list nos. 15 and 16, two undated manuscript maps. I haven't been able to date them precisely, but I think they must have been made after 1885.

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Leopoldian Imperial Cartography: The Case of the Kouilou-Niari Basin prior to the Foundation of the Congo Free State

by

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KEYWORDS. — History of Cartography; History of Geography; Leopold II; Congo Free State; Kouilou-Niari.

SUMMARY. — This study focuses on Leopoldian imperial geography in times of tension prior to the establishment of the Congo Free State. The Geographical Conference of Brussels in 1876 resulted in exploration missions undertaken by the *AIA*, the *CEHC*, and the *AIC* in the Congo Basin and adjacent areas. This process was accompanied by land grabbing operations, which remained not without consequences. Geopolitical tensions with France and Portugal forced Leopold II to make choices. These were cartographically translated into maps that not only showed the spheres of influence but also reinforced the territorial claims. A new analysis of maps edited by Alphonse-Jules Wauters and published by the *Institut national de Géographie* sheds light on the specific case of the cartographic representation of the Kouilou-Niari Basin, where the claims made by Leopold's *AIC* had been disputed by France since 1883. The maps express, through their visual discourse, the entanglement of cartography with imperial agendas in the run-up to the Berlin Conference in 1884-1885.

Introduction

This paper deals with the interaction of geography, cartography and empire building during the reign of Leopold II (1835-1909), King of the Belgians (r. 1865-1909) and future Sovereign of the Congo Free State (r. 1885-1908), in the period preceding the Colonial Conference of Berlin, the final Act of which was accepted on 26 February 1885. Its purpose is to explore issues related to the question of how the Belgian geographical movement — a term used here to define in an encompassing way the eclectic set of people, publications, and projects associated with mid- and late-nineteenth-century geographical societies and comparable institutions (Vandersmissen, 2008, p. 23) — became fascinated by imperial projects. Moreover, the hypothesis is that an intensification in this regard has taken place from the 1880s onwards. As geopolitical tensions between the European powers were increasing, the nature of geography's involvement with Leopold II's actions changed. At a time when Leopold II's enterprise in Africa came under pressure, cartography was explicitly used as a means of underlining the King's territorial claims. One way to demonstrate and better understand this process of gradual entanglement is to analyse maps and documents related to the European pursuit of exploration, occupation and acquisition of the contested Kouilou-Niari Basin — located in what is today known as the Republic of the Congo, formerly known as Congo-Brazzaville — which allows us to link the monarch, on the one hand, and an institutional triangle consisting of the Brussels

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Institut national de Géographie, the *Société royale de Géographie d'Anvers*, and the *Société royale belge de Géographie*, on the other hand, to explicit forms of imperial cooperation, directly related to business that mattered in Berlin.

The Berlin Colonial Conference (1884-1885)

Before looking deeper into this case, one should take a glance at the Colonial Conference which, on the initiative of the German Chancellor Otto von Bismarck (1815-1898), took place in Berlin from 15 November 1884 to 26 February 1885. While excluding African leaders, the fourteen participating countries all had imperial affairs on their minds. They were involved in a competition for sovereignty rights and economic interests in Africa that could easily degenerate into a multinational military conflict. At the Conference agreements were made about the suppression of slave trade, and the freedom of navigation on the Niger and Congo Rivers, the freedom of trade along the latter (Korinman, 1986, de Gemeaux & Lorin, 2013). In essence, principles were accepted that further legitimized the imperial race (Kohen & Hébié, 2018, p. 82). Chapter 6, art. 34 of the final Act contains a declaration on the conditions to be fulfilled for new occupations in Africa and addresses the question of how imperial powers should inform each other in the future in a civil way about territorial conquest: "Any Power which henceforth takes possession of a tract of land on the coasts of the African continent outside of its present possessions, or which, being hitherto without such possessions, shall acquire them, as well as the power which assumes a Protectorate there, shall accompany the respective act with a notification thereof, addressed to the other Signatory Powers of the present Act, in order to enable them, if need be, to make good any claims of their own". This is no less than a clear reference to the practices of both land grabbing and violence which were inherently linked to and became cornerstones of imperial competition in Africa (Gebeye, 2021, p. 50).

What matters is the Conference's indirect outcome: the consecration of the territorial claims of the privately-managed *Association internationale du Congo* in the Congo River Basin which, during the Conference, transformed into the Congo Free State – an independent state ruled by a European sovereign, Leopold II. The road leading to the creation of this political construct was long and bumpy and much has been written about the political side of the affair by many a historian since Émile Banning published in 1885 his *La conférence africaine de Berlin et l'Association internationale du Congo* (Bruxelles: Librairie C. Muquardt). Regarding historiography related to Belgian and Leopoldian involvement, one should mention the work accomplished by François Bontinck, Jean Stengers, Jean-Luc Vellut, Guy Vanthemsche, and Pierre-Luc Plasman (Bontinck, 1969, 1971; Stengers, 1953, 1988, 1989; Vellut, 2017; Vanthemsche, 2012; Plasman, 2017). However, many things are left unsaid when it comes to Congo Free State's relationship with the geographical sciences and cartography in Belgium. Only a few scholars pointed to this specific connection. Henri Nicolaï from the *Université libre de Bruxelles* wrote extensively about Leopoldian geographical imperialism, highlighting the role played by the journal *Le Mouvement Géographique,* which was initially published by the *Institut national de Géographie* (Nicolaï, 1988, 1993, 1994), a private initiative launched by the Polish immigrant editors Henry Merzbach (1837-1903) and Théodore Falk-Fabian (1845-1928). The periodical later fell into the hands of the *Compagnie du Congo pour le Commerce et l'Industrie*, a company headed by Albert Thys (1849-1915), a military officer and manager who had contributed to the design of the Leopoldian imperial framework in Africa from the very beginning. Nicolaï's work has inspired a younger

generation in developing studies in the same vein (Brugaillère, 1993; Henry, 2008; Dupont, 2021). Roland Baetens published the first history of the Antwerp Geographical Society, evoking its focus on Congo (Baetens, 1976). The Antwerp society will soon be included in this story.

The Rise of Imperial Geography in Belgium in the Second Half of the Nineteenth Century

It is useful to consider the state of geography in Belgium in the second half of the nineteenth century. Belgian "amateurs" of geography became connected to a wider movement that emerged all over the Western world. This movement was formed by a heterogeneous group of people and institutions sharing interest in a body of knowledge on the Earth which at the time was not yet promoted to the scientific status geography holds today. Scholars approached man's relationship with the spatial environment from very different angles and, initially, without much sense of methodology. The 1850s saw the rise of economic geography. Belgium's massive industrialization, with its effects on trade, transport and communication, inspired new ways of thinking about man and his material environment (Vandersmissen, 2010).

In 1871, Antwerp was the venue for the first international congress on geography. This meeting formed a core of people who aimed at systematically focusing on the study of the Earth in a Belgian context. Eclecticism prevailed, but economic geography became a dominant tendency. A new impetus came with the second international congress, held in Paris in 1875. The Belgian delegation experienced how geography became associated with colonization due to competition between the Western powers in Africa. Moreover, the Paris congress reinforced Leopold II's personal interest in geographic themes. The diplomat Émile de Borchgrave (1837-1917) represented the King and gathered information useful to him. The year 1876 is seen as the start of Leopold II's activities in Africa, a continent that caught the King's attention quite late, as evidenced by two memoranda entitled "*Rêves*" and "*Afrique*", dating from 26 August 1875 (Stengers, 1997). A year later, Leopold II organized the Geographical Conference of Brussels. Explorers and key players in the geographic movement of the time discussed the consequences of recent European exploration of the central parts of Africa while observing a map of the continent offered by Sir Rutherford Alcock (1809-1897), President of the British Royal Geographical Society, to the King. Over the next ten years, Leopold II used this movement emphatically as an instrument for establishing and materializing his own imperial agenda (Roeykens, 1956; Stengers, 1970; Conférence de Géographie de 1876, 1976; Vandersmissen, 2009).

There is a striking synchronism here, because in the same year Leopold II organized the Geographical Conference, the geographical societies of Brussels and Antwerp were launched. Their presidents, both generals in the Belgian army, Jean-Baptiste Liagre (1815-1891) in Brussels and Henri Emmanuel Wauwermans (1825-1902) in Antwerp, maintained good relations with the Court and were important for the merger of forces. Leopold II's impulse was a catalyst. At the societies' meetings the discourse of economic expansionism was popular. Echoing the humanist slogans of the Conference, the societies mobilized support for exploratory missions which, despite their scientific programme, had political and economic goals. They established relations with the King's organizations active in Africa: the *Association internationale africaine* (*AIA*), the *Comité d'Études du Haut-Congo* (*CEHC*), and the *Association internationale du Congo* (*AIC*). The societies contributed to the application of the "hero paradigm": a framework of fixed descriptions, attributions, rituals, and ceremonies aimed at giving the African enter-

prise, the explorers and, by extension, Leopold II a place in a heroic tradition. The societies followed the line of internationalism and free trade as advocated by Leopold II, but simultaneously attacked anyone who was threatening Leopold II's project. Finally, knowledge was disseminated among the Belgian elites who received detailed descriptions of the areas traversed by the explorers through lectures and maps published by the societies (Vandersmissen, 2014).

Cartography as an Ally in an Imperial Race against Time: The Case of the "Kouilou-Niari" Basin

On the ground, in Africa, things did not go as planned. With the explorer-journalist Henry Morton Stanley (1841-1904), Leopold II had caught a big fish in 1878. He landed on the royal payroll and had to give new impetus to a difficult undertaking, tackling the efforts of mainly French and, to a minor extent, Portuguese competitors in the Lower Congo region. Especially Pierre Savorgnan de Brazza (1852-1905) had caused a reverse of chances. After having explored, for France, the Ogooué region, he had reached the Congo River in 1880 and signed formal treaties with Illoy Loubath Imumba I (?-1892), the Makoko (or King) of the Teke people of Mbé, and with other chiefs in the area, allowing French settlements on the right bank. This gave the French government not just a pretext for claiming the northern side of the Congo River, but also strong "official" documents, which it ratified in 1882, much to the horror of Leopold II and, it must be said, to many others outside France (Stengers, 1976, 1994).

Several decisions and tumultuous actions followed, the results of which are powerfully depicted in a map bearing the title *Le Congo depuis l'équateur jusqu'à l'océan et la vallée du Niadi-Kwilu* (fig. 1). The map illustrates, better than any other document, the important fact that the geographical movement in Belgium entered a combative phase, taking the side of Leopold II in a real power struggle. The map was added to the *Bulletin* of the Antwerp Geographical Society for the years 1883-1884. Its title highlights a twofold geographical focus. First, there is the cartographic representation of the lower reaches of the Congo River. But it is the second focus that is of interest to this investigation. The map pays particular attention to the valley of a river called Kouilou in the coastal region of what is today the Republic of the Congo but which upstream from the Sounda Gorge takes the name Niari, Niadi being an alternative name used in the nineteenth century. The first focus requires no explanation, the second does.

It is important to dwell on some details. First, something about the publisher. This was not the Antwerp Society but the *Institut national de Géographie*, founded in Brussels in 1882. Its name is confusing. One might suspect that it was a government agency. However, it was a public limited company, as already mentioned set up by Merzbach with the support of the King and a circle of Belgian financiers close to the Court with the intention of bringing together geographical information and publishing it commercially (Vandersmissen, 2009; Dupont, 2021). The *Institut* became a competitor to the *Institut cartographique militaire*, which worked with public funds. The geographical societies did not have direct institutional ties to this publishing house, but it is nevertheless noted that members of the societies were among the first shareholders. The *Institut* had produced the map using information provided between January and July 1883 by explorers employed by the *AIC*, as indicated in the cartouche of the map. It is stressed that the data were gathered "*à la boussole de poche*", a clarification by which the *Institut* covered itself against possible imperfections. The elevations are depicted in shades of brown, the waterways with lines in blue, varying in thickness. The user of the map discovers the names of rivers and places and of peoples living

in the area. Two texts provide information about Stanley's exploration of *Lac Léopold II* (now Lake Mai-Ndombe) and of *Lac Mohumba* (now Lake Tumba). However, the most striking feature is the twenty-seven thick red dots with corresponding place names, also in red, and printed in larger capitals than the other place names. There is no legend here to clarify how the places marked in red differ from the others. But it is clear to everyone that one sees powerful representations of all stations founded by the organizations active in the region on behalf of Leopold II. Sixteen are situated on the banks of the Congo River. But what is more important for this investigation is the prominent place given on the map to stations situated north of the Congo River and in the Kouilou-Niari region — eleven in total, some with prominent names that explicitly refer to the Belgian monarch or his associates (fig. 2): *Stéphanie-ville* (named after Leopold II's daughter Princess Stéphanie, 1864-1945), *Philippe-ville* (after his brother Prince Philippe, 1837-1905), *Baudouin-ville* (after his cousin Prince Baudouin, 1869-1891), *Rudolfstadt* (after his Austrian son-in-law Archduke Rudolph, 1858-1889), *Stanley-Niadi* (after Henry Morton Stanley) — a powerful example of how geographic name giving can be used to enforce territorial claims.

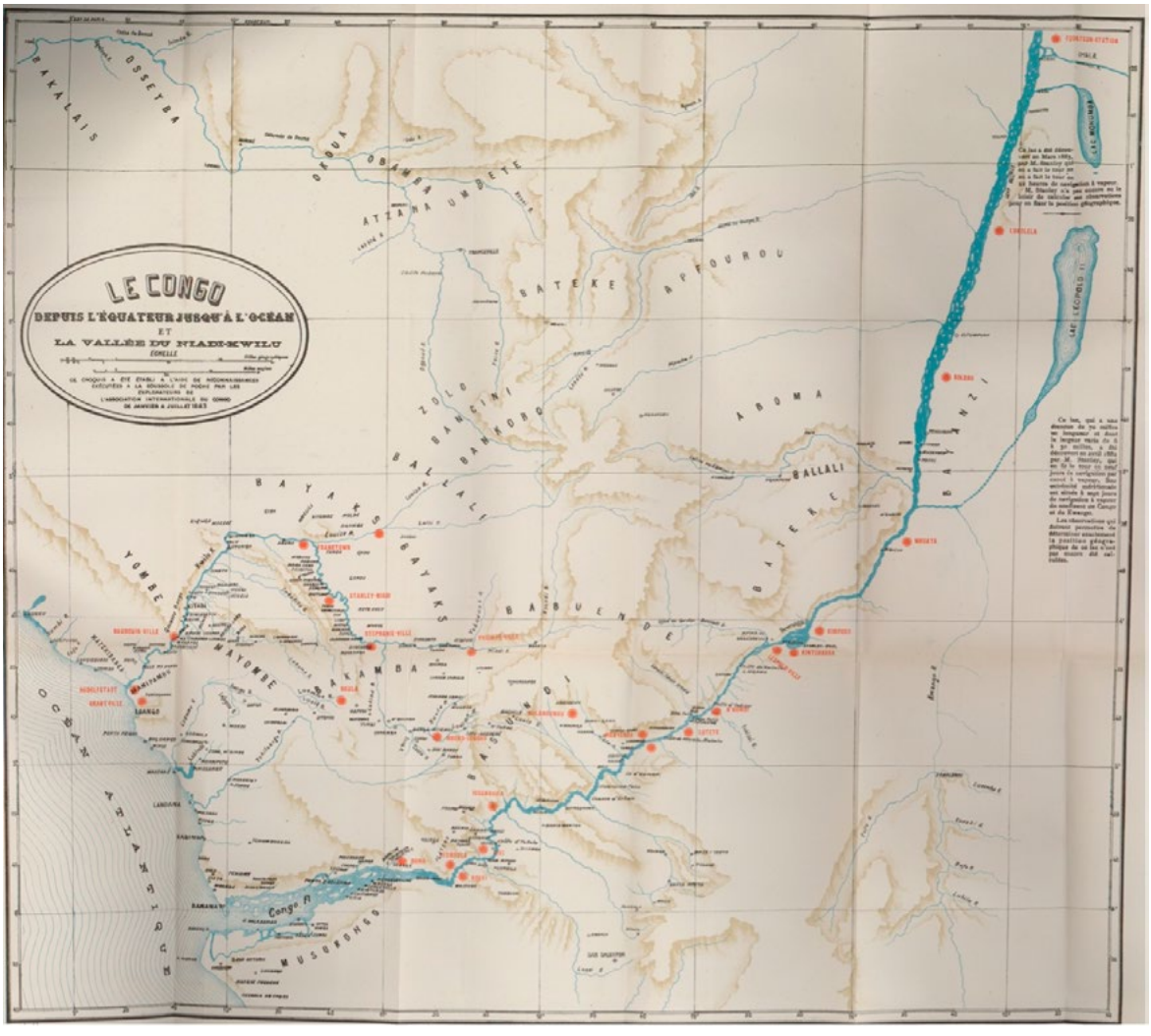


Fig. 1. — *Le Congo depuis l'équateur jusqu'à l'océan et la vallée du Niadi-Kwilu*. Brussels, Institut national de Géographie, November 1883, published in *Bulletin de la Société royale de Géographie d'Anvers*, 8 (1883-1884). Antwerp, Hendrik Conscience Heritage Library, A 16560 © EHC.

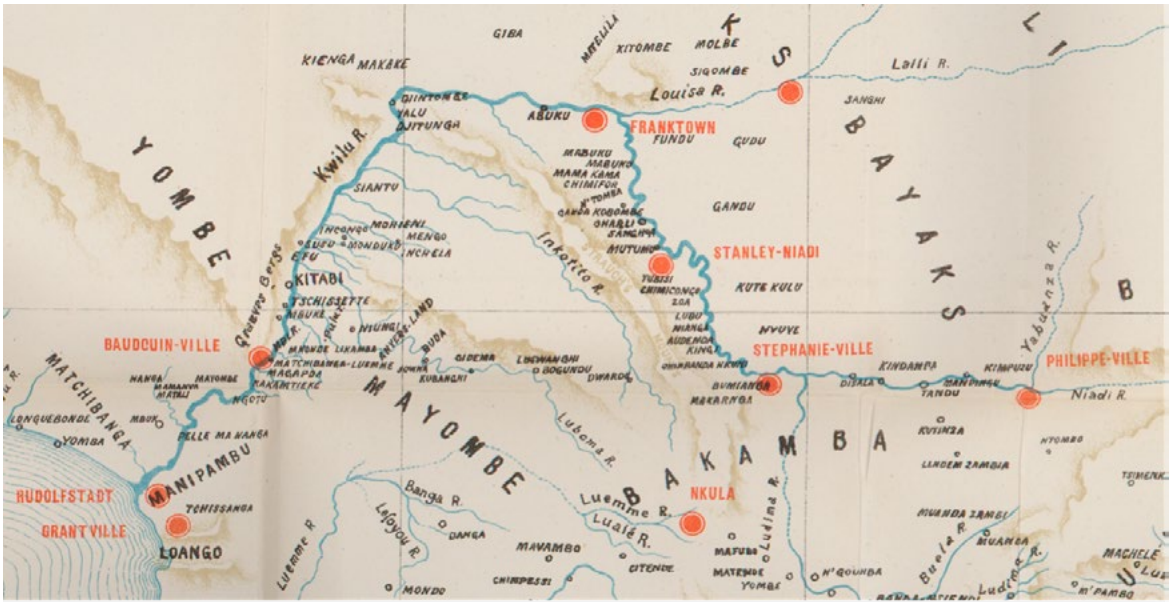


Fig. 2. — Representations of stations founded by the organizations active in the Kouilou-Niari Basin on behalf of Leopold II. Detail of the map at fig. 1. Antwerp, Hendrik Conscience Heritage Library, A 16560 © EHC.

To what extent did this map reflect the situation on the ground? The stations did exist, but their size was insignificant. None of them predated the year 1882. They were all the result of a hasty land grab operation, inspired by France's activities nearby and by Portugal's claim on the Congo mouth, which threatened to cut off Leopold's stations on the Congo River from direct contact with Europe. The neat presentation on the map hides a tiring, dangerous, frustrating, and violent race against time for the explorers engaged in the operation, but also, for the local populations living in the Kouilou-Niari region, a series of confrontations, manipulations, and robberies they had never experienced before.

The Stanley papers preserved at the Archives of the Royal Museum for Central Africa in Tervuren contain letters Stanley received from the King and his Brussels entourage in which direct orders were given to shield the flanks of the area Stanley had crossed in Lower Congo from Portuguese claims. A letter dated 6 December 1882 clearly shows the nervousness in Brussels. Leopold's aide-de-camp, Colonel Maximilien Strauch (1829-1911), was very concerned about the imminent recognition by England of Portugal's claim to the Congo estuary, which became more pertinent after the French ratification of the already mentioned agreement on 21 November of that year. The instruction is clear: "to take possession of the best strategic positions not yet occupied" [1]*. And the foundation of a station at the mouth of the Kouilou River is such a position. A letter sent from Brussels on 6 January 1883 is even more clear. Stanley was instructed "to make every effort in order to win over to our views some powerful chiefs" [2].

The operations on the ground were commanded by the English officer John Grant Elliott (1837-?) who first worked as an agent for the *CEHC* and the *AIC* (Heyse, 1948). The instructions he received from Stanley were all about pushing north from Vivi, opening routes to the Upper Congo region, and concluding treaties with local peoples in which sovereignty rights

* Numbers in brackets [ ] refer to the notes, pp. 191-192.

were obtained in exchange for gifts, the consequences of which were hardly, if ever, explained in substance. Grant Elliott was assisted by a few Europeans who worked on behalf of Leopold's organizations. When one goes through their biographies — most of them have a note in the *Belgian Colonial Biography* published by the *Institut royal colonial belge*, later known as the Royal Academy for Overseas Sciences — one notices that the content of their work and the way in which they carried out the assignments are barely discussed or problemized. Their names are nevertheless well known. Liévin Van de Velde (1850-1888), who has his monument in Ghent's *Citadelpark*, headed for the mouth of the Kouilou River and secured it for Leopold II by founding Rudolfstadt before the arrival of a French ship, which was obliged to retreat to Loango. He also founded Baudouinville on the Kouilou (Coosemans, 1952). John Grant Elliott himself reached in a short time the Niari region and left marks of his presence by founding "stations" where he left some of his men to command and negotiate with local communities. Edmond Hanssens (1843-1884) founded Philippeville and soon succeeded in establishing a line of communication with the region of Léopoldville, which was essential for justifying the unity of the operations and the territorial claims (Engels, 1948). All these men — Grant Elliott, Van de Velde, Hanssens, but also Alexandre Legat (1860-1898), Édouard Destrain (1854-1890), Jean-Pierre Husson (1854-1923), Victor Harou (1851-1923), Frédéric Orban (1857-1883), Arthur Hodister (1847-1892) — have been integrated into historiography under the hero paradigm, in which courage and self-sacrifice were linked to Leopold's programme for "civilization" and "progress". Liévin Van de Velde boasted in 1886 in a paper published by the Brussels Geographical Society that "not a single shot had been fired, not a drop of blood had been spilled for this important conquest" [3].

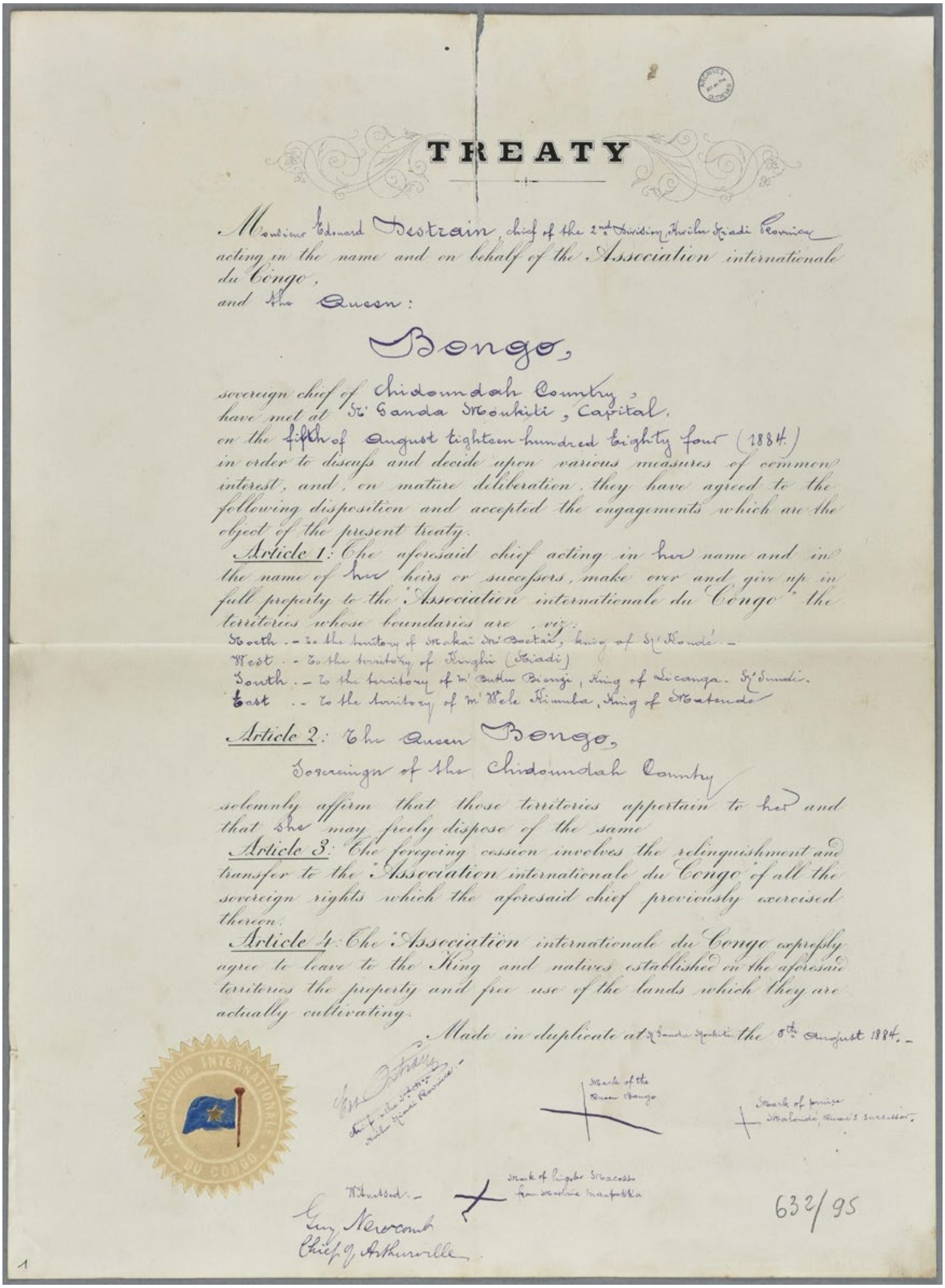
Although some valuable studies of treaties in Congo had already been undertaken in a fragmented way by some historians (Stengers, 1969; Vangroenweghe, 1980; Vellut, 1985), Christine Denuit-Somerhausen was in 1988 the first to study the practice of concluding treaties in Congo in a systematic and almost comprehensive way, pointing to the acceleration in the process around 1883. Based on careful comparison of treaties preserved mainly at the archives of the former Belgian Ministry of the Colonies, housed at the Foreign Affairs Archives in Brussels, she identified different types of contracts as well as their drafters and the areas they covered. In terms of content, she established that the treaties had evolved and that different or new emphases had been placed depending on the political situation at the time. Of importance to our research is her discovery that around November 1882 a new phase started in which the treaties explicitly began to include the transfer of sovereignty rights from local rulers to Leopoldian organizations such as the *CEHC* and the *AIC* (Denuit-Somerhausen, 1988).

Unfortunately, no attention was paid to the Kouilou-Niari region in this study. This omission is understandable because only treaties with a direct relationship with areas that were ultimately included in the Congo Free State were retained, which is not the case for Kouilou-Niari. However, thanks to digitization and online publication, we have been able to identify a very extensive, never-before-studied collection of original treaties directly related to the Leopoldian land-grabbing operations in the Kouilou-Niari valley, as they are all produced by agents of the *CEHC* and the *AIC*. At present these precious and revealing documents are preserved at the French *Archives nationales d'Outre-Mer*, located in Aix-en-Provence. It concerns two hundred and eighty-nine treaties concluded between 11 February 1883 and 26 September 1884 during campaigns of negotiating with and exerting pressure on local leaders, male and female. The rawness of the practices cannot be ignored. The articles stipulate that the local rulers involved

"make over and give up full property" of their territories to the *CEHC* and the *AIC*. These leaders signed mainly with a simple mark in the form of a cross. The persons who gave their agreement by signing with a cross were all indicated by a title, almost always king, queen, or prince, in such a way that their sovereignty was emphasized and could therefore not be questioned because there was no higher party who could revoke the renunciation of "the sole and exclusive right of control" of the land and of the navigation on the river(s). The treaties were written in French or in English, not in local languages. In exchange for the transfer of territorial rights, the local chiefs rarely received money, usually rolls of textile or spirits, especially gin. The agreements were very precise in terms of land delimitation, with clear geographic markers [4].

From the many treaties that share the same content we present here below, as an example, the one concluded on 5 August 1884 by Édouard Destrain on behalf of the *AIC* with queen Bongo, described as "sovereign chief" of "Chindoundah Country", at the capital "M'Ganda Moukiti" (fig. 3). The relinquishment of full ownership of the territories in favour of the *AIC* was final because Art. 1 clearly stated that queen Bongo accepted the engagement on behalf of herself "and in the name of her heirs or successors" [5]. As if the *AIC* agents wanted absolute certainty about the future, even the queen's successor had to sign the treaty with the same mark in the form of a cross. The ceded areas were precisely indicated, not only with a geographical description but also with the addition of the names of the respective rulers to the north, west, south, and east of the areas in question. Separate treaties were concluded with each of these rulers, creating a chain of adjacent territories, all of which henceforth fell under the authority of the *AIC* controlled by Leopold II. An important nuance here is that sovereignty rights were not equivalent to property rights. Art. 4 stipulated that "The *Association internationale du Congo* expressly agree [*sic*] to leave to the King [*sic*] and natives established on the aforesaid territories the property and free use of the lands which they are actually cultivating" [6]. It will be noted that no explicit statement is made about the ownership of land not yet cultivated.

Not all claims were laid down in treaties. Business agreements in the form of contracts also played a role. An important principle, as would later become clear in Berlin, was that powers which laid claim to territory in the interior of Africa had a starting point on the coast. Therefore, Leopold's men in the field had already looked for means to achieve this in the areas situated north of the Congo estuary. The files preserved at Aix-en-Provence also include an agreement (*contrat*) on the acquisition of the Kouilou estuary dating from 11 February 1883. It concerns an agreement (fig. 4a,b) made by Liévin Van de Velde with Manuel Gonçalves Saboga (?-?), a Portuguese citizen and *gérant en chef de la factorerie portugaise* in Loango, who renounced the possession of a bamboo dwelling house situated at the mouth of the Kouilou River, left bank, and of all land he owned up to the Dutch settlement further on, in exchange for a sum of 30 £ sterling [7]. Once again, explicit commitments for the future were embedded in the contract: the Portuguese agent had to promise never to make any reclaims regarding the land and the house in the future. Moreover, none of the neighbours were allowed to make a claim. This is also relevant considering the discussions for which Leopold II and his men were apparently already preparing. The rights were ceded directly to the *Comité de l'Expédition internationale*, which is noted with the address of its registered office: Brederodestraat number 7, Brussels – *i.e.* the *AIC* offices in the backyard of the Royal Palace [8]. In such a way the *CEHC* and *AIC* people involved constituted the province of *Kouilou-Niadi*, which was divided into four districts and became directly connected to the other territories under Leopoldian control.



TREATY

Monsieur Édouard Destrain, chief of the 2nd Division Kwilu Niadi Province acting in the name and on behalf of the Association internationale du Congo,
and the Queen:

Bongo,

sovereign chief of Chidoumdah Country,
have met at N'Ganda Nkoukiti, Capital,
on the fifth of August eighteen hundred eighty four (1884)
in order to discuss and decide upon various measures of common interest, and, on mature deliberation, they have agreed to the following disposition and accepted the engagements which are the object of the present treaty.

Article 1: The aforesaid chief acting in her name and in the name of her heirs or successors, make over and give up in full property to the "Association internationale du Congo" the territories whose boundaries are, viz:
North. – to the territory of Makaï M'Bootai, king of N'Dondé. –
West. – to the territory of Kinghi (Niadi)
South. – to the territory of M'Buku Bienji, king of Licanga. N'Gundi.
East. – to the territory of M'Wele Kimba, King of Matende

Article 2: The Queen Bongo,
Sovereign of the Chidoumdah Country
solemnly affirm that those territories appertain to her and that she may freely dispose of the same.

Article 3: The foregoing cession involves the relinquishment and transfer to the "Association internationale du Congo" of all the sovereign rights which the aforesaid chief previously exercised thereon.

Article 4: The "Association internationale du Congo" expressly agree to leave to the King and natives established on the aforesaid territories the property and free use of the lands which they are actually cultivating.

Made in duplicate at N'Ganda Nkoukiti the 5th August 1884. –

E. Destrain
Chief of the 2nd Division Kwilu Niadi Province

Mark of the Queen Bongo

Mark of prince Nkalondi, Queen's successor

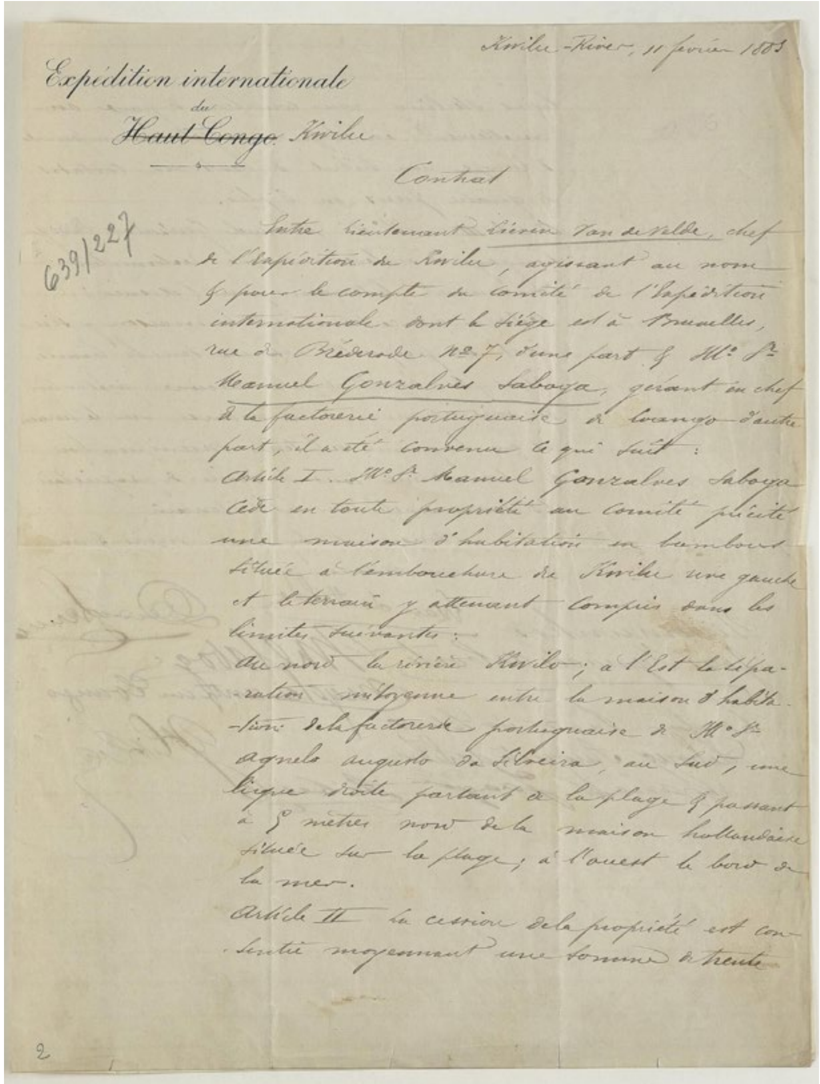
ASSOCIATION INTERNATIONALE DU CONGO

Witnessed. –
Guy Newcomb
Chief of Arthurville

632/95

Fig. 3. — Treaty concluded by Édouard Destrain on behalf of the *AIC* with queen Bongo, 5 August 1884. Aix-en-Provence, Archives nationales d'Outre-Mer, 40 COL 632, treaty n° 95 © ANOM.

a



Kwilu-River, 11 février 1883

Expédition internationale
du
~~Haut Congo~~ Kwilu

Contrat

Entre Lieutenant Liévin Van de Velde, chef de l'expédition du Kwilu, agissant au nom & pour le compte du Comité de l'Expédition internationale dont le siège est à Bruxelles, rue de Brederode N° 7, d'une part & M^r S^r Manuel Gonzalves Saboga, gérant en chef de la factorerie portuguaise de Loango d'autre part, il a été convenu ce qui suit :

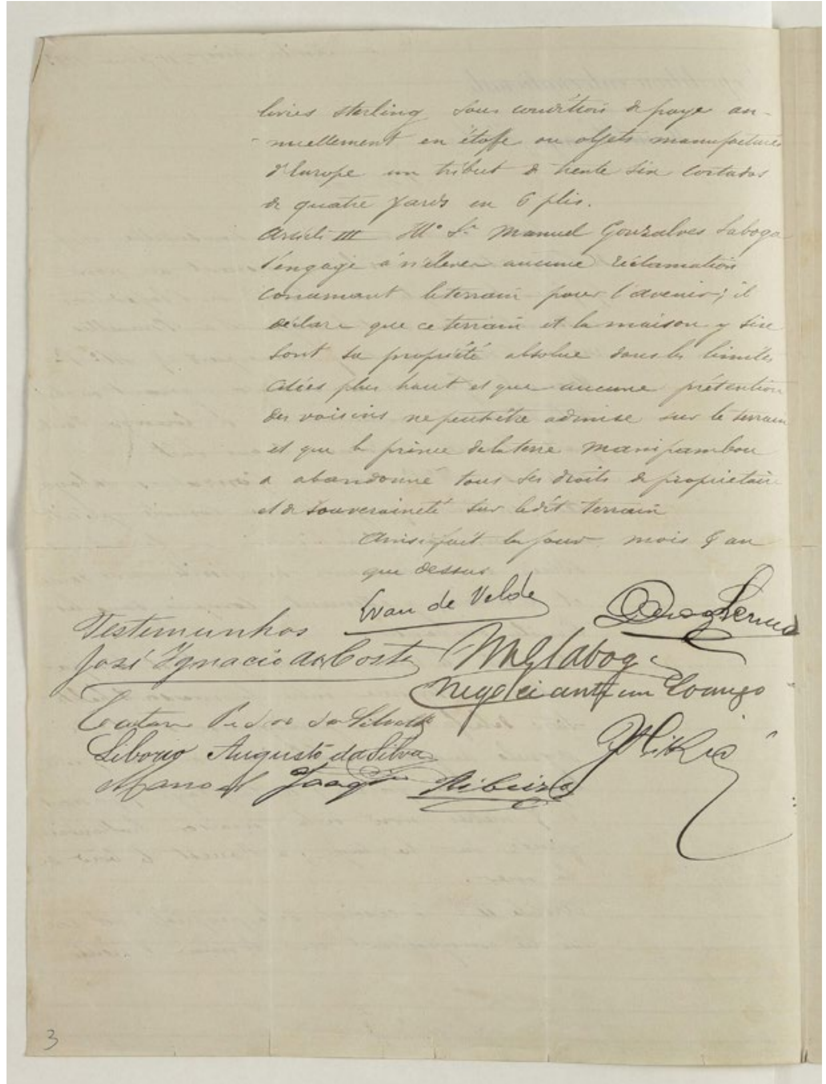
Article I. M^r S^r Manuel Gonzalves Saboga cède en toute propriété au Comité précité une maison d'habitation en bambou située à l'embouchure du Kwilu rive gauche et le terrain y attenant compris dans les limites suivantes :

au nord la rivière Kwilu ; à l'Est la séparation mitoyenne entre la maison d'habitation de la factorerie portuguaise de M^r S^r Agnelo Augusto da Silveira, au Sud, une ligne droite partant de la plage & passant à 5 mètres nord de la maison hollandaise située sur la plage ; à l'ouest le bord de la mer.

Article II La cession de la propriété est consentie moyennant une somme de trente

2

b



livres sterling sous condition de payer annuellement en étoffe ou objets manufacturés d'Europe un tribut de trente six cortados de quatre yards en 6 plis.

Article III M^r S^r Manuel Gonzalves Saboga s'engage à n'élever aucune réclamation concernant le terrain pour l'avenir ; il déclare que ce terrain et la maison y situé sont sa propriété absolue dans les limites citées plus haut et que aucune prétention des voisins ne pourrait être admise sur le terrain et que le prince de la terre Manipambou a abandonné tous ses droits de propriétaire et de souveraineté sur ledit terrain.

Ainsi fait le jour mois & an que dessus.

Liévin Van de Velde

Testemunhos
José Ignacio da Costa
M. G. Saboga
negociante em Loango
Liborio Augusto da Silva
Manoel Joaquim Ribeiro

3

Fig. 4a,b. — Agreement concluded between Liévin Van de Velde and Manuel Gonçalves Saboga, "Kwilu-River", 11 February 1883. Aix-en-Provence, Archives nationales d'Outre-Mer, 40 COL 639/1 © ANOM.

The Geographical "Triangle" in Full Force behind Leopold II

In Belgium, the *Institut national de Géographie* and the two geographical societies followed the evolution closely thanks to contacts with people in key positions at the *AIC*. The Antwerp Geographical Society, which included the map in its *Bulletin*, flooded its readers in 1883-1884 with a mass of information about the *AIC*'s progress in the field. At the same time, it praised the map that resulted from recent activities: "This map simply presents us with a new world. Where geographers used to leave nothing, are now hundreds of indications of all kinds. Fairly recent maps of Kiepert, Lange, Bastian etc. have aged incredibly, they look like old flintlock, placed next to a repeating Mauser rifle" — the comparison with firearms is probably coincidental but nevertheless significant [9]. The Antwerp Geographical Society argued that the *AIC* had acquired lands legally and that for de Brazza there was still enough ground left to expand French territories. The Society's conclusion sounds as if Leopold II was holding the pen: "Forward! And may God protect the valiant men who are creating a new world. What a joy that they will not be halted by small minds!" [10]. The Brussels Geographical Society published an extract of the map in the volume of its *Bulletin* and underlined it was "proof of the progress of the great work sponsored by our sovereign" [11].

The *Institut national de Géographie*, for its part, set up an expedition of its own which, it was said, would be purely scientific, and aimed at solving hydrographic problems. It was a small-scale mission headed by Dr Josef Chavanne (1846-1902), an Austrian who had already travelled in Central and North America, was praised for his meteorological knowledge, and had become the editor of the *Mitteilungen der Wiener Geographischen Gesellschaft* [12]. Nevertheless, it is striking that he was instructed to start his journey through the Niari region and then, on the border with the French sphere of influence, to continue and face the "unknown" [13].

In April 1884, the *Institut* launched its journal *Le Mouvement Géographique*. With regard to the political dispute about the status of the Lower Congo and the Kouilou-Niari, the tone had been set from the very first issue: "In the Lower Congo, the *Association* has been able to appreciate, on the occasion of recent unrest, the powerful prestige of its Flag. On the coast, north of Kouilou, the native chiefs have just spontaneously placed under its protectorate 370 kilometers of coastline. Portugal is forced to restrict its astonishing claims, to respect acquired rights and to admit as a border that of the *Association*, in Nokki" [14]. Editor-in-chief Alphonse-Jules Wauters (1845-1916) looked at the future with confidence, as the US Senate was ready to recognize the sovereignty rights of the *AIC*'s "free territories", as he called them [15]. The same year the *Institut* published Chavanne's detailed map of the disputed region, the *Carte de l'Afrique équatoriale entre le Congo et l'Ogooué, dressée d'après l'état des dernières explorations*. Now many more place names appeared on the map of the vast Kouilou-Niari region, as well as other geographical details, such as tributaries of the Kouilou, with indications of their names (fig. 5a). Moreover, as the legend shows, the map presents the coloured itineraries of twelve explorers, among whom Van de Velde, Grant Elliott and Hanssens, plus de Brazza and others. Besides, the legend also shows map symbols for missionary stations and trading posts, thereby putting the Kouilou-Niari effort into a wider context (fig. 5b). It must be stressed that this map does not yet represent Chavanne's own itinerary. As the map is undated, our hypothesis is that it is a map drawn by Chavanne before his departure to Central Africa, synthesizing the geographical knowledge at hand in early 1884, including the one about the

Kouilou-Niari region, and published by the financier of his mission. The map was published before the signing of the final Act in Berlin as it still mentions stations owned by the *AIC* in the Kouilou-Niari region. Chavanne's cartographic work related to Central Africa certainly deserves more in-depth research, as some sketches and short articles published in *Le Mouvement Géographique* in 1885 demonstrate that he made detailed topographic surveys, mainly in the Lower Congo region. The *Institut national de Géographie* received copies of Chavanne's findings at the end of 1884 [16].

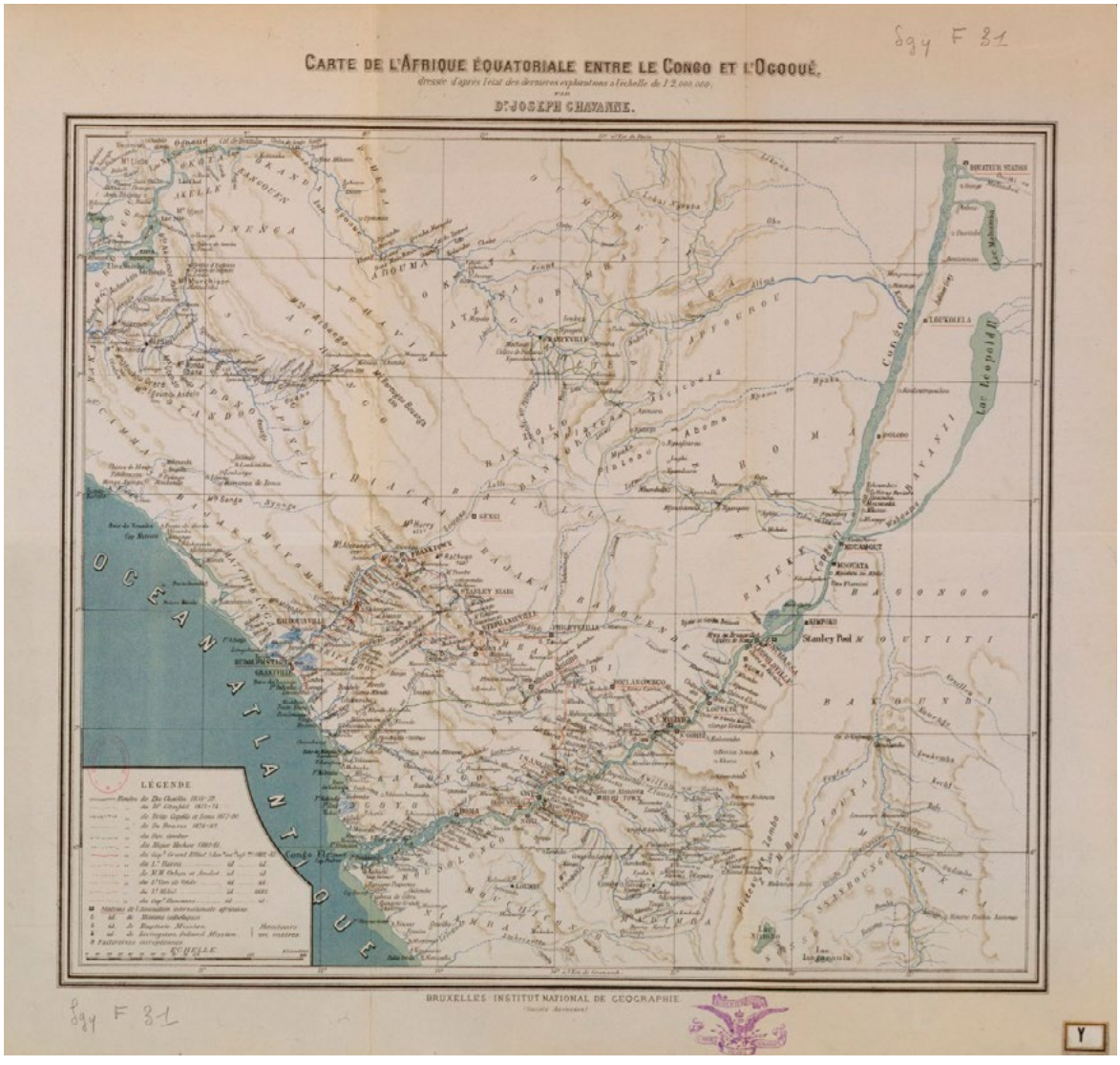


Fig. 5a. — *Carte de l'Afrique équatoriale entre le Congo et l'Ogooué, dressée d'après l'état des dernières explorations à l'échelle de 1:2,000,000; par Dr. Joseph Chavanne.* Brussels, Institut national de Géographie, 1884. Paris, Bibliothèque nationale de France, département Société de Géographie, inv. n° SGE SG Y F-31 © BnF.

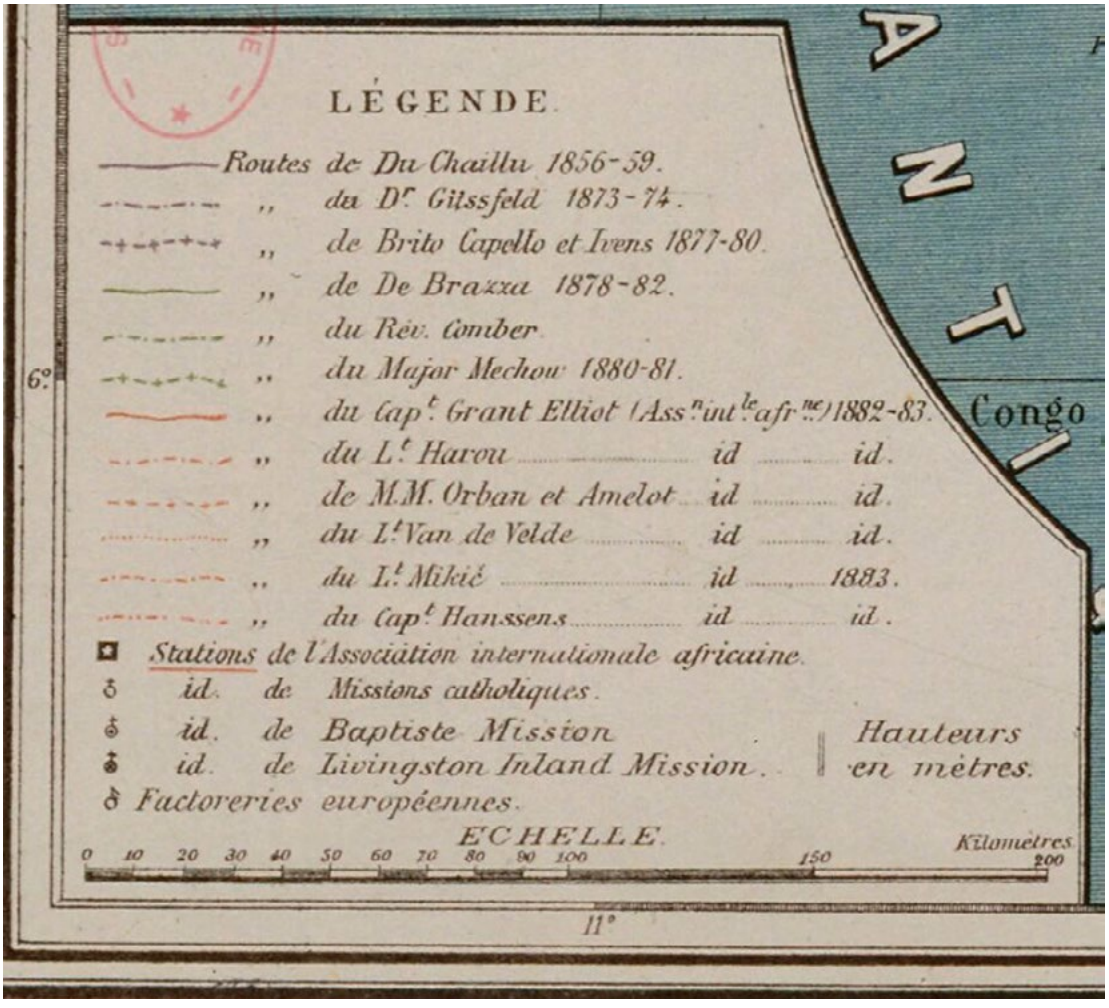
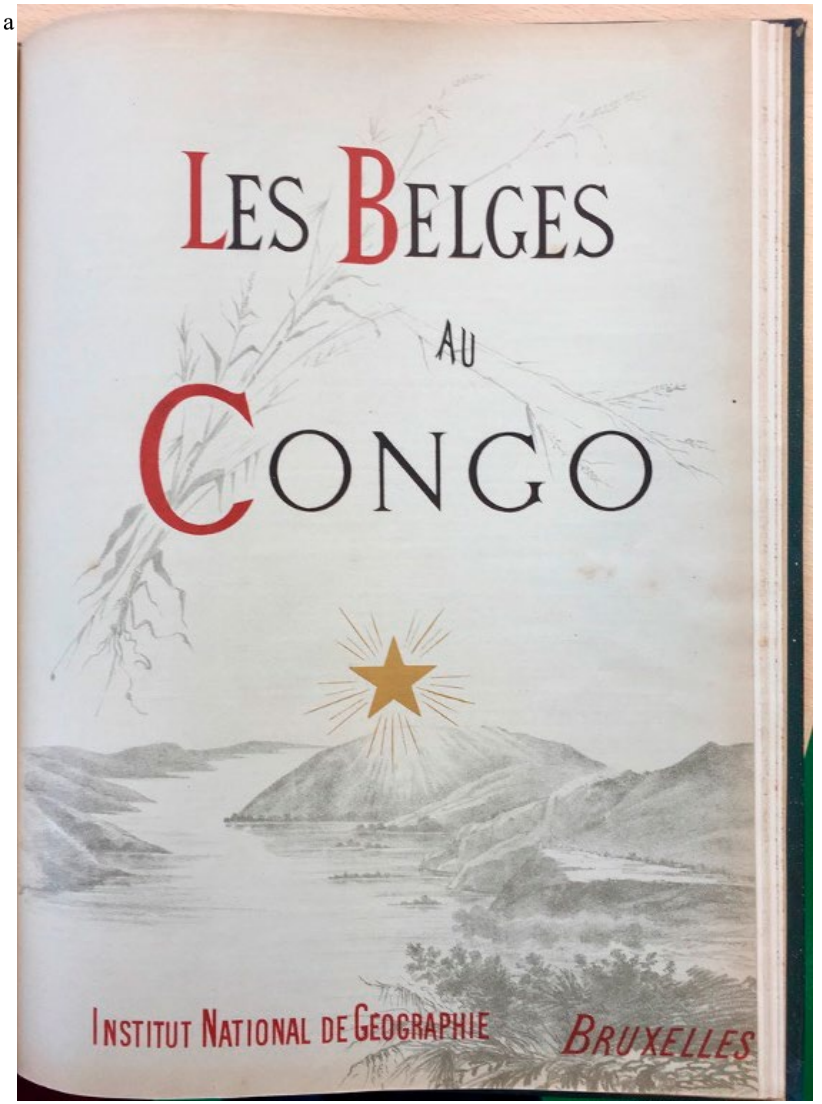


Fig. 5b. — Legend identifying the itineraries of twelve explorers in Chavanne's map. Detail of the map at fig. 5a. Paris, Bibliothèque nationale de France, département Société de Géographie, inv. n° SGE SG Y F-31 © BnF.

In the first days of 1885, while negotiations in Berlin were going full speed ahead, the *Institut* presented the readers of *Le Mouvement Géographique* with the supplement entitled *Les Belges au Congo* (fig. 6a). The cover's visual discourse was easy to understand: a pristine African river landscape, above which a radiant five-pointed star shines, evoking the one on the flag of the *AIA*, and with an unmistakably nationalistic claim, supported by the ideal of civilization: Belgians, bringers of Light into a world where Darkness reigned. In this brochure, the Kouilou-Niari region came into the picture, with portraits of *AIC* agents who were presented as selfless "heroes", committed to progress (fig. 6b). Once again it is striking how the somewhat disguised language surrounding the acquisition of sovereignty rights concealed the real practices on the ground. Nevertheless, it was clear to the editors that the dozens of treaties obtained through land grabbing and forced negotiation were key to the consolidation of the *AIC* as a territorial power on the African continent: "At the beginning of 1884, Captain Grant Elliott, appointed administrator of the province of Kouilou, added to this immense territory three times the size of Belgium, by contract with the native chiefs, the entire part of the coast which extends between the mouth of Kouilou, to the south, and the mouth of Setta-Camé, to the north, more than three hundred kilometers of coastline, where the agents of the *Association* were quick to fly the blue flag" [17].

a



b

Fig. 6a,b. — *Les Belges au Congo*. Brussels, Institut national de Géographie, 1885. Left (a): cover; right (b): "Le Kouilou" with the portraits of Guillaume Casman, Édouard Destrain, Liévin Van de Velde, and Frédéric Orban. Private collection © J. Vandersmissen.

To the brochure was added a *Croquis de l'Afrique centrale et du bassin du Congo tel qu'il a été délimité par la Conférence de Berlin* (fig. 7a). This map was carefully drawn up by Alphonse-Jules Wauters based on the mass of data he had acquired through reports and correspondence of *AIC* agents and many other actors on the ground. The map apparently served no explicit political purpose: it was essentially a physical map that focused on the Congo and its many tributaries. It was a representation of the Congo River Basin as it could be determined according to the most recent state of research. However, the map cannot of course be separated from the negotiations in Berlin, where the Conference was nearing its conclusion, and where the boundaries of this Congo River Basin were indeed essential elements in a fierce debate about territorial claims. Hence, it was certainly not without political intentions that the Kouilou-Niari region was obviously included by Wauters within the zone of the Congo Basin indicated in yellow, even though this valley clearly did not belong to it, based on geographical arguments. The readers could see the vastness of the unexplored areas, denoted by the term "*inexploré*". But, what was more, the red dots on the map were not to be ignored. A legend now unequivocally identified them as stations of the *AIC* (fig. 7b). The yellow-coloured shape on this map is that of the Congo Basin, as per the map's title. In addition, the last part of the legend indicates that the part shown in yellow represents the "free trade area". This double designation is probably due to the fact that the Congo Basin represented as the catchment area of its river system (as far as then known) was initially (date of the map, 1 January 1885) the area intended to be declared for free trade (as confirmed in article 1, paragraph 1 of the final Act of the Berlin Conference) [18].

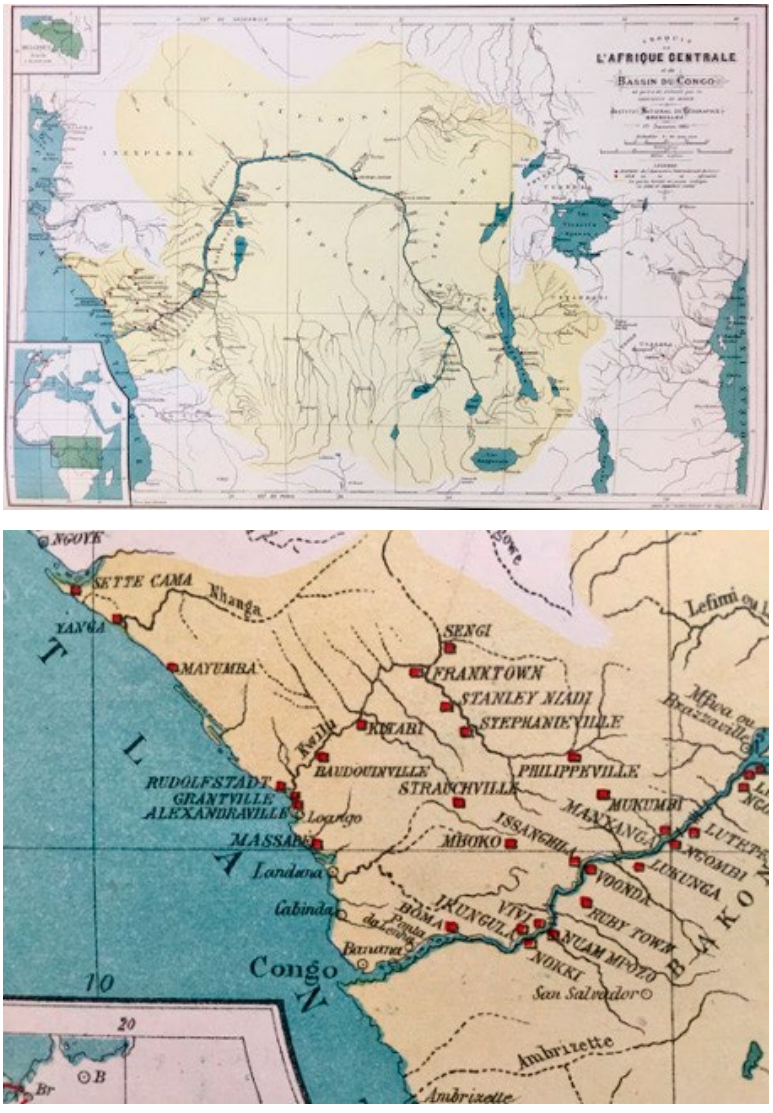


Fig. 7a,b. — *Croquis de l'Afrique centrale et du bassin du Congo tel qu'il a été délimité par la Conférence de Berlin.* Scale: 1:10,000,000. Brussels, Institut national de Géographie, 1 January 1885. Above (a): the map; below (b): detail with a representation of the *AIC* stations in the Kouilou-Niari region. Private collection © J. Vandersmissen.

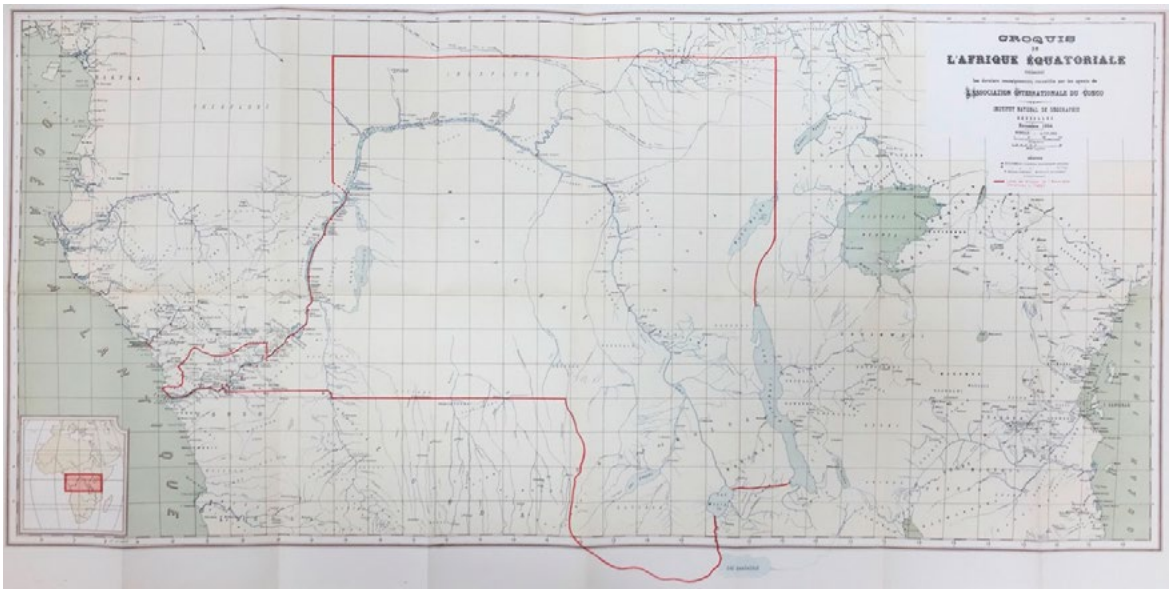
Concluding Remarks: A Settlement Worth 300,000 Francs…

It was all to no avail. Leopold II had to accept that the Kouilou-Niari valley would pass into new hands. Berlin was not the only place where negotiations were held. The King and his associates fought on many fronts simultaneously. There was a direct dialogue with Paris. On 5 February 1885, a convention was signed between the French government and the *AIC*. The Kouilou-Niari province was ceded to France. Leopold gave in. It was an important concession, allowing him to make a step forward elsewhere. He thus secured his claim on the vast area lying beyond the left bank of the Congo River.

The Archives of the Royal Palace in Brussels preserve diplomatic letters about the agreement's implementation. France in no way wanted to present Portugal with a fait accompli. The *AIC* still had to settle its issues with that party separately. But the turning point had been taken. The Berlin negotiations about the final Act's phrasing soon came to fruition. Practical issues, such as the determination of borders between the French territories and the future Congo Free State, had to be settled by a special committee. Cartography once again played its role. Maximilien Strauch, on behalf of Leopold II, submitted a file to Paul de Borchgrave d'Altena (1827-1901), the King's negotiator in Paris, in relation to the agreements concluded with the French Minister of Foreign Affairs Charles de Freycinet (1828-1923). This file contained a map published by the *Institut national de Géographie* in November 1884 (fig. 8a), a copy of which can be found in the Archives of King Leopold II's Cabinet [19]. On that copy the borders of the future Congo Free State are drawn in a rough way. The red line passes through the zone with stations founded by the *AIC* (fig. 8b). There, the Kouilou-Niari valley and its stations are amputated from the Congo region.

As soon as the Berlin Conference was over, Adolphe-Jules Wauters published the first version of his *Carte politique de l'Afrique centrale* in *Le Mouvement Géographique* (fig. 9). Again, as was the case for most other maps discussed in this paper, apart from the first one, this map indicates longitude with reference to both the Paris *and* the Greenwich prime meridian. It represents the borders of the Portuguese, German, Spanish, British and Zanzibari possessions in Central Africa. Furthermore, the Congo Free State and the French possessions are represented in their most primitive states. It should be observed that the former AIC stations in now French Kouilou-Niari region became part of the "free trade area" as defined in Berlin. More border corrections would be made in the years ahead.

Leopold II got his money back. It involved administrative issues such as handing over the original treaties concluded by the *AIC*, seen as proof of the transfer of sovereignty rights. This is why the two hundred and eighty-nine treaties are at present at the French *Archives nationales d'Outre-Mer* in Aix-en-Provence. The King received an indemnity of three hundred thousand francs for the territories the *AIC* had to give up. He was not fully satisfied, believing that the expenses had been almost ten times higher. But the sum was considered acceptable, as he was now able to start new operations in "his" Congo Free State [20]. The *Institut national de Géographie* and the Geographical Societies of Antwerp and Brussels paid tribute to the King, with laudations and special publications. In the coming decades, their contributions to imperial geography and cartography would continue to grow.



a

b

Fig. 8a,b. — *Croquis de l'Afrique équatoriale contenant les derniers renseignements recueillis par les agents de l'Association internationale du Congo*. Brussels, Institut national de Géographie, November 1884. Scale: 1:4,000,000. Brussels, Archives of the Royal Palace, Archives of the Cabinet of King Leopold II, inv. n° 260 © ARP. The red drawing of boundaries has been added at a later stage in the frame of negotiations with France. Above (a): the map; below (b): detail of the Kouilou-Niari valley © ARP.

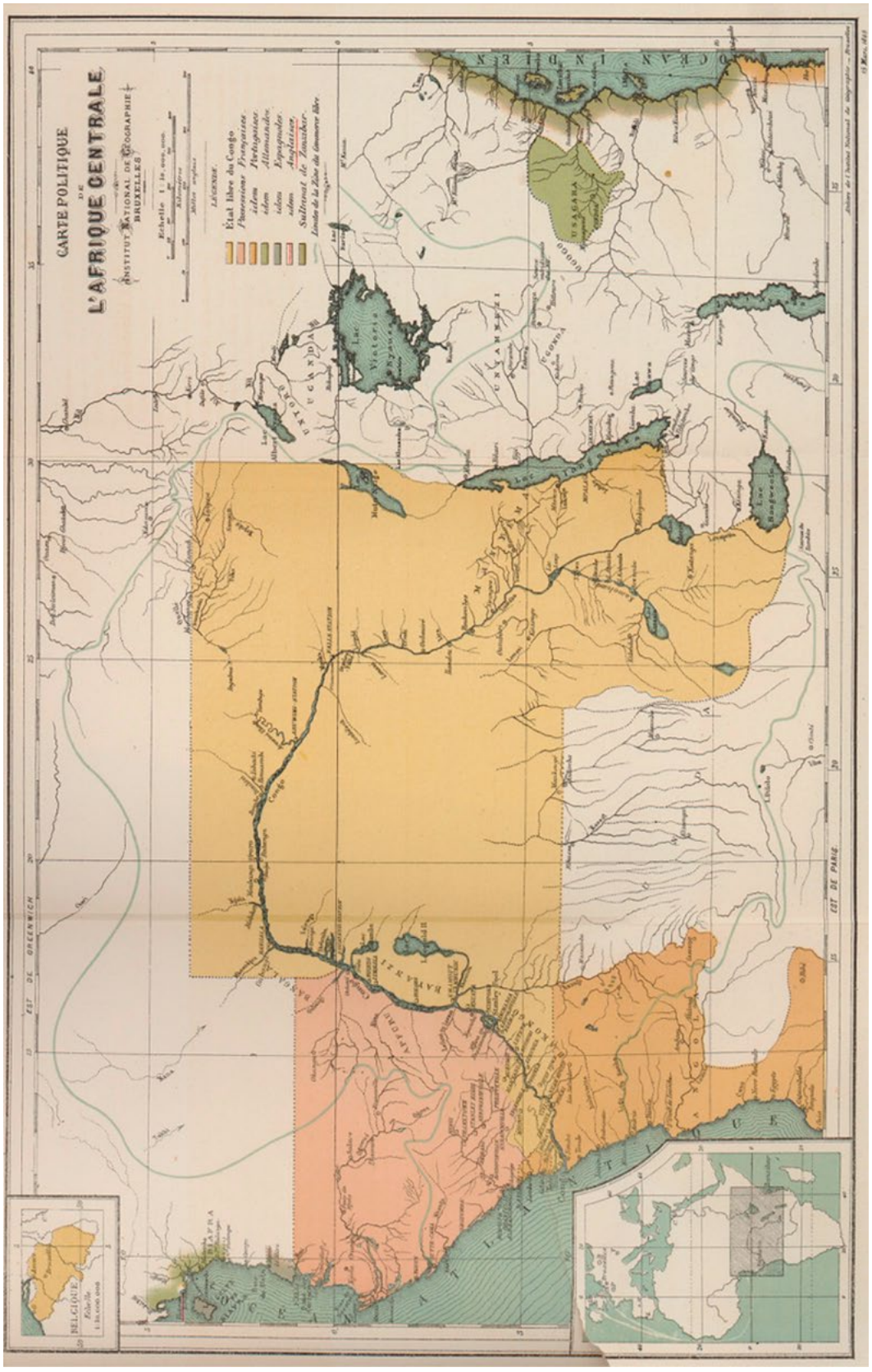


Fig. 9. — *Carte politique de l'Afrique centrale.* Scale: 1:10,000,000. Brussels, Institut national de Géographie, 1 March 1885. Private collection © J. Vandersmissen.

OVERVIEW OF HISTORICAL EVENTS

27 August 1876	Foundation of the *Société belge de Géographie*, Brussels
12-14 September 1876	Geographical Conference at the Royal Palace, Brussels – creation of the *Société internationale africaine* (*AIA*)
20 November 1876	Voting on the articles of association of the *Société de Géographie d'Anvers*
14 January 1877	First official meeting of the *Société de Géographie d'Anvers*
12 August 1877	H.M. Stanley arrives in Boma after descending the Congo River
25 November 1878	Creation of the *Comité d'Études du Haut-Congo* (*CEHC*), Brussels
10 December 1878	H.M. Stanley signs a contract with the *CEHC* in view of the foundation of stations
17 November 1879	Creation of the *Association internationale du Congo* (*AIC*), Brussels
October 1882	The *CEHC* decides to organize an expedition to the Niari
12 January 1883	The expedition to the Niari led by John Grant Elliott departs from Vivi with instructions given by H.M. Stanley
11 February 1883	Agreement concluded between Liévin Van de Velde and Manuel Gonçalves Saboga about the *AIC*'s possession of the estuary of the Kouilou River
15 November 1884	Start of the Berlin Colonial Conference
5 February 1884	Convention signed between the French government and the *AIC* – the Kouilou-Niari region is ceded to France
26 February 1885	End of the Berlin Colonial Conference – signature of the final Act

NOTES

[1] Tervuren, Archives of the Royal Museum for Central Africa, Stanley papers, inv. n° 919, letter from Colonel Strauch to Henry Morton Stanley, Brussels, 6 December 1882.

[2] Tervuren, Archives of the Royal Museum for Central Africa, Stanley papers, inv. n° 921, letter from Colonel Strauch to Henry Morton Stanley, Brussels, 6 January 1883.

[3] L. Van de Velde, "La région du Bas-Congo et du Kwilou-Niadi: usages et coutumes des indigènes", in *Bulletin de la Société Royale Belge de Géographie*, 10, 347-412 (1886); original quote in French, pp. 360-361: "Le drapeau bleu à l'étoile d'or flottait dans une vingtaine de villages importants et de nombreux traités plaçaient tout le bassin du fleuve sous la souveraineté de l'Association. Chose remarquable: aucun conflit ne s'était élevé avec les indigènes, pas un coup de fusil n'avait été tiré, pas une goutte de sang n'avait été répandue pour cette importante conquête".

[4] Aix-en-Provence, Archives nationales d'Outre-Mer, Ministère des Colonies-Traités (1687-1911), Afrique subsaharienne, Congo, Oubangui-Chari et Tchad (ancien Congo français), Province du Kwilu-Niadi (traités passés par la Belgique), 11 février 1883 – 26 septembre 1884.

[5] Aix-en-Provence, Archives nationales d'Outre-Mer, 40 COL 632, treaty n° 95 concluded by Édouard Destrain on behalf of the *AIC* with queen Bongo, 5 August 1884.

[6] *Ibidem*.

[7] Aix-en-Provence, Archives nationales d'Outre-Mer, 40 COL 639/1, agreement concluded between Liévin Van de Velde and Manuel Gonçalves Saboga, "Kwilu-River", 11 February 1883.

[8] *Ibidem*.

[9] "Le Congo", in *Bulletin de la Société Royale de Géographie d'Anvers*, 8, 268-272 (1883-1884); original quote in French, p. 269: "cette carte nous présente tout simplement un monde nouveau. Là où jadis les géographes ne mettaient rien, se trouvent maintenant des centaines d'indications de toutes sortes. Les cartes assez récentes des Kiepert, des Lange, des Bastian etc. ont incroyablement vieilli. Elles font l'effet de vieux fusils à pierre, placés à côté d'un mauser à répétition".

[10] *Ibid.*; original quote in French, p. 272: "En avant! et que Dieu protège les hommes vaillants qui sont en train de créer un nouveau monde. Quel bonheur qu'ils ne se soient pas laissé arrêter par les petits esprits!".

[11] "Le Congo, depuis l'Équateur jusqu'à l'Océan et la vallée du Niadi-Kwilu", in *Bulletin de la Société Royale Belge de Géographie*, 8, 105 (1884); original quote in French, p. 105: "preuve du progrès de la grande œuvre patronnée par notre souverain".

[12] "Chavanne Josef", in *Österreichisches Biographisches Lexikon 1815-1950*, 1, 142 (1957).

[13] "Notre carte de l'Afrique centrale", in *Le Mouvement Géographique*, 1(2), 6 (1884).

[14] "L'Association internationale africaine", in *Le Mouvement Géographique*, 1(1), 3 (1884); original quote in French, p. 3: "Dans le bas Congo, l'Association a pu apprécier, à l'occasion de troubles récents, le puissant prestige de son Drapeau. Sur le littoral, au nord du Kilou, les chefs indigènes viennent de placer spontanément, sous son protectorat, 370 kilomètres de côtes. Le Portugal se voit contraint de restreindre ses étonnantes prétentions, de respecter les droits acquis et d'admettre pour frontière celle de l'Association, à Nokki".

[15] *Le Mouvement Géographique*, 1(1), 3.

[16] *Le Mouvement Géographique*, 2(8), 30 (1885): "Le docteur Chavanne, qui, à la fin de l'année dernière, était revenu passer quelque temps en Europe, pour s'y remettre d'une splénoncie qu'il avait contractée en Afrique, retourne au Congo. […] Nous avons la satisfaction d'apprendre à nos lecteurs que le savant géographe continuera, comme par le passé, à tenir le *Mouvement géographique* au courant de ce qui se fait là-bas et à lui fournir des études sur les côtés les plus intéressants de la question africaine. À ce propos, disons ici que les quelques mois que le docteur a passés en Europe ont été consacrés au calcul de ses observations et à la confection d'une carte du bas Congo. Cette carte, dont l'épreuve corrigée est entre les mains de l'Institut national de géographie, est dressée à l'échelle de 1:200.000. Elle donne en détail toute la partie de la côte occidentale, qui s'étend entre Landana et Shark-Point, le cours du Congo depuis Banana jusqu'à Boma; puis, dans des cartouches: 1° à l'échelle de 1:100.000, le Congo entre Tchinsala et l'île Tchiongo, c'est-à-dire la partie si intéressante du cours du fleuve devant Boma depuis Fétiche-Roc jusqu'au-delà de l'île des Princes; 2° et 3° à l'échelle de 1:25.000, les plans de Banana et de Boma. Ce document, bien autrement complet et précis que la carte de l'amirauté anglaise et que n'importe quelle carte portugaise, sera mis en vente dans quelques semaines".

[17] *Les Belges au Congo* (Bruxelles, Institut national de Géographie, 1884); original quote in French: "Au commencement de l'année 1884, le capitaine Grant Elliott, nommé administrateur de la province de Kouilou, a, à cet immense territoire trois fois grand comme la Belgique, ajouté par contrat passé avec les chefs indigènes, toute la partie du littoral qui s'étend entre l'embouchure du Kouilou, au sud, et l'embouchure de Setta-Camé, au nord, plus de trois cents kilomètres de côtes, où les agents de l'Association n'ont pas tardé à faire flotter le drapeau bleu".

[18] E. Banning, *Le partage politique de l'Afrique d'après les transactions internationales les plus récentes (1885 à 1888)*. Bruxelles, Librairie européenne C. Muquardt, p. 161.

[19] Brussels, Archives of the Royal Palace, Archives of the Cabinet of King Leopold II, inv. n° 260.

[20] Brussels, Archives of the Royal Palace, archives relating to the external development of Belgium during the reign of Leopold II, inv. n° 137, titled: "Négociations avec le gouvernement français pour la reprise, par la France, des stations créées par l'AIC au Niadi-Kwilu (négociations Rouvier)".

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Maps to defend the Kaiser in Ottoman Asia: German Military Cartography of the Sinai, Palestine, and Mesopotamia, 1915-1918

by

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KEYWORDS. — Ottoman Asia; Sinai Peninsula; Palestine; Mesopotamia; *Vermessungsabteilung 27*.

SUMMARY. — From 1915 onwards, the German Supreme Command deployed military cartographers to the Asian theatres of war of the Ottoman Empire on the Sinai Peninsula (1915-16), Palestine (1917-18), and Mesopotamia (1916-18). By September 1918 nine German topographical series covered significant parts of Ottoman Asia: *Operationskarte* at scale 1:800,000, *Karte des türkisch-ägyptischen Grenzgebietes* at scale 1:250,000, *Karte von Mesopotamien (und Syrien)* at scales 1:400,000 and 1:200,000, and *Karte von Palästina* at scales 1:250,000, 1:168,960, 1:100,000, 1:50,000, and 1:25,000. These topographical series consist of at least one hundred and eight released sheets of which some saw up to seven editions. This paper introduces newly-accessible map sheets and editions, and, for the first time, provides figures with detailed exemplary appraisals of characteristics of these map series.

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In 1836-39, Helmuth von Moltke, who later rose to serve as chief of staff of the Prussian army, was a trailblazing officer who established a tradition of German officers advising the Ottoman army (von Moltke, 1841). Over the decades, German military relationships with the Sultan's armed forces steadily grew tighter. When the Ottoman Empire joined the Central Powers in World War I, well over three hundred German officers served in the Turkish army or were attached as advisors. However, a special German surveying section was deployed to the Levant only late into the war to survey, draw, and print military maps of the provinces to the south of Anatolia. The section's purpose was to cartographically support the defence of both empires when the Ottoman-German alliance was forced to retreat in these parts of Ottoman Asia from 1916 onwards.

This paper first introduces the strategic settings of German war cartography in Ottoman Asia and then provides an overview of the complicated structure of German military mapping institutions. Following this discussion are three regional case studies — the Sinai Peninsula, Mesopotamia, and Palestine — and appraisals of the respective military situations along with the map series that emerged from each. These three cases cover the bulk of German mapping in Ottoman theatres. The Caucasus front, where the Turks and Russians fought the fiercest battles for Ottoman Asia, is not included here due to the lack of significant German terrain reconnais-

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sance and mapping activities. German maps of that theatre of war relied on pre-war surveys and cartography (fig. 1), Ottoman maps, as well as captured Russian and British maps.

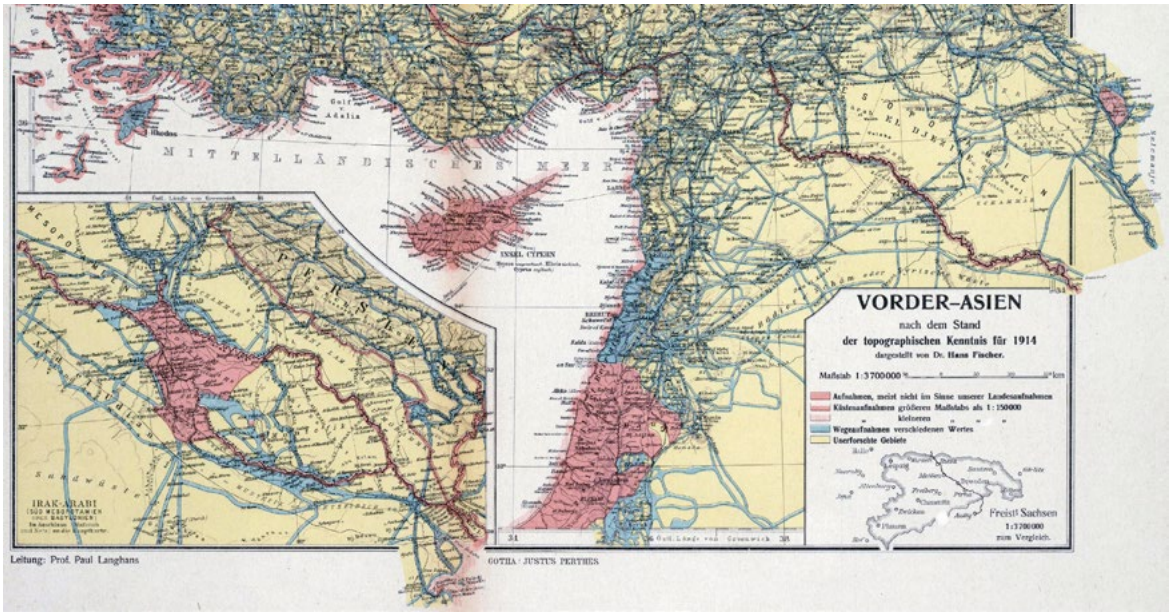

Fig. 1. — Detail of the lower half of an orientation sheet in 1:3.7 million on the status of topographic surveys in Ottoman Asia in 1914 by long-time Orient cartographer Hans Fischer. The colour code of terrestrial red indicates surveys, but mostly not in the scales and qualities of European surveys, is restricted to Palestine, the Euphrates, and Tigris in Mesopotamia, as well as the plains between these rivers south of Baghdad. Coastal solid red is used for surveys larger than the scale 1:150,000, coastal vertical red stripes for surveys in a smaller scale, blue corridors are used for route observations of various accuracies, and terrain in yellow is used for 'unexplored regions', still making up most of Trans-Jordan, Syrian, and Mesopotamian regions beyond urban centres and well-travelled rivers and streets [*Dr. A. Petermann's Mittheilungen aus Justus Perthes' Geographischer Anstalt*, vol. 66 (1920), Map 22 – University of Texas at Arlington, Special Collections, Handset].

This treatment is a new take on a short preliminary carto-bibliographical survey published in the *Proceedings of the International Cartographic Association*, vol. 3, 2021 ("A provisional guide to German military topographic map series of Ottoman Asia in the First World War"). Since that first sounding new map material has been made accessible, especially thanks to map scholars and collectors Michael Brown (Israel), Jürgen Espenhorst (Germany), and Rick Smit (Netherlands). Their communications, and the investigations they triggered, resulted not only in improved listings in the tables of topographical map series but also in a revised assessment of the cartographic body.

The author has personally inspected either original prints or scans of all map sheets and their editions listed in tables 1-5*. The bulk of the discussed German military topographical map series of Ottoman Asia can be found (ranked in order of relevance) in the following repositories:

— Staatsbibliothek zu Berlin, Kartensammlung;
— Bayrisches Hauptstaatsarchiv (München), Abteilung Kriegsarchiv;
— National Library of Israel (Jerusalem), Map Collection;
— Deutsches Archäologisches Institut, Abteilung Istanbul;
— Library of Congress (Washington DC), Geography & Map Division.

* See tables at the end of the text (pp. 225-228).

Even from a cursory look through the expanded table listings, however, noticeable gaps remain not only but especially for Palestine and adjoining areas. Therefore, the author requests that readers contact him about not yet listed map sheets and further editions of listed sheets.

Germany's Military Interest in Ottoman Asia, 1914-1918

On 3 August 1914, the Ottoman Empire joined the Great War on the side of the Central Powers (Germany and Austria-Hungary) against the Entente Powers (primarily Britain, France, and Russia), although they initially kept this intent secret under the guise of 'armed neutrality'. German hopes were that the addition of about three hundred thousand Ottoman soldiers, in whose armies numerous German military staff officers had already for decades served in positions of high command, would pull significant Entente forces away from the European fronts and offer Germany an allied base to attack Britain's otherwise inaccessible empire directly. The Suez Canal, an Achilles' heel for the logistical cohesion of the British Empire, was an especially tempting goal. For the Ottomans, on the other hand, the goal was rather Egypt, the land beyond that waterway. For centuries, the country of the Nile had been an Ottoman dependency until the British de facto annexed it in 1882. The since 1908 ruling modernizing Young Turk government in Constantinople longed to take Egypt back. Further strategic options eyed by Berlin were opening fronts in the oil-rich Persian Gulf and the Caucasus, vital assets or targets to Britain and Russia respectively (Reichsarchiv, 1933, p. 164). However, the Ottoman Empire soon proved to be a burden for the Central Powers, owing to its poor economic development, an inept civilian and military administration, and fighting forces that not yet had recovered from their humiliating defeat in the Balkan War of 1912 or implemented its lessons.

The operational areas German and Ottoman planners expected in this theatre were mostly in remote corners of the Empire: the Sinai Peninsula, the Arabian Peninsula down to Yemen, the Persian Gulf, and eastern Anatolia. None of these emerging operational areas was closer to the capital and economic hub Constantinople than 1,600 km while others were as remote as 2,400 km. Communication and provisioning were not only challenged by the sheer distances but even more by the presence of unruly mostly non-Turkish populations in rugged desert or mountainous terrains, and, above all, dated caravan paths and underdeveloped and generally neglected roads. The few railway lines towards the theatres of war remained incomplete throughout World War I. The rail gaps in the southern Anatolian mountain ranges of Taurus and Amanus, for example, held up the deployment of troops and materials to Mesopotamia, Palestine, and Arabia for weeks if not months (Reichsarchiv, 1933, pp. 165-166).

As it would transpire, the *Oberste Heeresleitung* (= German Supreme Army Command) was not aware of these severe strategic burdens of its new ally. Intially, the German strategists intended to give the Ottoman Empire time to deploy in Palestine and eastern Anatolia under cover of armed neutrality. In the face of the massive Russian summer attack on the German Empire and Austria-Hungary, however, Berlin almost immediately changed course and pressed Constantinople for relieving counterstrikes. The ruse of armed neutrality ended in late October by the Ottomans opening naval warfare against Russia in the Black Sea. By November, the Ottomans and Russians began campaigns in mountainous eastern Anatolia that evolved into almost four years of shifting front lines. Initially, the Russian forces drove the Ottomans far back into their own territory, taking a heavy toll on soldiers and material as well as a strong secondary effect on operations in all the other Asian fronts (Reichsarchiv, 1933, pp. 169-171).

The Anatolian front, and its spread into Ottoman-Russian-British fighting in western Persia since 1915, triggered only a few German maps.

The British counterattack in the Sinai and their slow progress in Mesopotamia over the summer and autumn of 1915 coincided with the ill-fated opening of a seaborne gambit to capture Constantinople and with it to force a swift Ottoman surrender. To this end, the British and French on 25 April 1915 landed an invading army on the Gallipoli peninsula north of the Dardanelles Strait. The ensuing massive battle for Gallipoli undoubtedly represents the most prominent of all the Ottoman theatres of war, but no German original surveys took place during the eight months of that campaign. Here German map support was restricted to reprinting existing Ottoman or enemy maps. Anglo-French attempts to conquer the well-defended peninsula failed and on 9 January 1916 the last attackers evacuated the peninsula (Reichsarchiv, 1933, pp. 177-191). Strategically this could be called an Ottoman 'victory', but it came at a price. While the Central Powers were noticeably relieved for months on European fronts in 1915, the Ottomans had to pull armies and resources from other fronts to defend the capital and maintain a sizeable force around the Dardanelles for the remainder of the war.

Only when Bulgaria entered the war on 14 October 1915 as ally of the Central Powers, which by then had defeated Serbia in between them and Bulgaria, this provided Germany and Austria-Hungary the previously missing land bridge with the Ottoman Empire. It was now possible to send supplies and auxiliary troops directly to Constantinople by rail (Reichsarchiv, 1933, pp. 192-193). On 17 January 1916 the first train with military supplies from Berlin arrived in Constantinople. The opening of this supply artery coincided with the retreat of the Entente from Gallipoli a week earlier, alleviating the immediate threat to the Ottoman capital (Reichsarchiv, 1936, p. 603). That strategic advantage was more than annulled by the effects of the British-induced Arab Revolt that broke out in June 1916 in the Hejaz region of western Arabia. At first of only limited effects that revolt nevertheless cut off about ten thousand Ottoman soldiers who thereafter got stuck in isolated pockets stretching from Medina southeastward to Yemen for the rest of the war. While this transformed Ottoman Arabia south of Aqaba for two years until the summer of 1918 de facto into a "frozen theatre of war" (Pope & Wheal, 2003, p. 353), it was a constant threat to the German-Ottoman positions in Palestine and Mesopotamia.

By mid-1916 the *Oberste Heeresleitung*, through reports received from German officers embedded in the Ottoman armies, realized the declining performance of the Ottoman transportation network with its backbone being the incomplete and inefficient railways. Because the extension of the Baghdad railway from Ras al-Ain in the direction of Mosul dragged on, the German Supreme Army Command resorted to another mode of transportation. The Germans employed a section of the Euphrates River for the makeshift transport of armaments downstream to Baghdad. Nevertheless, this did not overcome the limiting bottleneck through which all supplies for Ottoman and German operations south of Anatolia had to pass through: even before the head station of the Euphrates flotilla could be reached, there were and remained the railway gaps in the Taurus and Amanus mountain ranges. Instead of accelerating construction to close these gaps, the Ottoman government as from the second quarter of 1915 'deported' the heavily Armenian railway workforce, causing both huge casualties and losses of construction expertise. Inevitably, from the onset inadequate and now deteriorating transport services exacerbated supply difficulties on all Asian fronts. Military commanders were ultimately unable to obtain supplies of food and clothing, which contributed to an increasing rate of desertion.

Overall, the signs were clear that the Ottoman Empire faced growing military and economic exhaustion two years into the war. Despite its own growing shortages, the German Empire tried to shore up Ottoman forces. By autumn 1916 the Germans delivered sixteen columns of trucks, deployed a railway engineering company to the Taurus region, and dispatched new rolling stock. These reinforcements increased the German military personnel serving within or alongside the Ottoman army and navy to around six hundred and thirty officers and five thousand nine hundred men (Reichsarchiv, 1936, p. 616).

While the German involvement in the Ottoman-Russian front in eastern Anatolia was limited, this front most concerned the Ottoman headquarter and shaped its strategic decisions as well as the allocation of men and material (Reichsarchiv, 1936, p. 609). No German topographic map series focused on eastern Anatolia, which was only marginally covered by the northeastern sheets of *Operationskarte* and *Karte von Mesopotamien (und Syrien)* (tabs. 1 & 3) as well as reprints of Ottoman and Russian map series. After years of first Ottoman retreats and then a bloody stalemate, the Russian February revolution in 1917 caused the Russian front in eastern Anatolia to rapidly disintegrate. The October 1917 Bolshevik revolution, along with the following treaty of Brest-Litovsk on 3 March 1918, took Russia out of the war. The administrative collapse of the Russian Empire in the Caucasus gave the Ottomans the windfall opportunity not only to regain the pre-war border, but to pursue a Pan-Turkish expansion into the Caucasus. That last-minute military advance culminated in their capture of Baku on the Caspian Sea on 14 September 1918. Taking the oilfields of Baku resulted in severe disputes between Berlin and Constantinople over their claims in a post-revolutionary Russia. The *Oberste Heeresleitung* envisioned the main task of Ottoman operations as fighting against the British in Mesopotamia and Palestine while otherwise establishing cooperation with Bolshevik Russia to secure oil supplies from Baku for the German war economy (Reichsarchiv, 1942, p. 35). This dispute swiftly was ‘resolved’ by the Ottoman and associated German forces surrender to the British and French on 30 October 1918.

The Complicated Organization of German Military Cartography

Reflecting the empire’s federal structure, the kingdoms of Prussia, Bavaria, Saxony, and Württemberg all maintained separate general staffs with survey sections during peacetime, while the Prussian general staff and its *Kartographische Abteilung der Königlich Preußischen Landesaufnahme* (= Cartographic Section of the Royal Prussian Survey) only took over directing the federated German armies and their surveying sections during wartime (Espenhorst, 2016, p. 90).

Because many of the trigonometrical, topographic, and cartographic staff of the Royal Prussian Survey (and the federated surveys) and the general staff itself left in the summer of 1914 for active duty in the field, and all parties expected a rapid German victory, the *Kartographische Abteilung der Königlich Preußischen Landesaufnahme* effectively ceased to function. All that remained in Berlin was the *Stellvertretender Generalstab* (= Deputy General Staff) for administrative purposes. In surveying and mapping the *Kartographische Abteilung des stellvertretenden Generalstabs* (= Cartographic Section of Deputy General Staff) kept a low profile by supplying the field armies with prints and minor revisions of existing map series (Espenhorst, 2016, p. 92).

The German armies on the eastern and western fronts soon operated in insufficiently mapped areas or advanced beyond the map coverage. The armies set up their own *Vermessungsabteilungen* (= Survey Sections), while the *Kartographische Abteilung des stellvertretenden Generalstabs* took on the production of maps for theatres of war without German army survey sections, such as the dispersed German units in Ottoman Asia. In the absence of German pre-war reconnaissance and the initial lack of German military surveyors in the battle regions of Ottoman Asia, the *Kartographische Abteilung des stellvertretenden Generalstabs* was forced to rely its map production on thrown together civilian data, captured enemy maps (some merely reprinted in translation), and only from 1916 on a sizeable amount of survey material provided by the increasingly deployed German expeditionary forces.

It was not until April 1917 that the realization that the small *Kartographische Abteilung des stellvertretenden Generalstabs* was unable to meet the growing demand for cartography resulted in the reactivation of *Kartographische Abteilung der Königlich Preußischen Landesaufnahme*. By then, however, the *Vermessungsabteilungen* of the field armies had already been firmly established as on-site rapid response units. These units established a custom of dating and numbering their often hastily made and rapidly revised maps for easy distinction of successive editions. By the end of the war, some ten thousand men served in military mapmaking in Berlin and in the numerous army-affiliated surveying sections (Espenhorst, 2016, p. 93).

In returning to the outbreak of hostilities in Ottoman Asia, the Sultan's military had only a few maps or series of maps of the future combat areas. Often these were of foreign pre-war origin, too small in scale for tactical needs, and severely out of date (fig. 2). Because of the lack of current large-scale Ottoman or German military survey material, the *Kartographische Abteilung des stellvertretenden Generalstabs* in a makeshift action started with reprinting map series on combat areas for the Ottoman Empire. The first such project in 1915 was a bilingual German-Turkish reprint of a British map to aid with the defence of the Dardanelles (Holzhausen, 1937, p. 167). To create their own spatial intelligence in areas of highest need, the *Oberste Heeresleitung* in the same year dispatched the first few cartographers along with the initial detachment of auxiliary troops towards Constantinople. Until these mapping experts could get active, 1915 still was dominated by individual activities that resulted in better drawn maps, including explorer and geographer Albert Tafel (1876-1935), who began to survey the Euphrates in Mesopotamia, while Major Hans von Ramsay (1862-1938) from the German colonial forces in Africa undertook clandestine route traverses on the Sinai Peninsula towards the Suez Canal. In addition, small German map units were created in Erzurum and Baghdad in 1916, the latter under archaeologist Walter Andrae (1875-1956) (Holzhausen, 1937, p. 167).

With the massive increase of German expeditionary forces in Ottoman Asia in 1917 not only the reconnaissance but also the map production, especially in Palestine, now happened in the field which cut out the long distance and time-consuming communication with Berlin. These efforts were aided by the map series on the Sinai Peninsula and a second map series with coverage of western Asia which were compiled and printed in Berlin: to meet the strategic planning needs of the German general staff the *Kartographische Abteilung des stellvertretenden Generalstabs* in 1914 embarked on compiling the *Operationskarte* (= Operational Map; tab. 1) at scale 1:800,000. Including a few sheets finished after the armistice in November 1918, by 1920 this series comprised more than eighty sheets ranging from Ireland's west coast to western Persia (Espenhorst, 2016, pp. 112-113). A sizeable number — fourteen sheets — covered the Asian parts of the Ottoman Empire (fig. 3).

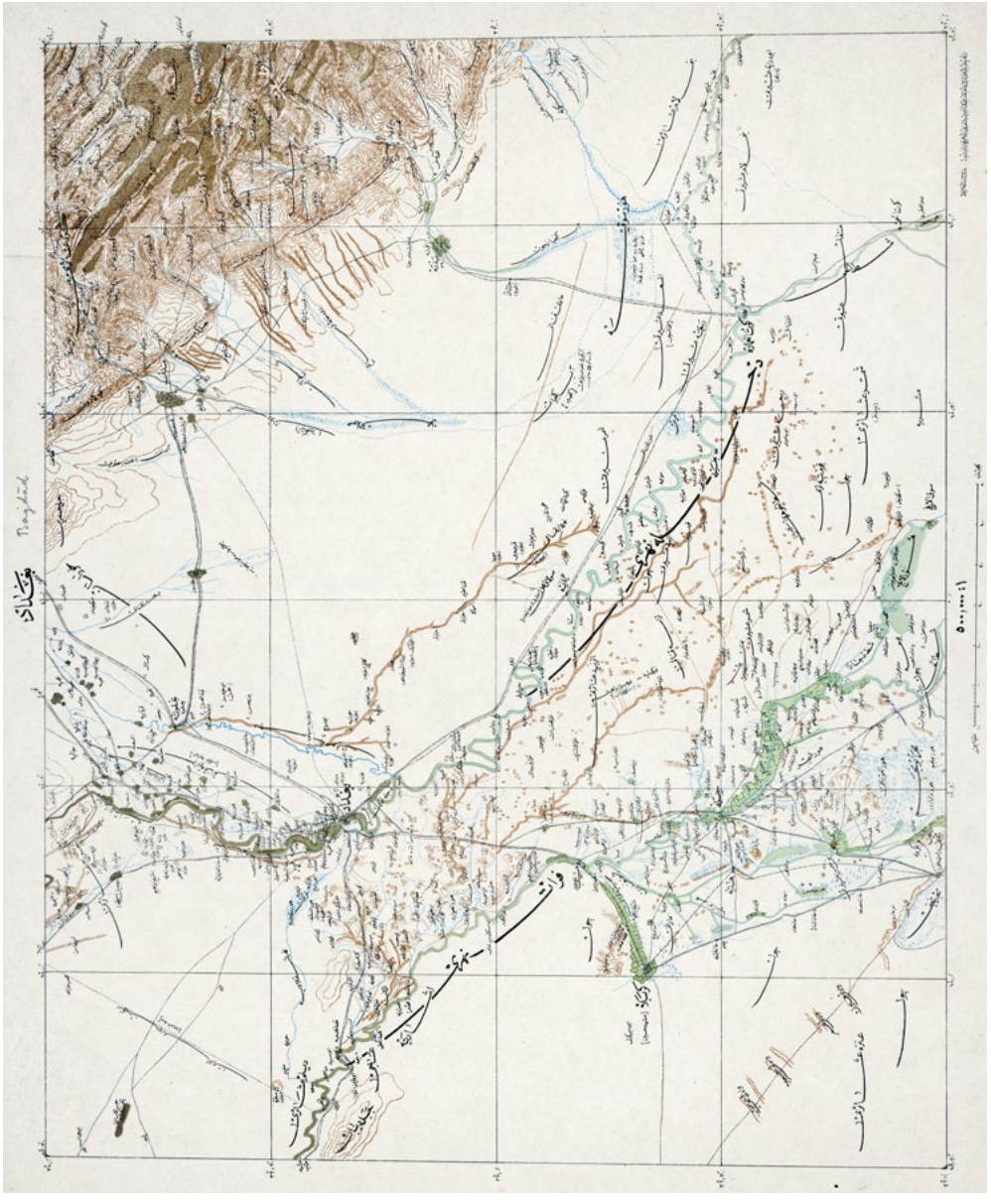

Fig. 2. — Sheet 1 Baghdad is part of the Ottoman four sheet map series of the province Iraq of 1915-16 (according to Muslim calendar) at scale 1:500,000. To guide military operations in countering the British progress upstream the Euphrates and Tigris towards Baghdad, located on the narrowest part of the plain between the two rivers, it lacks topographic features and, unlike German map series (see figs. 3 & 7), provides only a few toponyms even in the densely-populated fertile plains along the rivers [*Staatsbibliothek zu Berlin – Kartenabteilung, Kart D 6407 Blatt 1*].

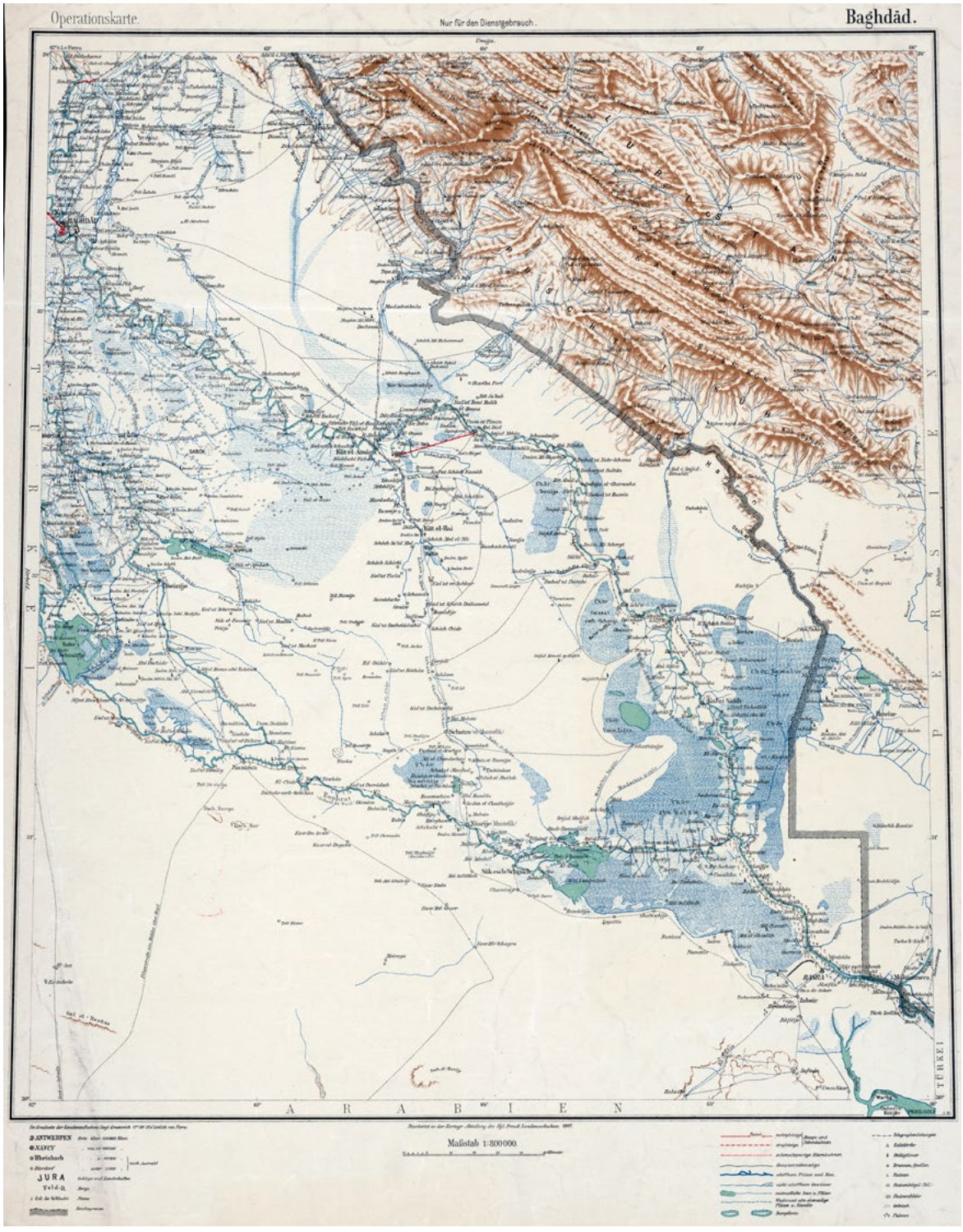

Fig. 3. — Sheet Baghdad of *Operationskarte* at scale 1:800,000 (1917, but print mark shows January 1918 in the neat line) is smaller in scale than the Ottoman map series Iraq (see fig. 2), still it contains more line features crucial for any ground operations, especially roadways, settlements, and toponyms. The area covered are the plains of Euphrates and Tigris in southern Mesopotamia with Persian mountain ranges in the NE corner and the Mendeli region (see fig. 7) along the NW sheet edge [*Staatsbibliothek zu Berlin – Kartenabteilung, Kart F 1448*].

The Sole Map Series to Support an Attack Operation: Sinai Peninsula, 1915-1916

Late in 1914 Ottoman forces did not rally, as one might have expected, for a counterattack to capture back Basra that the British had taken in late November. Instead, own imperialist desire and pressure from the *Oberste Heeresleitung*, which was desperate to get relief on the western front, the Ottomans prepared an attack across the British possession Sinai Peninsula on the Suez Canal. Both Constantinople and Berlin regarded the canal as a war-deciding Achilles' heel of the British colonial empire. Germany supported these offensive Ottoman plans by dispatching the first auxiliary units in late autumn, army railway engineers to advance supply lines towards the border and a naval medical unit. The discussed rail issues delayed the deployment of about sixteen thousand men for the Ottoman attack until mid-January 1915. This small and insufficiently equipped force nevertheless crossed into the northern Sinai Peninsula and on 26 January 1915 waged a week-long attack on the Suez Canal, even briefly crossing into Egypt. Superior British defence, however, forced the Ottomans to retreat to its supply base in southern Palestine, but the attacker maintained outposts to control a sizable portion of the northern Sinai (Reichsarchiv, 1933, p. 172; Schulz 2012, p. 89).

The weakness of the Ottoman forces and supplies, coupled with the British advances in Mesopotamia and the Russians in eastern Anatolia, let both Berlin and Constantinople in November 1915 arrive to the strategic assessment that an invasion of Egypt, as was the goal in January, was no longer within realistic reach. But raid-like disruptions of the shipping traffic on the Suez Canal were still deemed not only feasible but also desirable. To strengthen the Ottoman attack forces, in which neither Berlin nor the German officers embedded in the Ottoman armies had great faith, German special forces were sent in mid-January 1916 but had to use the bottleneck rail connection Constantinople – Aleppo – Damascus – Jerusalem. This first sizable German expeditionary force was code-named "Pascha". It consisted of about one thousand six hundred and fifty men, mostly in artillery, machine gun platoons, an air squadron, and other special units. The first German units arrived in the southern Palestinian desert at the end of March 1916, but it took until June for the German-Ottoman deployment to be 'somewhat' ready for action (Reichsarchiv, 1936, p. 610).

After almost half a year of subdued hostilities — the Ottomans only staged a number of smaller raids on the canal that the British easily thwarted but did not follow up — the Ottomans thought in July 1916, the hottest part of the year, the attack squadron was prepared to cross the Sinai, mustering eighteen thousand men and as many camels in the supply train. The advance failed to overcome fortified British positions in the battle at the fortified waterhole Bir Romani from 3 to 5 August 1916 and the Ottomans had to retreat to El Arish by mid-August (Schulz, 2012, p. 90). By then, the British had received significant reinforcements, not the least by transferring battle-hardened Indian troops from the Mesopotamia theatre of war, and until the end of 1916 drove the Ottoman-German alliance all the way back to the (Anglo-)Egyptian-Ottoman border just west of the Palestinian border city Gaza (Reichsarchiv, 1933, p. 194). Thus, the front returned to where the Ottomans had made their first push into the Sinai exactly two years prior.

Until the First Battle of Gaza in March 1917, the small German air squadron attached to the Ottoman forces since 1915 remained a serious match for the steadily growing British air squadrons. The German planes also undertook aerial reconnaissance of enemy positions and supply lines (Neumann, 1920, p. 526). Orientation of the German pilots themselves, however, was

significantly limited during the attacks on the Suez Canal in 1915 and 1916, due to the lack of any maps at larger scales. The Suez sheet of the *Operationskarte* at 1:800,000 was too small in scale and the same region of the *Karte des türkisch-ägyptischen Grenzgebietes* at medium scale of 1:250,000 was notoriously unreliable in details on topography and current infrastructure, not to mention military details. At the turn to 1917, the front became stationary west of Gaza. The British and the Ottoman-German forces dug in, and reconnaissance of the British trenches and supply lines became indispensable for efficient deployment of the increasingly outnumbered Ottoman-German forces and the direction of their artillery fire. It was at this point that the German aerial reconnaissance had to rely on one single camera that could take serial pictures supplemented the outdated existing glass-plate cameras, allowing faster photography of long strips of ground. This new device enabled pilot first lieutenant Jancke and his observer vice-sergeant Kern of the German air squadron to craft, in an effort of many weeks, a sketch map in amateurish fashion from overlapping aerial pictures that roughly was at the scale of 1:100,000. It was not until the joint German-Ottoman army group 'Yildirim' began to arrive in mid-1917 that, adding the four new German air squadron numbers 301, 302, 303 and 304 (Neumann, 1920, pp. 527, 529), for the first time a German army unit specialized in surveying and mapping began to address professionally the cartographic needs of the defenders of Palestine.

A long three years earlier, the cartographic rendering of the northern Sinai Peninsula was simple. The best larger-scale map series, which also covered southern Ottoman Palestine, were the northeastern sheets of the series "Egypt" at scale 1:125,000 (GSGS 2427), compiled by General Staff, Geographical Section of the War Office in London, and printed in 1909-1915. In the east that map series extended to Petra in Trans-Jordan and in the north just to the Sinai border village of Rafah. Importantly, the series incorporated the 1906 survey results of the Ottoman-Egyptian border from Rafah on the Mediterranean to Eilat at the head of the namesake gulf of the Red Sea (Fischer, 1940, pp. 74-75). To furnish the German expeditionary forces — and the officers of the Ottoman army units — with 'Prussian standard' maps for the attack on the Suez Canal, the general staff in Berlin commissioned major Hans von Ramsay, a seasoned surveying hand from German East Africa and Cameroon, on a clandestine reconnaissance mission into the British Sinai Peninsula. The route traverses and inquiries undertaken by von Ramsay focused especially on roadways and waterholes. Since the German officer was unable to approach the British-held apron of the Suez Canal (Alt, 1920, p. 99), his reconnaissance, and the resulting map, included much less information on the western portions of the peninsula.

Based on all previously published material, including GSGS 2427 "Egypt", and limited reconnaissance data like von Ramsay's observations, the *Kartographische Abteilung des stellvertretenden Generalstabs der preußischen Armee* compiled and issued the classified "Karte des Türkisch-Ägyptischen Grenzgebietes (zwischen Hedschas-Bahn und Sues) […]" (= Map of the Turkish-Egyptian border area [between Hejaz Railway and Suez]) at a scale of 1:250,000 in four sheets (tab. 2). The map series covers the area between the longitudes 32°-36° east and the latitudes 29° 25'-32° north. The (first edition) topographical terrain drawing shows brown form lines but only a few spot heights, though eleven types of water for the advancing German-Ottoman units. Some editions of this map series are geared for dual field use by German and Ottoman officers and therefore bilingual with Latin (German) and Turkish (Arabic characters) lettering. The first edition of each of the four sheets carries the date '1915'. However, according to Alt (1920, p. 99), who wrote just a few years later, the first edition was printed only in

‘early 1916’. Possibly the print date is correct, but it took months for the sheets to arrive in southern Palestine.

During the Ottoman-German attacks on the Suez Canal in 1915 and 1916 copies of a new edition of the British General Staff map series “Sinai Peninsula” (GSGS 2761) at the scale of 1:250,000 were captured. These carried extensive British surveys and water explorations conducted eastwards to Beersheba in Ottoman Palestine in 1913-14, officially for the scholarly Palestine Exploration Fund. The young archaeologist T. E. Lawrence (1888-1935) took part in that reconnaissance, and two years later would help incite the Arab revolt against Ottoman rule. This new British map series and other captured sheets helped to correct later editions of the German map series (Fischer, 1940, p. 75), especially the sandy plains on the north coast of the Sinai and the massively changing traffic routes passing through it, which were expanded both by the British and the Ottomans during their respective advances (fig. 4). As on all fronts of World War I, aerial photography emerged as an important source for real-time topographical reconnaissance. In the Sinai and southern Palestine, the German map series benefited from the presence of Air Squadron 300 (Holzhausen, 1937, p. 166), the very first to be deployed on this front in spring 1916.

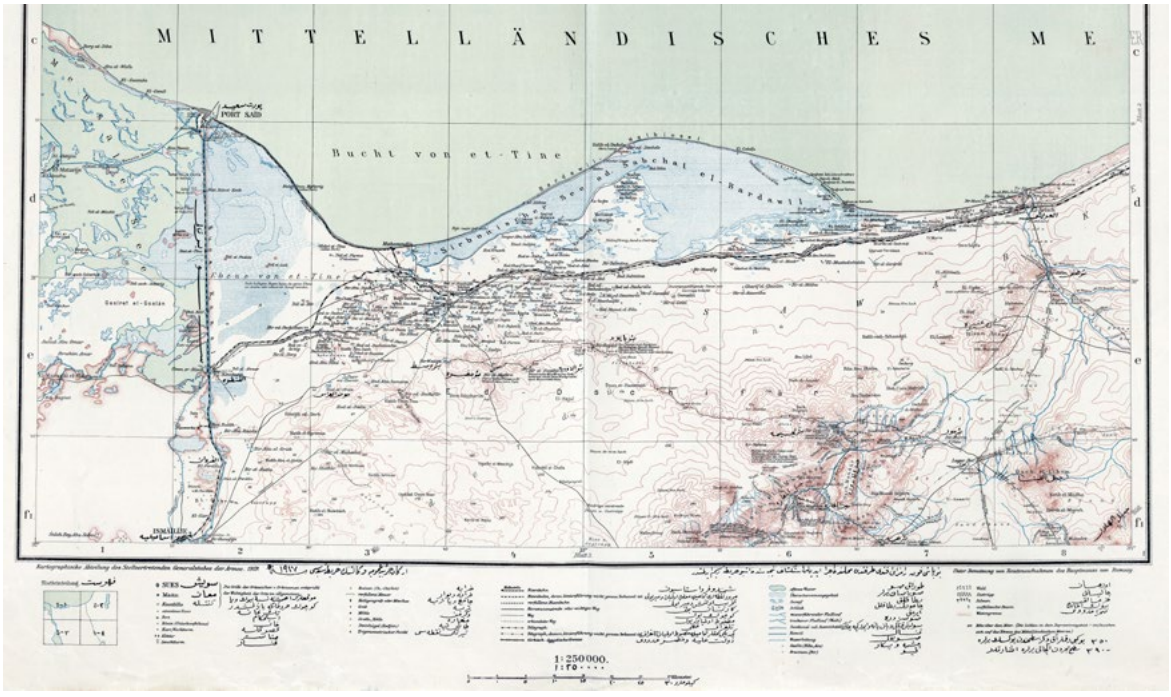

Fig. 4. — Detail of the southern half of *Blatt 1* (Port Said), the NW sheet of the four sheet map series *Karte des türkisch-ägyptischen Grenzgebietes* at scale 1:250,000. The last found edition of 1917, released about a year after the final German-Ottoman attack across the northern Sinai Peninsula on the Suez Canal on the left edge of the sheet, provides a detailed dual language German-Turkish (in Arabic letters) legend. The map itself, however, for which the topography and detailed depiction of the coastal network of roads, railways and communication lines, developed extensively by 1917, benefited from the back-and-forth of the front lines, aerial reconnaissance and captured British maps. As a hint to reality that no Ottoman advance into the Sinai, let alone into the vicinity of the Suez Canal, was imaginable anymore, the sheet gives only a few settlements and strategic places in Turkish language (in Arabic letters) [Library of Congress – Geography & Map Division, G8301 s65 s 250 P7].

A Map Series Anticipating a Long Retreat: Mesopotamia, 1916-1918

Just a few days after London declared war to Constantinople it landed on 8 November 1914 a well-equipped expeditionary force of mostly Indian troops on the fortified island of Fao at the confluence of the Shatt al-Arab into the Persian Gulf. Ottoman resistance was so weak that on 22 November the British had already taken Basra, the hub of southern Mesopotamia, and Qurna, at the confluence of the Tigris and Euphrates, 250 km inland from the Gulf coast (Reichsarchiv, 1933, p. 173). Due to a steady stream of supplies and even some reinforcements the British in September 1915 captured Kut al-Amara on the Tigris, about 200 km southeast of Baghdad. They used this position to stage a surprise dash for Baghdad that the Ottomans narrowly thwarted on 22-25 November at the Battle of Ctesiphon on the southern outskirts of the city. Now fortune changed sides, at least for a couple of months: the British were forced to retreat to Kut al-Amara, where the Ottomans besieged them and, after fending off British relief attempts, on 29 April 1916 forced the about thirteen thousand men in Kut al-Amara to surrender.

When the *Oberste Heeresleitung* realized that, first, the second attack on the Suez Canal likely would be a long shot and, secondly, that the Ottomans struggled to defend Baghdad and keep control of Mesopotamia, Berlin in early 1916 reluctantly dispatched the first auxiliary units into this theatre of war. In February, the first German airplanes and pilots arrived alongside largely German-manned cargo flotillas on the Euphrates and Tigris to sidestep the notorious inefficient rail and roadways (Reichsarchiv, 1936, p. 607). After the debacle at Kut al-Amara, British forces regrouped and received reinforcements, steadily increasing to a peak of about two hundred fifty thousand well-provisioned men by the end of 1917. Three years into the war the Ottomans could not pull together more than fifty thousand ill-equipped soldiers who at best could engage in delaying actions. With fortune now back on the side of the well-provisioned, the British captured Baghdad on 11 March 1917 and Samarra on 23 April (Pope & Wheal, 2003, p. 316).

Only the vastness of Mesopotamia left the Ottomans and the few Germans some chances for delaying tactics, but that resistance increasingly became unorganized. In summer 1917, a German pilot and his plane reached the rail terminus of the Baghdad Railway in southeastern Anatolia. To fly the remaining 250 km across unfamiliar landscapes to the closest air base in Mosul, he asked for a map. The local German supply officer had indeed recently received a long-awaited pack of maps. Upon inspection, however, these turned out to be Turkish maps in Arabic letters of Kut al-Amara and Baghdad, which places the British had conquered already in February and March. To offer some assistance, the seasoned supply officer provided the pilot verbal descriptions of the mountain ranges and rivers which were to be followed and which were either already occupied or threatened by the enemy and thus to be avoided (Neumann, 1920, p. 532). After Baghdad and Samarra were captured in spring 1917 the Ottoman retreat northwards slowed down, but only because the British relocated many of their troops to the Sinai to strengthen the forces along the Gaza-Beersheba line for the invasion into Palestine. After reaching Anah on the Euphrates on 28 March 1918 and briefly capturing Kirkuk on May 7, the British again withdrew many fighting units for the all-decisive September attack in Palestine.

Ottoman Mesopotamia, besides modern Iraq, also included the northeastern parts of Syria, essentially the flood plains on both sides of the Euphrates and Tigris rivers, with its desert fringe southwards to Arabia and the foothills of the Persian mountain ranges to the northeast, and was more than ten times larger in size than Ottoman Palestine. Including the Trans-Jordan regions, nowadays more or less Jordania, the civilian as well as the military Ottoman pre-war map cov-

erage rarely went beyond mid-scale orientation maps and map series. From 1916 detached German officers produced a greater number of (manuscript) maps, including such on the transportation relevant Euphrates and Tigris Rivers. With an even worse history of surviving German military files than for Palestine and a lack of publications by veterans involved in the German mapping series of Mesopotamia, only the sole released map series can tell some of its history.

One of the advantages of a comprehensive appraisal of German military mapping across Ottoman Asia is the comparative inspection of the German military map sheets on Mesopotamia and Palestine. Fortunately, a few test prints of the Mesopotamia map series survived. Rendered obsolete by the British advances up Euphrates and Tigris rivers, these test sheets were re-used by *Vermessungsabteilung 27* (= Survey Section 27) due to the scarcity of map paper for printing updated editions of their sheets of *Karte von Palästina* (for a detailed discussion of *Vermessungsabteilung 27* see below). So far, this is the strongest indication that Survey Section 27 was at least involved if not in charge of drawing and printing the sheets of *Karte von Mesopotamien (und Syrien)* at scale 1:400,000 (tab. 3, figs. 5 & 6) since its deployment to the Asian theatre of war in September 1917. Although *Kartographische Abteilung des stellvertretenden Generalstabs der Armee* resp. *Kartographische Abteilung der Königlich Preußischen Landesaufnahme* are printed as issuers on the sheets of this map series, it would match with the observation that only five sheets had a single edition each in 1916, but all other sheets and editions (in all thirty-two editions) relatively match the formation of *Vermessungsabteilung 27* in Berlin in spring 1917, its deployment to Aleppo, Jerusalem, Nazareth and Damascus with the last identified edition (Sheet D. Damaskus, September 1918) being a tempting fit with the then last days of operation of the Survey Section in the Omayyad city.

A further indication are telling gaps in the numbering sequence printed on the sheets and editions of *Karte von Palästina*, especially the many missing work assignments up to number 50. The missing numbers, which are listed at the end of this paper, could have been assigned internally but not printed on editions of *Karte von Mesopotamien (und Syrien)* at scale 1:400,000 and the related *Karte von Nordbabylonien* at the tactical much-better-to-use scale of 1:200,000 (tab. 3), of which so far only two sheets in a single edition could be located (fig. 7).

Finally, when a retreat of Ottoman-German forces from Mesopotamia and Palestine to Anatolia became a strong possibility, the *Kartographische Abteilung der Königlich Preußischen Landesaufnahme* adapted sheets of the 1:200,000 map series of the Imperial Ottoman Survey on southern Anatolia in the summer of 1918. This series meant to complement the northern edge of the Survey's own map series *Karte von Mesopotamien (und Syrien)* at the smaller scale of 1:400,000. These adapted sheets came with a German legend and lettering in four-colour lithographic print: Adana, Biredschik, Ma'asch, and Membidsch. In fact, the release of these sheets coincided with the hasty last retreat of Ottoman-German forces after the British had broken through the defence line in central Palestine in mid-September 1918.

While the much smaller area of Palestine could be surveyed and mapped relatively quickly, German military maps of the vast regions of Mesopotamia and modern northeastern Syria could rely only on extremely limited aerial reconnaissance, occasional plane-tabling, and even only a few rather old-fashioned route traverses observed from horseback. Therefore, German sheets on Mesopotamia often were issued only after their sheets' respective areas were lost to the British forces that steadily advanced upstream along the Euphrates and Tigris rivers. Even if such maps in occasional bilingual German-Turkish print were released in a timely fashion, the Ottomans by that time lacked the strength to put them to effective use in counterattacks.

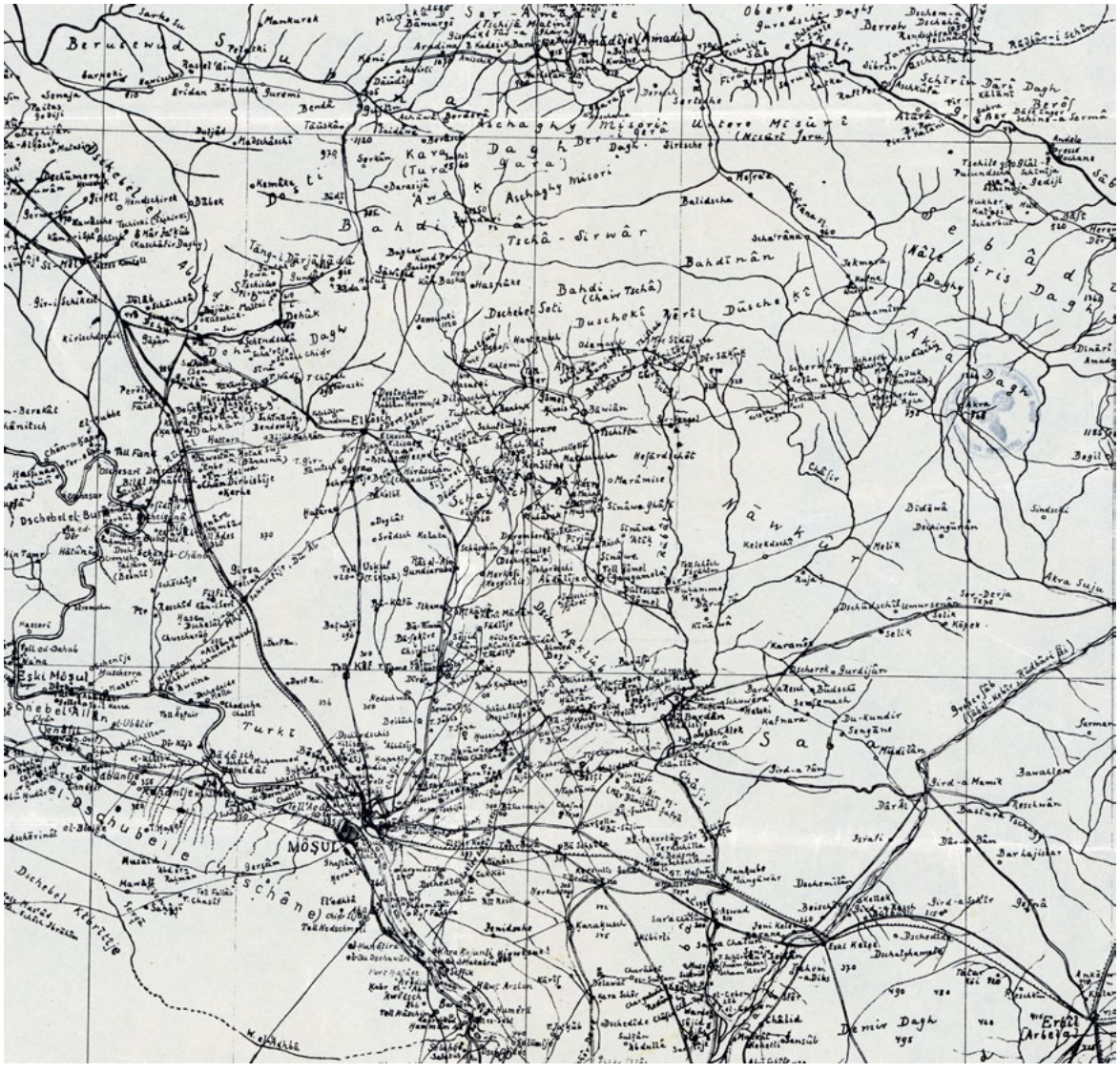

Fig. 5. — Internal print (detail) of an undated manuscript ‘first draft’ at scale 1:300,000 for Sheet 4b Mosul of *Karte von Mesopotamien (und Syrien)* ultimately at 1:400,000 (see fig. 6). Likely intended to solicit comments and corrections from units in the field. The extract of the draft shows selected line features (hydrography, roads, and railways), settlements, and toponymy but no relief for an area around Mosul bounded by Eski Mosul (W), Amadije (N), Erbil (SE), and Wadi el-Adhba (S) [*Staatsbibliothek zu Berlin – Kartenabteilung, Kart D 6201 Blatt 5*].

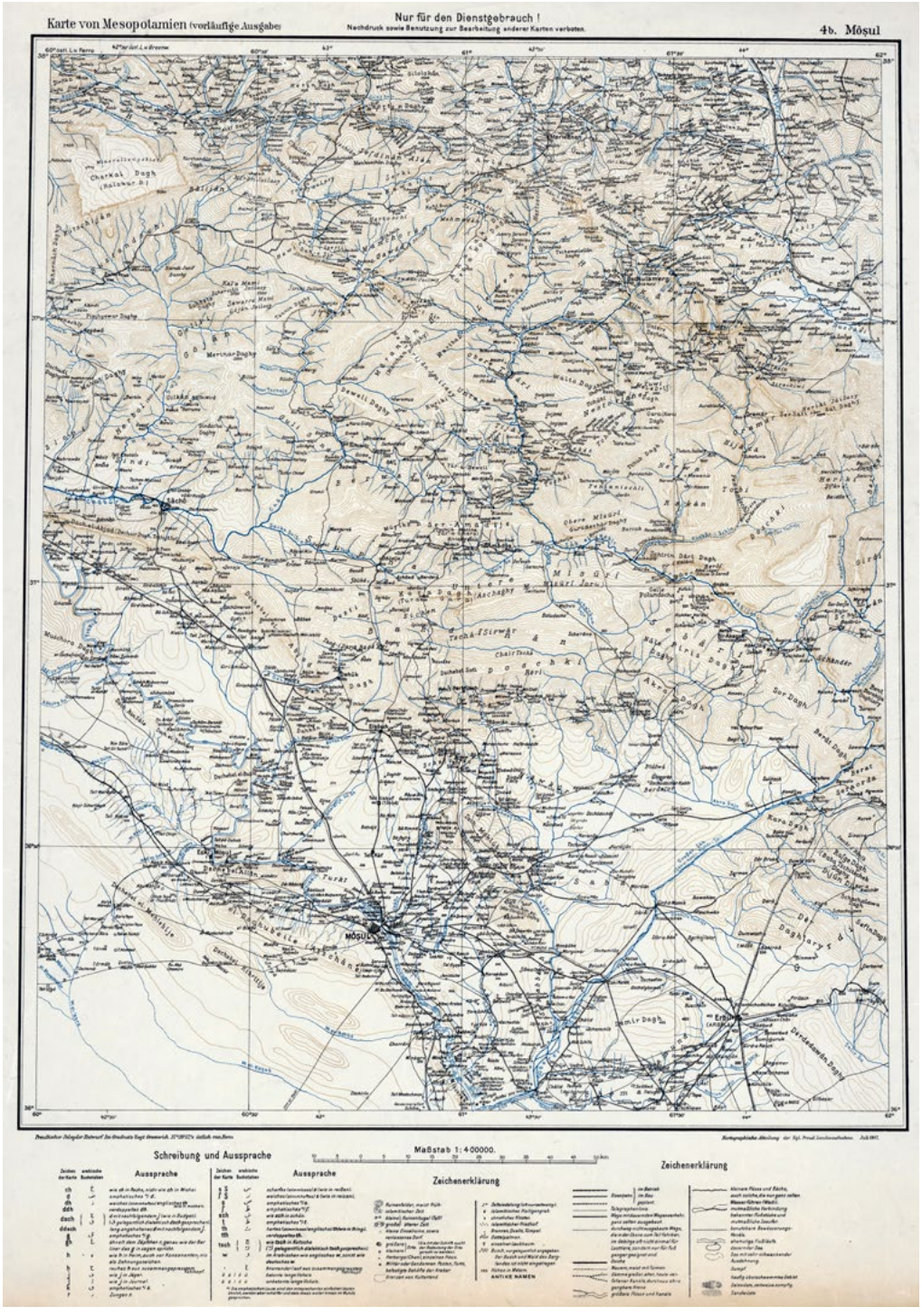

Fig. 6. — As with all the sheets of *Karte von Mesopotamien (und Syrien)* this edition of Sheet 4b Mosul at scale 1:400,000, dated July 1917, contains only a tentative topography by form lines without absolute heights. The sheet shows detailed features on the hydrography, roads and railways, communication lines and settlements. The central to southern portion shows the definitive version of the earlier manuscript draft at scale 1:300,000 (see fig. 5). Note the extensive legend on the left side below the mapped area that includes a list of how the transliterated letters (Arab to German) should be pronounced so that Ottoman allies and the local population could understand a name read from this map sheet [*Staatsbibliothek zu Berlin – Kartenabteilung, Kart D 6202*].

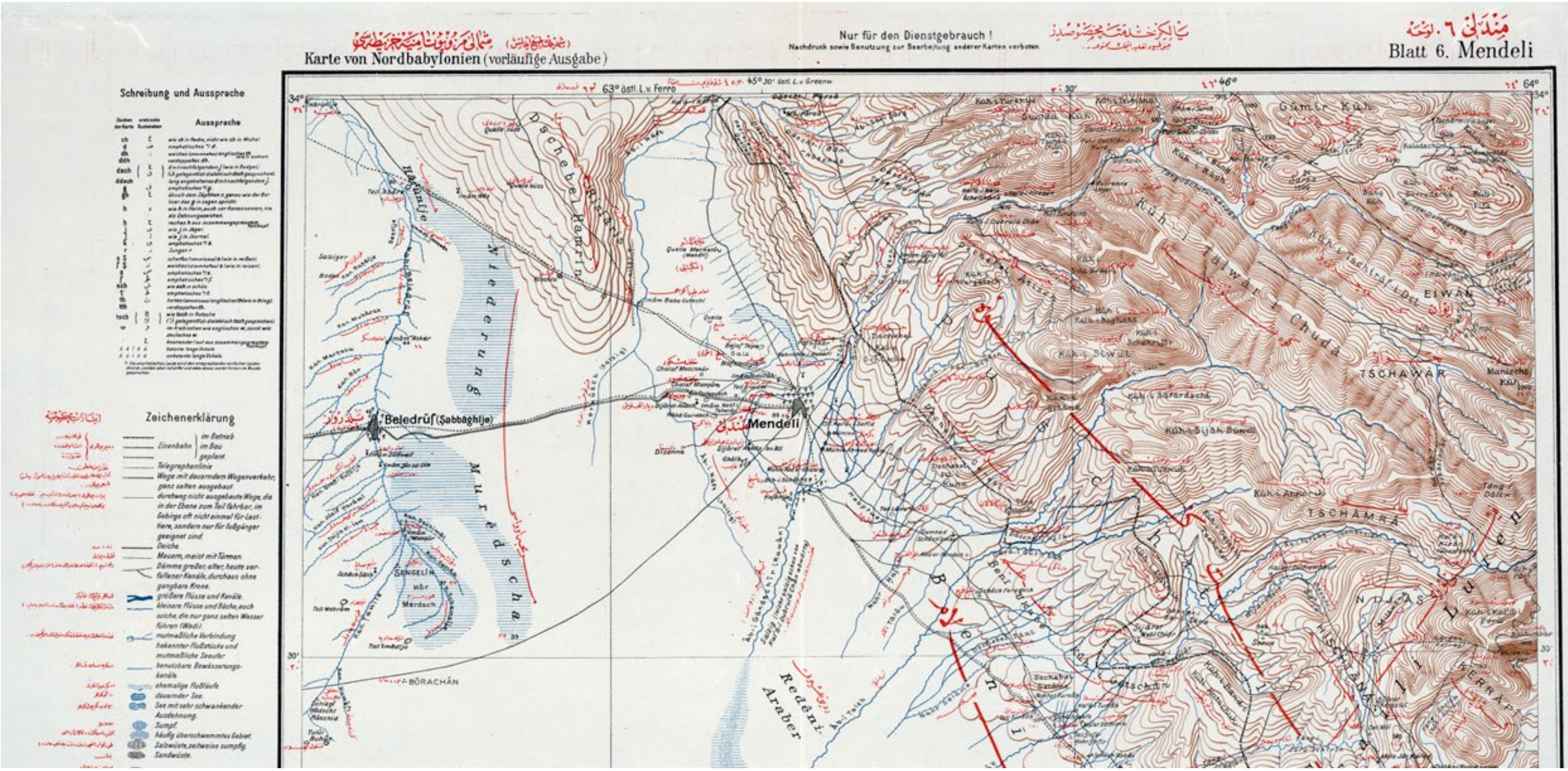

Fig. 7. — Detail of the upper half of *Blatt 6 Mendeli* of *Karte von Nordbabylonien* at scale 1:200,000, dated January 1918. This sheet is the enlarged mid-scale companion to Sheet 5d Baghdad of *Operationskarte* (1:800,000, 1917; see fig. 3) and to Ottoman Sheet 1 Baghdad of the map series Iraq (1:500,000, 1915-16; see fig. 2). The tentative form lines of Persian mountain ranges to the east of the Mesopotamian plains indicate insignificant progress on terrain reconnaissance over pre-war maps but an adaptation to joint Ottoman-German use in the field by an extensive map print and fully bilingual legend in German and Arab (see caption of fig. 6) [*Staatsbibliothek zu Berlin – Kartenabteilung, Kart D 6450 Blatt 6*].

Vermessungsabteilung 27 and Five German Map Series of Palestine and Trans-Jordan, 1917-1918

Any offensive operations in Palestine and Mesopotamia relying on the steadily weakening Ottoman forces had become a pipe dream by the turn of 1916/1917. To hold the bleeding, at least, the *Oberste Heeresleitung* reacted by reinforcing the German expeditionary forces through relocating more troops from the European western and eastern fronts as well as recruiting new units. The German hope was this would enable the Ottoman armies to muster a sustained defence of both Mesopotamia and Palestine in the summer of 1917 (Reichsarchiv, 1942, p. 420). This hope was fueled by the fact that on western outskirts of the border town Gaza the Ottomans twice, on March 26 and April 17, fended off British attempts to break into Palestine. On the other hand, there was the devastating loss of the Mesopotamian metropolis of Baghdad on 11 March 1917.

To stem the rising British tide, Berlin and Constantinople agreed upon a joint operation in Mesopotamia that essentially replicated the 1916 second attack on the Suez Canal. For that purpose, a mixed Ottoman-German army group with the code name ‘Yildirim’ (= lightning) was formed and notably was placed not under Ottoman but German command. The core of the German units was to be the transferred German ‘Pascha’ units that had already reinforced the Ottoman forces that led the unsuccessful second Suez attack in the summer of 1916. That core received substantial reinforcements to form ‘Pascha II’, which on 1 October 1917 officially was designated as *Deutsches Asien-Korps* (= German Asia Corps). ‘Pascha II’ was not meant to operate on its own but to be embedded in the new Ottoman army group F ‘Yildirim’, which auspiciously was placed under the command of Erich von Falkenhayn, who had been chief of the German general staff in 1914-16.

Deutsches Asien-Korps or ‘Pascha II’ consisted of three infantry battalions, a ranger battalion, field artillery, four air squadrons with a total of sixty-five airplanes, and several technical units, in all about four thousand five hundred men or slightly less than half the strength of a German division. As had become customary for a German army operating on European front lines, this for the first time within the expeditionary forces in Ottoman Asia included a *Vermessungsabteilung* or Survey Section. The composition of the German corps — unrealistically — was based on the belief that the Ottomans could provide rail transport, horses, and pack animals. And aggravating, the mechanized nature of the German special forces with their demands on the transport performance of the incomplete rail network vastly exceeded the needs of Ottoman formations of a comparable size (Reichsarchiv, 1942, p. 421). Even before the rapid deterioration of the transportation and supply chains from the summer of 1916, the eight machine rifle groups dispatched in early 1916 to join ‘Pascha I’, required fifty-one days to travel from Berlin to Beersheba. By 1917 this problem became even worse; infantry battalion 701 needed ninety days to travel from Pomerania to Nablus in central Palestine, of which only twenty-seven days were travelling, and sixty-three days were interruptions. The battalion spent twenty-two days of them at Haidar Pasha, the railhead on the Asian bank of the Bosporus in Constantinople, twenty-five days at the Amanus track gap, and fifteen days in Nazareth (Reichsarchiv, 1942, p. 427). The rail gap in the Taurus and Amanus mountains, coupled with the increasing lack of locomotives and fuel, caused that only three of the five ‘Yildirim’ divisions arrived in the staging area of Aleppo by the end of September 1917. The movement of the

German Asia Corps was delayed even more with many units still at home in September, and others waiting in Constantinople for further transport (Reichsarchiv, 1942, p. 422).

By late summer 1917 it had become obvious that the British had learned their lesson from the first two lost battles of Gaza in the spring and regrouped their superior military force by transferring most men, weapons, and supplies from Mesopotamia to the northeastern Sinai Peninsula to seek the military decision in the Asian theatre of war by an invasion of Palestine and a further push northward into Anatolia, the Ottoman heartland. Therefore, the Ottoman Supreme Command successfully pleaded with their German counterparts to divert 'Yildirim' away from the extensive and poorly supplied Mesopotamian theatre of war to instead strengthen the defence of much smaller Palestine (Schulz, 2012, p. 90).

The fading-away of the summer heat brought about the end of the long stalemate along the Gaza-Beersheba line. The British Palestine campaign had swollen to about ninety-five thousand well-provisioned men and gained aerial superiority, facing just thirty-three thousand defenders of Ottoman-German army group 'Yildirim' (Pope & Wheal, 2003, p. 353). On 27 October 1917, British artillery began to shell heavily on Gaza, supported by naval forces. On October 31, the British attacked Beersheba, which they captured by nightfall. On the night of November 7, the Ottomans were forced to evacuate Gaza, which they had defended successfully in March and April. The next day the full width of the Ottoman-German front line between the Mediterranean and the Dead Sea depression began to withdraw steadily with great loss of men and material. It was not until mid-December that they could stabilize a front line that ran to the north of Jaffa, Jerusalem, and Jericho (Reichsarchiv, 1942, p. 425).

The British had achieved their strategic goal, chiefly having captured Jaffa and Jerusalem, and now paused both for organizing their long backward supply lines and sit out the winter rains. In March 1918 they took to the offensive again by extending their operations into the rugged Trans-Jordan, drawing on the support of the Arab rebellion, and all an effort to overstretch the vastly outnumbered defenders (Pope & Wheal, 2003, p. 353). This extension of the war zone to Trans-Jordan considerably increased the need for constantly updated tactical mapping from the river's east bank well into the Arabian desert, while the British continued to further amass troops and equipment for a decisive final attack in late summer.

The launch of a German map series on Palestine was deemed unnecessary because that Ottoman province until the end of 1916 figured only as a stage for marshalling troops and supplies for incursions into the Sinai Peninsula and attacks on the Suez Canal. For these purposes, the existing orientation maps and series sufficed. For orientation of the supply line units, *Kartographische Abteilung des stellvertretenden Generalstabs* already in 1915 had reprinted the Palestine Exploration Fund's "Map of Western Palestine". That series had been surveyed in 1871-1877, to produce a twenty-six sheet map series at the scale of 1:63,630 and won recognition as the most detailed and accurate nineteenth-century representation of the regions between the Mediterranean and the Jordan river. Unfortunately, as it would turn out, Berlin reproduced only the 1881 derived edition of the reduced scale of 1:168,960 on sixteen small sheets. The cartographic situation fundamentally had changed already late in 1916, when the British had driven back Ottoman and German troops to Gaza and it became a tactical burden to organize the defence of Palestine when early in 1917 the British pushed the front across the border to the line of Gaza-Beersheba.

When the *Deutsches Asien-Korps* was conceptualized in spring 1917, a surveying unit was an integral part as had become usual with German armies on the eastern and western fronts (Alt, 1920, pp. 99-100). This task was assigned to the newly-formed surveying detachment, *Vermessungsabteilung 27* (Survey Section 27), operating under the command of captain Dr. Ing. (= Doctor of Engineering) Walther Hinrichs (1882-1964). He had studied archaeology, art history, and architecture and in 1909 got the doctorate in the latter field. In 1909-11 the Royal Berlin Museums detached Hinrichs to the excavations in Assur in upper Mesopotamia. Thereafter he served as an excavation architect in Egypt and Nubia (Rehm, 2020, pp. 5-6). Hinrichs thus enjoyed a good knowledge of the broader region, its people, and the Arabic language.

Like all units of the German Asia Corps, the *Kartographische Abteilung der Königlich Preußischen Landesaufnahme* furnished the Survey Section 27 with a booklet entitled *Kurze Militärgeographische Beschreibung von Palästina* (= Short military geographical description of Palestine) to guide their reconnaissance (Espenhorst, 2016, p. 119). The section accompanied 'Pascha II' on its long and difficult deployment route via Constantinople to Aleppo. There it briefly was quartered in Turkish barracks in mid-September 1917 and started its cartographic activity. The first work orders centred on producing maps for a then contemplated counterattack against the rebellious Arabs under Emir Feisal and the British archaeologist-turned-intelligence-agent T. E. Lawrence, who operated from Aqaba against the Hejaz railway. However, this work made little progress due to regional illnesses that had incapacitated the section's staff that was new to the Levant. Already at the end of September 1917 *Vermessungsabteilung 27* had been on the move again, when the army group 'Yildirim' was definitively reassigned to the Gaza front. It was characteristic of the, at that time, intolerable cartographic situation that the pilots of the German air squadrons upon leaving Aleppo could not be given large-scale maps of their destinations in southern Palestine for guidance (Holzhausen, 1937, p. 167).

The second home to Survey Section 27 was Jerusalem, where it arrived ahead of other staff of army group 'Yildirim' on 12 October 1917. The cartographers were moved into an empty house near the German-Protestant run Syrian orphanage in the Bukhara district. The working conditions were poor, with a lack of local material to set up offices and kerosene for the lamps after dark. The Germans had little hard currency and the Arabs no longer took Ottoman paper money. The trigonometric fieldwork of *Vermessungsabteilung 27* was supposed to be supported by detailed Ottoman soldiers. However, most of them were captured deserters, who usually soon ran away again (Holzhausen, 1937, p. 168). Systematic surveying was difficult since the section arrived in Jerusalem when the front collapsed after stalling for months between Gaza and Beersheba. Instead, the Ottoman and German forces needed as quickly as possible provisional sheets of areas where it was expected that the new front line would stabilize.

Early November saw *Vermessungsabteilung 27* on the move, again, when army group 'Yildirim' evacuated Jerusalem and retreated to the north, now operating in areas without cartographic cover. The NE sheet of *Karte des türkisch-ägyptischen Grenzgebietes* at scale 1:250,000, which was still in widespread use for operations on the Palestine front in October 1917, only extended north to about the Ramla-Amman line. *Vermessungsabteilung 27* undertook the remarkable emergency effort to produce within only thirty-six hours for staff officers of the army group two hundred copies of a single sheet map called *Mittel-Palästina* (fig. 8). This sheet was dated 30 November 1917 and provided a northern extension to the NE sheet of the Sinai map series (tab. 4). This cartographic parforce ride was only possible because the section possessed a single copy of the British map series at the scale of 1:168,960, itself a 1915 reprint

by *Kartographische Abteilung des stellvertretenden Generalstabs* of a reduced version by the Palestine Exploration Fund of its (by then) about two-generation-old map series at scale 1:63,360. This quick work may have saved the day, but it highlighted the pressing need for maps of the upcoming battlegrounds. It is noteworthy, too, that in the spring of 1918 this emergency fix called *Mittel-Palästina* had to be repeated, when British and Arab forces extended the front into Trans-Jordan. This forced *Vermessungsabteilung 27*, once again, to draw an emergency map, an eastern extension of *Mittel-Palästina* that was titled *Ostjordanland Südl. Teil* (dated 11 April 1918). This map again followed the British scale of 1:168,960, and only made revisions taken from smaller German pre-war maps and the few field surveys German soldiers had conducted in the area.

Fig. 8. — Sheet *Karte von Mittelpalästina*, dated 30.11.1917, at medium scale 1:168,960 already at first glance reveals that it was hastily drawn. The terrain is rough even for form lines (brown), basic hydrography (blue) and only major roadways, railway lines, and a small number of settlements (black). The sheets Kalkilje (see fig. 12) and its NE enlargement in sheet Azzun 59 N.O. (see fig. 13) cover the area to the east of the town (spelt here) Kilkilje (= modern day Qalqilya) on the north-south railway line near the latitude of the coastal town of Arsuf (= today part of Herzliya) [National Library of Israel, Maps, Pal 1236].

After barely a month, the section had to move, again, and on November 13 along with headquarters of army group ‘Yildirim’ set up offices, workshops, and printing presses to Nazareth (fig. 9), its fourth base, in an Arab school and the Franciscan monastery. When the British advance northwards paused for the rainy season, *Vermessungsabteilung 27* had a three-month long and relatively undisturbed residency in Nazareth. At the end of November, it produced another extension sheet entitled *Karte von Nordpalästina* at the for a German map unusual scale of 1:168,960 but easily explained by the fact that it was based on the Palestine Exploration Fund map series of that scale. But this large sheet also benefited from corrections taken from a captured copy of the latest edition of the British General Staff’s map series of Palestine at the scale of 1:250,000 (Alt, 1920, p. 100; Holzhausen, 1937, p. 168). After these early adaptations of British maps, the Survey Section 27 issued its first ‘own’ map series of Palestine at the still-to-be considered medium scale of 1:250,000 (tab. 5, figs. 10 & 11). The first two map sheets released were meant to provide the northern extension to *Karte des türkisch-ägyptischen Grenzgebietes*. The sheets *Palästina südlicher Teil (Samaria)* and *Palästina nördlicher Teil (Galilee)* again owed much to the captured British General Staff’s map series at scale 1:250,000. Such rehashed overview-scale maps based on old and new British map series satisfied strategic needs but did not aid on-the-spot tactical orientation for fighting units and the air wings (Holzhausen, 1937, p. 170). A large-scale map series was needed, as quickly as possible.

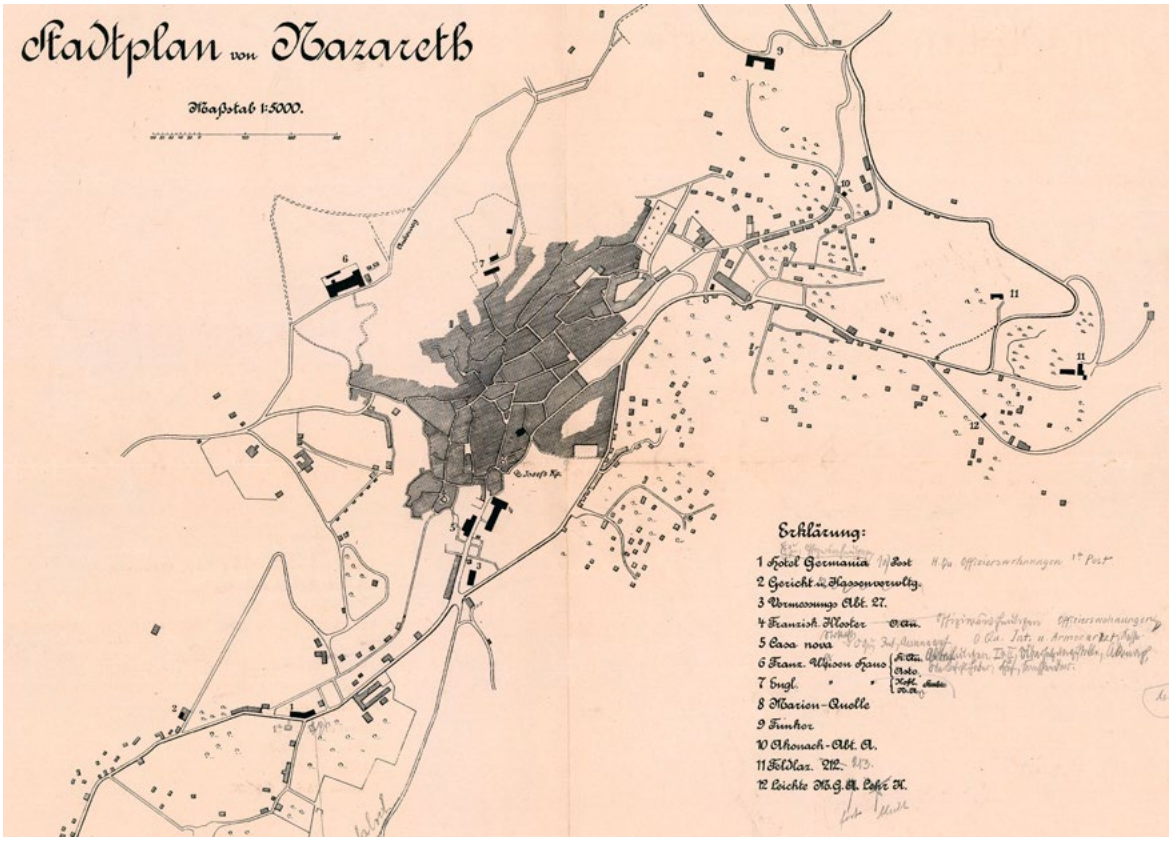

Fig. 9. — City plan of Nazareth (detail) at scale 1:5,000 with numbers highlighting buildings occupied by German ‘Pascha II’ units with workshop (= 3) and administration (= 5, Casa Nova) of *Vermessungsabteilung 27* on the southern outskirts of town on the road to Jerusalem. Undated plan (presumably late November 1917) surveyed and printed by *Vermessungsabteilung 27* (assigned production # 21) at scale 1:5,000 with manuscript annotations of occupation changes after printing the plan [National Library of Israel, Map Nazareth 9].

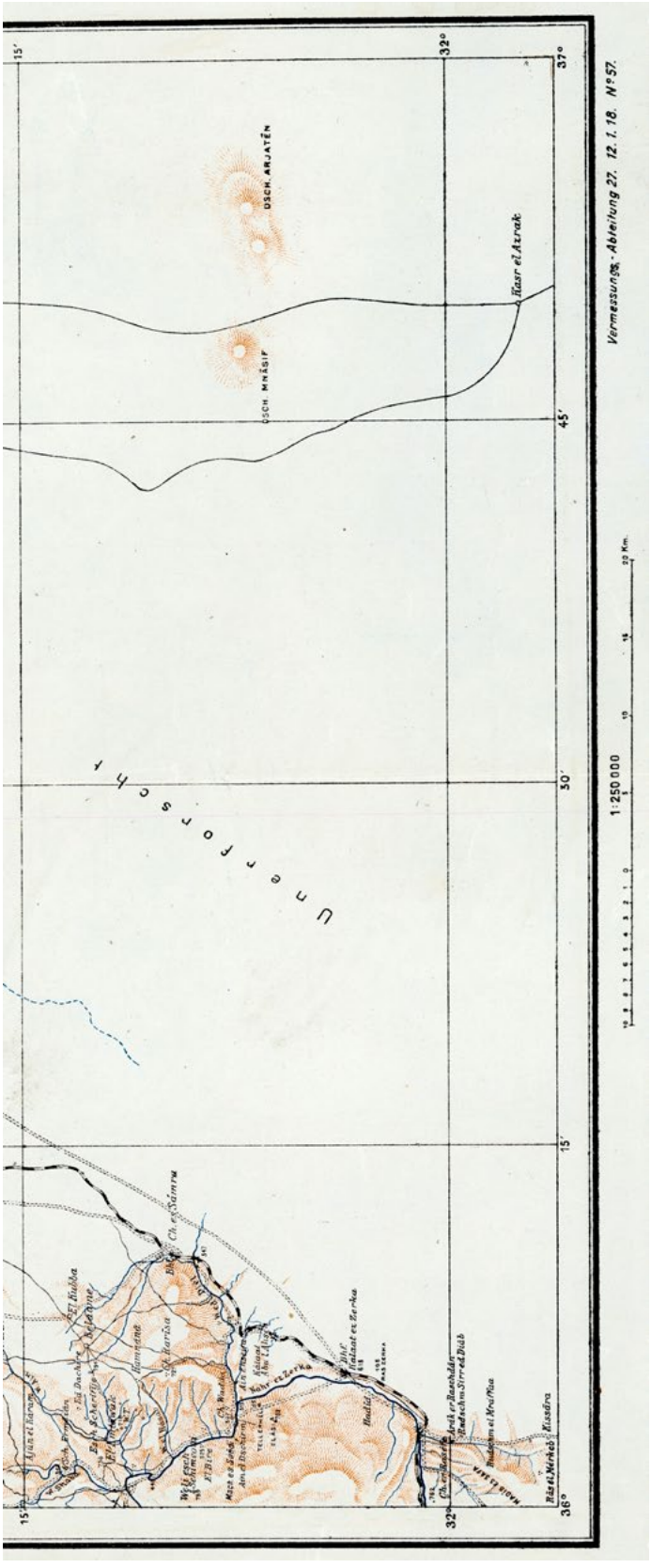

Fig. 10. — This extract from the hitherto earliest identified edition of Sheet Hauran, with its date 12.01.1918 exactly six months earlier than the latest found edition (see fig. 11), is practically void of any topographical information east of the Hejaz railway from Damascus to Lake Tiberias and south of the Hauran massif. Instead, it labels the southern third of the area covered by this sheet *unerforscht* (= unexplored) [National Library of Israel, Maps, Middle East 137 Sheet 57].

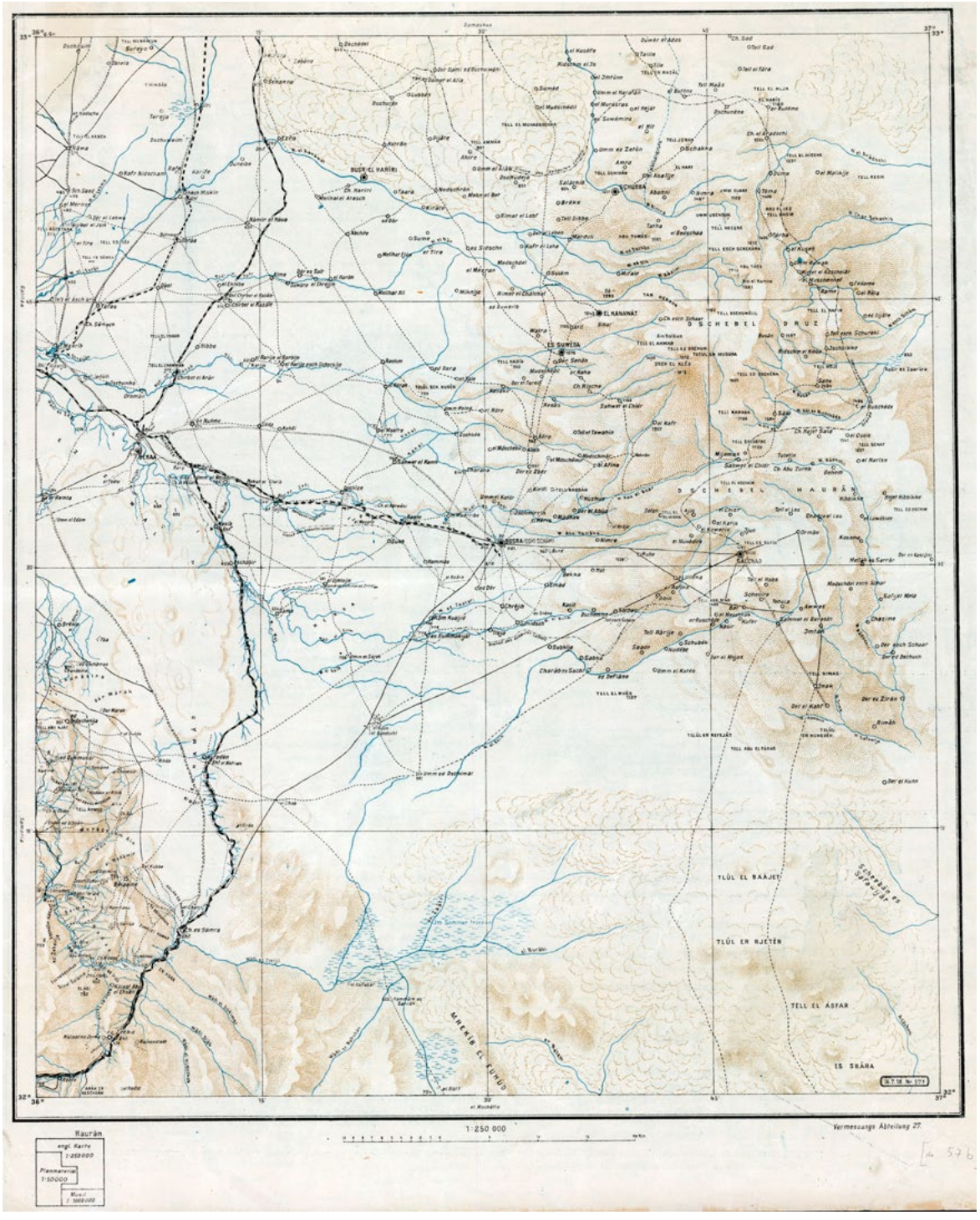

Fig. 11. — The most recent identified edition of the Sheet Hauran at orientation scale 1:250,000 is dated 16.07.1918. Its dominant feature is the namesake mountain massif in southern Syria in the NE quadrant. Note the inset sketch left below the mapped area that credits most of the right half of the sheet to a British map of the same scale, most of the left side to reductions from the 1:50,000 map series by *Vermessungsabteilung 27*, and the southern desert regions, still blank on the first found edition of January 1918 (see fig. 10), were filled in topographically from a then still unpublished 1:1,000,000 map by Alois Musil [National Library of Israel, Maps, Middle East 137 Sheet 57b].

The breakthrough moment for German military cartographers was when, by accident, their commander captain Hinrichs in Haifa came across the yellowed but complete twenty-six sheets of the Palestine Exploration Fund's semi-official British "Map of Western Palestine" at its original large scale of 1:63,360. A quick field check showed that the terrain surveys on which the map was based were, though four decades old (1872-1877), outdated on settlements and communication lines, for the most part were accurate even when in parts superficial. However, the "Map of Western Palestine" after its publication in 1880 has never been updated and, obviously, lacked the since greatly changed settlement patterns, not the least those of Jewish and Christian immigrants, as well as construction of roads and railways. Therefore, the old British map could not meet modern military tactical needs but provided a useful base for natural topography (Goering, 1925, p. 123; Fischer 1940, p. 77).

Based on the data transfer from the "Map of Western Palestine" *Vermessungsabteilung 27* developed its large-scale tactical German map series *Karte von Palästina* (= Map of Palestine) at the scale of 1:50,000. Although the first sheets were released in mid-January 1918 with only little retouches to the British map series, the entire front line had been covered already by mid-February 1918. Later editions of the first sheets, as well as the sheets that were added in the following months, increasingly incorporated original field surveys by the Survey Section 27 and photogrammetric interpretation of aerial pictures supplied by the at the best time six air squadrons (Holzhausen, 1937, p. 170).

In addition to extracting old and current enemy material, *Vermessungsabteilung 27* began to systematically survey the rear areas once the front lines had consolidated in southern Palestine at the end of 1917. In some areas this grew into extensive triangulation networks partially filled with tachymetric surveys of terrain and paths. By redrawing the old British Palestine Exploration Fund map series at scale 1:63,360 and interpreting aerial photographs made by German air squadrons, and filling in own triangulation and topographical surveys, a comprehensive German war map series of central and northern Palestine and adjoining areas emerged between February and September 1918 at a scale of 1:50,000 in forty sheets. Some of these map sheets went through multiple revised editions; *Blatt* (= sheet) 59, Kalkilje (fig. 12), even reached a seventh edition (tab. 4). To complement this main series with more detailed terrain representations of selected areas close to the (then stagnant) front line, the small Survey Section 27 over the summer did extensive field work and in August and September 1918 issued seven sheets at the scale of 1:25,000. These even larger-scale sheets employed plane tabling and thus for some areas showed real contours (isohypses) instead of the hitherto merely tentative form lines. The advances over the British map series of the 1880s and the captured smaller-scale current British war maps were chiefly the updated and precise representation of settlements and traffic routes as well as some corrections on the topography like the bends of the lower Jordan river and the shores of the Dead Sea. While *Vermessungsabteilung 27* diligently produced sheet after sheet for its series at scales 1:50,000 and 1:25,000, the *Kartographische Abteilung der Königlich Preußischen Landesaufnahme* in Berlin aided with publishing revisions of the reduced-scale print of the Palestine Exploration Fund, such as the 1917 *Karte von Mitteljudäa* (= Map of Central Judaea) at the original scale of 1:168,960 (Fischer, 1940, p. 76).

Although *Vermessungsabteilung 27* in Nazareth was twenty-five times closer to the front than *Kartographische Abteilung der Königlich Preußischen Landesaufnahme* in Berlin, this still proved to be too far behind the stalemate front for tactically needed almost real-time cartographic support of the fighting units. Therefore, it was decided to establish advanced field

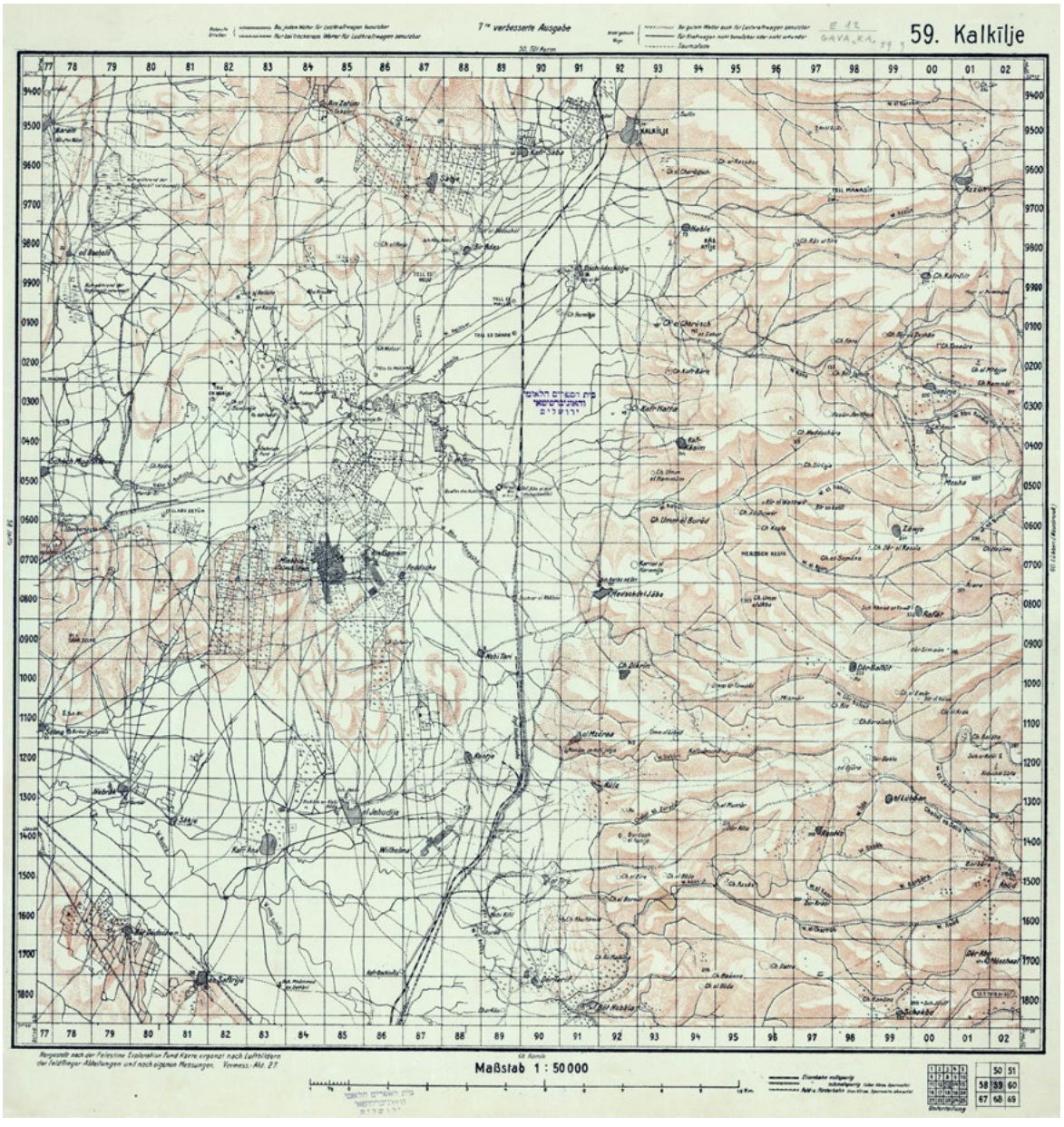

Fig. 12. — For terrain representation the Sheet 59 Kalkilje, as is characteristic with the map series at scale 1:50,000, shows tentative form lines that for the most were taken from the surveys of the 1870s and the map series at scale 1:63,360 of the Palestine Exploration Fund. Updates of the terrain rendering were due to aerial photogrammetry and limited field surveys by *Vermessungsabteilung 27*. In contrast, the roads, railways, and the settlements were brought up to current status. The stagnant front line enabled that the shown edition of 13.07.1918 had already been the seventh edition since (likely) early April. Sheet Azzun 59 N.O. (see fig. 13) is the 1:25,000 enlargement of the NE quadrant of Sheet 59 Kalkilje. Note the German Christian settler colony Wilhelmina, which provided valuable local informants to the Survey Section 27, directly to the west of the railway line in the south. When issued in July 1918, the area in the southern half of the sheet was already occupied by British forces. This is indicated by the insertion of a rail line named *Engl. Vollspurbahn* (= English full-gauge railroad, in contrast to the Ottoman narrow-gauge railways) up to the centre of the sheet and an apparent rail gap (removed tracks) to the southernmost serviced Ottoman railhead Ras el Ain. The sheets of both map series 1:50,000 and 1:25,000 carry a block grid overprint to aid aerial navigation as well as artillery target direction [National Library of Israel, Maps, Pal 1248].

mapping units for rapid trigonometric and topographical terrain reconnaissance in closer liaison with major detachments of the army group. By the end of November 1917 two such units were established in Nablus and Tulkarm, followed in January 1918 by a third one in Jericho, which later moved across the Jordan river to Al-Salt. For the lack of an organigram, a mere tentative approximation on the structures of *Vermessungsabteilung 27* during that period of its peak production, four task groups may be identified:

— Trigonometrical surveyors and topographers, performing trigonometric and topographic surveys in the field as well as for measuring firing solutions for frontline artillery;
— Translators for the correct identification, translation, and transliteration of place names;
— Geologists for the search and evaluation of water in arid Palestine and Trans-Jordan;
— Photogrammetrists to interpret and process aerial photographs supplied by the air squadrons.

Commensurate with the need of army group 'Yildirim' headquarters and its fighting units for detailed and up-to-date maps, the staff of *Vermessungsabteilung 27* was increased several times, reaching a peak in the summer of 1918 with five officers and about one hundred and sixty non-commissioned officers and men. Crucial local intelligence among the latter were sixteen volunteers from the Württemberg Templar settler colonies in central Palestine, who were assets because of their intimate knowledge of the country and languages (Holzhausen, 1937, p. 171).

To fill the map sheets on areas on the 'other side' of the front with current data, the section relied on captured maps and photogrammetric processing of aerial photography from the German air squadrons of army group 'Yildirim'. Along with field printing, which cut out the months of courier service to and from Berlin, the versatile methods to gather and process spatial data on both sides of the front lines enabled a rapid issuing of new and updated sheets. The presence of a fully-fledged surveying unit with field printing equipment enabled the first sheets of a provisional military map series to appear within weeks (Alt, 1920, p. 101). A specific challenge was the transcription of Arabic names and designations into the Latin alphabet, further complicated by the demand that the result had to be equally intelligible for the inexperienced tongues of German soldiers and for the ears of the Arabic speakers they encountered in the field.

The increasingly difficult supply situation in Palestine in mid-February 1918 forced *Vermessungsabteilung 27* to move further away from its work field, the front lines, to its fourth base, the Syrian capital Damascus, in hope for a steadier stream of supplies. As a part of the headquarters of army group 'Yildirim' was still in Nazareth, however, the section left a newly-formed fourth field map unit to ensure close coordination with the command of the air squadrons. In Damascus, the Survey Section 27 with seven months had the longest residency during its short service life of just about one year. In the Syrian metropolis it moved into the Imperial Stables on Djemal Pascha Boulevard, where two newly-arrived high-speed printing presses were set up. These presses significantly increased the output of maps. As in Nazareth, *Vermessungsabteilung 27* printed and likely updated the map sheets of *Karte von Mesopotamien (und Syrien)* at the scale of 1:400,000 (tab. 3) for the neighbouring theatre of war on behalf of the credited but far away compiler *Kartographische Abteilung des stellvertretenden Generalstabs* resp. *Kartographische Abteilung der Königlich Preußischen Landesaufnahme.* A tell-tale sign of the Survey Section's involvement in the Mesopotamia maps is fact that a representative of

the 6th Ottoman Army, which operated in Mesopotamia, periodically was detached to Damascus. According to Holzhausen, one of the very few authors with contemporary knowledge on *Vermessungsabteilung 27*, the section while in Damascus was the "center of all cartographic work in the Middle East war zone" (Holzhausen, 1937, p. 172).

The map sheets of the areas east of the Jordan, according to Holzhausen, were based mainly on *Operationskarte* at scale 1:800,000, the 1907 Hejaz map at scale 1:300,000 compiled by the Viennese orientalist Alois Musil (1868-1944), and the aerial photographs that the Survey Section 27 could obtain. Musil is particularly interesting, because he became a key influencer to northern Arabia in 1915 and, in some respects, was the 'Lawrence of the Central Powers'. Further cartographic surveys of extensive regions in Trans-Jordan were provided by long-time Haifa resident, surveyor, and archaeologist Gottlieb Schumacher (1857-1925). Finally, the survey maps compiled for the Hejaz railway under the supervision of its project manager, Heinrich Meißner Pasha (1862-1940), provided an additional source of current information (Holzhausen, 1937, pp. 170-171). The Ottoman Land Survey, whose activities cannot be included in this paper, contributed a few single-sheet maps on the greater Palestine regions, including a map of Jerusalem at the scale of 1:200,000, which also covered the entire Dead Sea (Fischer, 1940, p. 77).

During the summer of 1918 army group 'Yildirim' ordered an offshoot reproduction series at scale 1:100,000 of the by then established Palestine map series at scale 1:50,000. Because these smaller-scale sheets were handy and showed a clearer terrain presentation, they quickly became the preferred orientation map, especially among pilots. In the other direction of scale, preparatory work for a plane-table series at the scale of 1:25,000 (fig. 13) began in the spring of 1918. Because of significant absences of personnel due to sick leave, the summer heat, and the increasingly hostile local Arab population, this largest-scale German map series only slowly progressed. Despite these adversary circumstances, by September 1918 seven precisely detailed and true to nature contoured sheets were completed (tab. 4).

At the same time even in Damascus, far behind the front lines, supplies were dwindling to such a degree that it curbed the section's operations significantly. Always extremely limited, railway operations deteriorated even further due to the lack of firewood and rolling stock. Just one of the many adverse effects on the work of *Vermessungsabteilung 27* was the suspension of deliveries of map paper from Germany. The only available remedy was to print on the back of obsolete map sheets of areas now far beyond the actual front lines, mainly from the Mesopotamian series. Not after long these surplus paper stocks also ran out (Holzhausen, 1937, p. 172). At this point, just one year into its existence, the Survey Section 27 in terms of its production, and despite its early roots in and substantial borrowing of data from the Palestine Exploration Fund maps, has made a significant step forward into the modern age both in terms of working methods (aerial photographs, photogrammetry) and content (accuracy of terrain representation, updating of settlements and traffic lines). As for terrain rendering, the meandering course of the Jordan river and the arid mountainous country to its east received a reliable and precise representation for the first time (Alt, 1920, p 102).

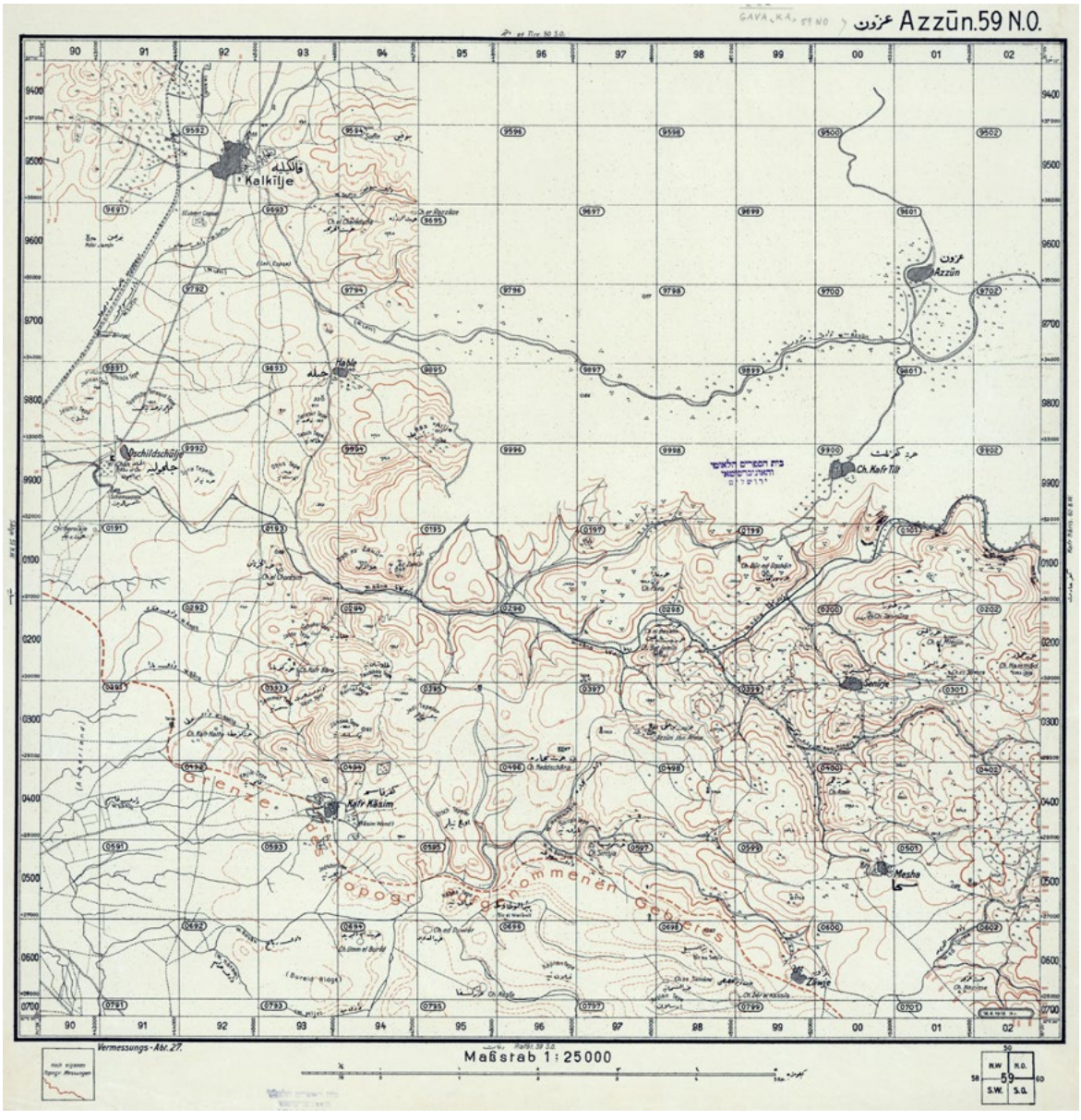

Fig. 13. — The summer 1918 stalemate of the front line to the north of Jaffa enabled *Vermessungsabteilung 27* to undertake field observations of the combat area from the Mediterranean into the hill country of Samaria and released, as part of its largest-scale map series at scale 1:25,000, Sheet Azzun 59 N.O. on 18.08.1918. Noteworthy is the absence in the NE quadrant of any topography and the line diagonally across the SW quadrant designated as *Grenze des topographisch aufgenommenen Gebiets* (= Border of the topographically surveyed area) as euphemism for the longer relatively stagnant front line. The German side of the 'contact line' shows true isohypses with numerous absolute heights and detailed settlement features, based on aerial stereo-photogrammetry and plane tabling on the ground, while the British side could only be rendered in tentative form lines. The overprinted block grid served the same purpose as with Sheet Kalkilje (see fig. 12) at scale 1:50,000 for which Sheet Azzun is the enlargement of its NE quadrant [National Library of Israel, Maps, Pal 1248].

Collapse of *Deutsches Asien-Korps* and *Vermessungsabteilung 27*, September 1918

In the early morning hours of 19 September 1918, the final British attack on the expansive front line from the Mediterranean across the Jordan river into the Arabian desert opened with an artillery barrage in the coastal area. On the other side of the trenches and barricades were just twenty thousand Ottoman rifles and about one thousand men cavalry left. Of the six melted together German battalions, three of each stood east of the railroad and east of the Jordan, in all no more than two thousand five hundred men with just a handful of still operational aircraft (Reichsarchiv, 1942, p. 438).

Without facing serious resistance, the British infantry, supported by numerous airplanes, pushed through in the so-called Battle of Megiddo. The British cavalry found its way and at daybreak on September 20 attacked the headquarters of army group 'Yildirim' in Nazareth. Although the attack was repulsed, the appearance of enemy troops 80 km behind the front within less than twenty-four hours indicated how untenable the Ottoman-German positions were. This had been foreshadowed for months by the hemorrhaging from the breakdown of (unpaid) civil service, shortages in all supplies, low morale, and desertions (Reichsarchiv, 1942, p. 439; Pope & Wheal, 2003, p. 354). British air raids destroyed the defender's artillery and whole columns of vehicles that blocked the mountain roads and paths. Within a week, 'Yildirim' lost almost all its artillery, the Ottoman-German units disintegrated, and a now openly hostile Arab population harassed the retreating splintered units (Reichsarchiv, 1942, p. 440).

The crushed army group 'Yildirim' was driven northwards 300 km to Aleppo before it could collect its remnants for a final stand. Even this was only because the British, as before in the Palestine campaign, paused to organize their supply lines. On 25 October, British-Arab forces began to advance on Aleppo, not meeting any effective resistance. On 30 October, the Ottoman Empire signed an armistice with the Entente Powers, which went into effect the following day. Its stipulations included the surrender and repatriation of about twenty-five thousand German military personnel and civilians still in the defeated country (Reichsarchiv, 1942, pp. 441-442).

Inevitably, *Vermessungsabteilung 27* was included in the collapse of the German 'Yildirim' units. Its advanced field map units in Nazareth, Nablus, Tulkarm and Al-Salt escaped immediate capture or destruction only by joining the hastened Ottoman-German retreat. However, they lost most of their survey notes and cartographic material. Ironically, the unit's Damascus headquarter spearheaded an effort to shield the runaway retreat from the collapsed front. German troops in Damascus formed a detachment to march south into Deraa to stop the advancing Arabs under Emir Feisal at the crucial junction of the Hejaz and Palestine railways. Captain Hinrichs of the Survey Section 27 took command and was joined by volunteers from the head office of *Vermessungsabteilung 27*. They left behind only twenty-seven non-commissioned officers and men to prepare the survey section's relocation to makeshift facilities further to the north. The remnants of the four field map units, which lost thirty-two men in the retreat, managed to get through to Hinrichs in Deraa, and on September 27 he marched the detachment back to the Omayyad city Damascus. By then the column had swollen to five hundred German soldiers separated from their units (Holzhausen, 1937, p. 174).

The left behind staff of *Vermessungsabteilung 27* meanwhile had moved what it could take along to Aleppo into a half-ruined caravansary in the middle of the bazaar and even managed to set up a makeshift office with printing machines. But soon after captain Hinrichs had caught up with that staff, the Survey Section 27 was relocated in October yet again, to Bosanti on the

northern slopes of the Taurus Mountain. There the remnants of army group ‘Yildirim’ tried to gather as well. After the Ottoman Empire signed the armistice on October 30, the surviving men of *Vermessungsabteilung 27* were brought to Constantinople early in November along with other German units. After an internment for three months, the Survey Section 27 on 29 January 1919 boarded a German steamer (Holzhausen, 1937, p. 175) and left for an uncertain fate in revolutionary Germany.

It has to be assumed that most of the production of *Vermessungsabteilung 27* during its brief but energetic life of less than one year — field notes, files, cartographic drafts, undistributed stocks of printed sheets — was lost during the fleeing retreat from Nazareth to Bosanti in September and October 1918 or during the repatriation (Alt, 1920, p. 103). Therefore, with only a few exceptions the map sheets must speak for themselves. Although classified and often carrying the warning in the top margin *Darf nicht in Feindeshand gelangen* (= Must not fall into enemy hands) in bold letters, at least one copy of most of the German military sheets and editions on the Sinai, Mesopotamia, and Palestine survived. But there are still significant gaps as is evidenced by the discontinuities in the internal production numbers (tabs. 4 & 5). Work numbers for sheets produced by *Vermessungsabteilung 27* that are not yet located include:

Nos. 1-19	72-74	116-117	155-156
24-26	76-78	119	170-171
28-43	80-81	121-124	173
45	83-85	130	175
48-50	88-96	132	177
53-56	98-99	134	179
58-59	103-104	137-138	No. 181 and higher
61-64	106	141-142	
66	109-110	145-148	
68	112-114	150-151	

While it is likely that sheets resp. edtions of the map series *Karte des türkisch-ägyptischen Grenzgebietes*, *Karte von Mesopotamien (und Syrien)*, and *Karte von Nordbabylonien* carried some of the ‘missing’ production numbers, but were not printed on these sheets, the readers of this paper are asked to notify the author about sheets that are not (yet) included in the tables hereafter.

Where are the files and cartographic material that had survived the collapse of the Palestine front, the fleeing retreat, and the capitulation of September-October 1918? All files, correspondence, map drafts, and prints created or received in Berlin throughout the war and what little somehow had survived the downfall of *Deutsches Asien-Korps* and *Vermessungsabteilung 27* and made it back to Berlin, was transferred to the National Archives in Potsdam. Along with the files of the *Preußische Landesaufnahme*, the parental organization of *Kartographische Abteilung der Königlich Preußischen Landesaufnahme*, which unfortunately had not been designated for evacuation during the Second World War, these suffered a complete loss on 14 April 1945, when the archives burned out following an Allied air raid. Due to the lack of

official sources and veteran recollections the cartographic legacy of a remote outpost of German military mapping can only be a sketch with many currently unanswerable voids. Yet, it is another testimony that even good maps are not sufficient in themselves to win a campaign.

TABLES

Table 1

Operation Map – 1:800,000
General Staff's strategic planning map series for Europe & Near East,
fourteen sheets on Asian parts of the Ottoman Empire

Kartographische Abteilung der Königlich Preußischen Landesaufnahme [= KA-KPL] or
Kartographische Abteilung des stellvertretenden Generalstabs der Armee [= KA-sGA]:
Operationskarte (series title often omitted on the sheets) – scale: 1:800,000 – lithography – classified.
Production dates: series since 1914, Ottoman Asia 1915-18.

Konia, 1915 [KA-sGA] + [January 1918]
Konstantinopel, 1915 (printed 1916) [KA-sGA]
Suez, 1915 [KA-sGA]

Angora, [September 1916] [KA-KPL]
Beirut, 1916 [KA-sGA]
Trapezunt, [September 1916] [KA-sGA]

Baghdad, 1917 [KA-KPL] – see **fig. 3**
Bosra, [December 1917] [KA-KPL]
Erzerum, [September] 1917 [KA-KPL]
Mosul, 1917 / [January 1918] [KA-KPL] (editions 1917 and 1918 possibly identical)

Aleppo, [January 1918] [KA-KPL]
Aidin, [January 1918] [KA-KPL]
Kerbela, [January 1918] [KA-KPL]
Urmija, [January] 1918 [KA-KPL] + de-classified edition in [late] 1918

Table 2

Map of Turkish-Egyptian Border Region – 1:250,000 in four sheets.
Map of the Sinai Peninsula and southern Palestine between the Hejaz railway (east) and the Suez Canal (west)

Kartographische Abteilung des stellvertretenden Generalstabs der preußischen Armee:
Karte des türkisch-ägyptischen Grenzgebietes (zwischen Hedschasbahn und Sues) […] – scale: 1:250,000 – lithography – classified – 'preliminary edition'.
Production dates: 1915-17.

Blatt 1 (= Port Said) in five editions:
1915, 1st edition 1916, 1st edition 1916 – Turkish in Arabic letters, 2nd edition 1916, edition 1917 – see **fig. 4**

Blatt 2 (= Rafah) in four editions:
1915 – bilingual German and Turkish in Arabic letters, 1916, 2nd edition 1916, 2nd edition 1916 – Turkish in Arabic letters

Blatt 3 (= Suez) in three editions:
1915, 1st & 2nd editions 1916, 1916 – Turkish in Arabic letters

Blatt 4 (= Aqaba) in three editions:
1915 – bilingual German and Turkish in Arabic letters, 1st & 2nd editions 1916, 1916 – Turkish in Arabic letters

Table 3

Map of Mesopotamia (and Syria) – 1:400,000 (plus two appendix series at 1:200,00).
Medium-scale tactical map series of regions between southeastern Anatolia, et, Persia, and northern Arabia, twenty sheets in up to four editions plus three composite sheets

Kartographische Abteilung der Königlich Preußischen Landesaufnahme [= KA-KPL] or
Kartographische Abteilung des stellvertretenden Generalstabs der Armee [= KA-sGA]:
Karte von Mesopotamien (und Syrien) – scale: 1:400,000 – lithography – classified – 'preliminary edition'.
Production dates: 1916-18.

B. Adana, May 1918 [KA-KPL]
C. Tarabulus, May 1918 [KA-KPL]
D. Damaskus, February 1918 [re-?]printed September 1918 [KA-KPL]
E. Jerusalem, March 1918 [KA-KPL]
1b. Aleppo, May 1918 [KA-KPL]
1c. Hama, May 1918 [KA-KPL]
1d. Bosra, May 1918 [KA-KPL]
1e. Kaf, "November 1919" [*sic*! – likely print error] [KA-KPL]
2c. Der es-Sor, 1916 [KA-sGA] + December 1917 [KA-KPL]
3b. Mardin, May 1918 [KA-KPL]
3c. Ana, 1916 [KA-sGA] + February 1918 [KA-KPL] + February 1918 – bilingual German and Arabic [KA-KPL]
3d. Wadi Hauran, October 1917 [KA-KPL]
4a. Wan, October 1917 + January 1918 [KA-KPL]
4b. Mosul, July 1917 + August 1917 [KA-KPL] – see **figs. 5 & 6**
4c. Samarra, 1916 + 1916 update of SE quadrant only + May 1917 + October 1917 [KA-sGA]
4d. Kerbela, 1916 [KA-sGA] + February 1918 [KA-KPL]
5b. Urmija, November 1917 + July 1918 [KA-KPL]
5c. Suleimanije, 1916 + August 1917 but printed in 1918 [KA-sGA]
5d. Baghdad, 1917 + April 1917 + September 1917 + December 1917 [all KA-sGA]
6c. Kirmanschah, February 1917 [KA-sGA]

Composite extracts from sheets 1b, 1c, 2c, 3c, 4c, 4d *Karte des Euphrat von Dscherablus bis Felludscha*, August 1917 [KA-KPL]
Composite print from sheets 4d and 5d with parts of sheets 4c and 5c *Samarra – Baghdad – Kerbela*, August 1917 [KA-KPL]
Composite print *Baghdad – Samarra – Kerkuk*, April 1918 [labelled 'in the field']

Kartographische Abteilung der Königlich Preußischen Landesaufnahme:
Karte von Nordbabylonien – scale: 1:200,000 – lithography – classified – 'preliminary edition'.
Production date: 1918.

Blatt 6. Mendeli, January 1918 – see **fig. 7**
Blatt 9. Kut el-Amara, January 1918

Sheets adapted from the Ottoman series 1:200,000 on Anatolia

Adana, July 1918 [KA-KPL]
Biredschik, August 1918 [KA-KPL]
Ma'asch, September 1918 [KA-KPL]
Membidsch, 1918 [KA-KPL]

Table 4

Map of Palestine, 1:100,000, 1:50,000, and 1:25,000 (plus 1:168,960).
Large-scale tactical map series of northern and central Palestine and Trans-Jordan, at scale 1:50,000 as base series in forty-one sheets plus very large-scale combat area reconnaissance series 1:25,000 in seven sheets and smaller-scale orientation derivatives (composite sheets) at 1:100,000 (and, for some areas, base for 1:250,000)

Vermessungsabteilung 27:
Karte von Palästina (series title often omitted on the sheets) – lithography – classified.
Production dates: 1917-18.

a) Scale: 1:168,960 (transitional from copying Palestine Exploration Fund map sheets to independent map series)

No. 20a – *Karte von Nordpalästina*, 20.11.1917
No. 22 – *Karte von Mittelpalästina*, 30.11.1917 – see **fig. 8**
No. 115 – *Ostjordanland Südl. Teil*, 11.04.1918 (No. 115a, 10.05.1918, is a unique manuscript annotated version)

b) Scale: 1:100,000 (reduced combined print from sheets of the 1:50,000 map series)

No. 143a – *Zusammendruck Tul Kerm – Jericho*, 27.04.1918 + 16.07.1918 [= reduced combined print of 1:50,000 sheets 50-52 & 57-61 & 67-70]
No. 172 – *Zusammendruck es Salt – Amman*, 27.08.1918 [= reduced combined print of 1:50,000 sheets 61-63 & 70-72]

c) Scale: 1:50,000 (*No*. refers to production # within *Vermessungsabteilung 27*, *Blatt* refers to sheet # in series 1:50,000)

No. 44a – *Blatt 69 Jerusalem*, 28.03.1918
No. 46b – *Blatt 70 Jericho*, 16.03.1918 + No. 140a – *Blatt 70*, 2nd improved edition, 23.05.1918 + No. 140b, 3rd improved edition, 01.08.1918
No. 47a – *Blatt 68 Ramleh*, 05.04.1918 + No. 139 – *Blatt 68*, 3rd improved edition, 17.05.1918
No. 51a – *Blatt 60 Lubban*, 18.04.1918 + No. 51b, improved edition, 18.05.1918
No. 52b – *Blatt 50 Tul Kerm*, 09.04.1918 + No. 52c, 4th improved edition, 30.04.1918
No. 60a – *Blatt 80 Ain el Ruwer*, 09.02.1918 + No. 60a, 03.07.1918 + No. 60b, 3rd improved edition, 09.07.1918
No. 63c – *Blatt 61 ed Damje*, 01.05.1918 + No. 149 – *Blatt 61*, 2nd improved edition, 21.06.1918 + No. 149a, 3rd improved edition + No. 149a, 4th improved edition, 31.07.1918
No. 65c – *Blatt 59 Kalkilje*, revised edition, 21.04.1918 + No. 65c, 17.06.1918 + No. 65d, 7th improved edition, 13.07.1918 – see **fig. 12**
No. 67 – *Blatt 52 Tubas*, 19.01.1918 + No. 67b, 19.06.1918
No. 67a – *Blatt 71 Hesban*, 10.04.1918 + No. 76c – *Blatt 71*, 4th improved edition, 10.07.1918 + No. 76d, 5th improved edition, 02.08.1918
No. 69a – *Blatt 51 Nablus*, 25.03.1918 + No. 69, June 1918 + No. 69b, 3rd improved edition, 25.07.1918 + No. 69d, 4th improved edition, 27.08.1918
No. 71a – *Blatt 67 Nahr Rubin*, 19.04.1918 + No. 71, June 1918 + No. 71b, 2nd improved edition, 10.07.1918
No. 76 – see under No. 67a
No. 79 – *Blatt 43 Dschenin*, 15.02.1918
No. 82c – *Blatt 42 Kaisarje*, 05.05.1918
No. 86a – *Blatt 62 es Salt*, 08.04.1918 + No. 86c, 4th improved edition, 26.06.1918 + No. 86d, 5th improved edition, 05.08.1918
No. 97 – *Blatt 53 Adschlun*, 13.03.1918
No. 101 – *Blatt 72 Amman*, 19.03.1918 + No. 101b, 2nd improved edition, 24.06.1918 + No. 101c, 3rd improved edition, 27.08.1918
No. 102b – *Blatt 63 Kalaat ez Zerka*, 2nd improved edition, 10.07.1918
No. 105 – *Blatt 54 Dscherasch*, 23.03.1918
No. 107 – *Blatt 45 et Tajibe*, 23.09.1918
No. 111a – *Blatt 34 Haifa*, 1st improved edition, 11.07.1918
No. 118a – *Blatt 35 Nazareth*, 23.05.1918
No. 120 – *Blatt 46 Deraa*, 24.09.1918
No. 125 – *Blatt 55 el Mefrak*, 01.05.1918

No. 126 – *Blatt 58 Jaffa*, 01.05.1918 + No. 126a, 2nd improved edition, 06.07.1918
No. 127 – *Blatt 79 Bethlehem*, 30.04.1918
No. 128 – *Blatt 78 Bet Dschibrin*, 01.05.1918
No. 129 – *Blatt 47 Dschize*, 03.05.1918
No. 131 – *Blatt 44 Besan*, 07.05.1918 + No. 131, improved edition, 01.09.1918
No. 133 – *Blatt 48 Bosra*, 11.05.1918
No. 135 – *Blatt 39 Chirbet el Razale*, 12.05.1918
No. 136 – *Blatt 64 el Hallabat*, ???.1918
No. 139 – see under No. 47
No. 140 – see under No. 46
No. 144 – *Blatt 69 Jerusalem*, 2nd improved edition, 12.06.1918
No. 149 – see under No. 63
No. 152 – *Blatt 82 Kalaat Ziza*, 22.06.1918
No. 153 – *Blatt 77 Dschulis*, 14.06.1918
No. 154 – *Blatt 76 Wadi el Hesi*, 25.06.1918
No. 166 – *Blatt 36 Tiberias*, 25.07.1918
No. 167 – *Blatt 38 el Mzerib*, ???.1918
No. 168 – *Blatt 90 Ain Dschidi*, ???.1918
No. ? [not printed on sheet] – *Blatt 37 Mkes*, 02.09.1918
No. ? [not printed on sheet] – *Blatt 81 Madeba*, no date [1918]

d) Scale: 1:25,000

No. 169 – *Blatt Wilhelma. 59. S.W.*, 12.08.1918
No. 174a – *Blatt Rafat. 59. S.O.*, 1st improved edition, 15.09.1918
No. 176a – *Blatt Abwen. 60. S.W.*, 1st improved edition, 15.09.1918
No. 178a – *Blatt Sabje. 59. N.W.*, 1st improved edition, 15.09.1918
No. 180 – *Blatt Muannis. 58. N.*, 08.09.1918
No. ? [not printed on sheet] – *Blatt Azzun. 59. N.O.*, 18.08.1918 – see **fig. 13**
No. ? [not printed on sheet] – *Blatt Jafr. Haris. 60. N.W.*, ???.1918

Table 5

Untitled map series at scale 1:250,000 of northern Palestine, northern Trans-Jordan and southern Syria, some sheets do not fit into a series grid, closely related to the series ‘Map of Palestine’ (see tab. 4).

Vermessungsabteilung 27:
Untitled – scale: 1:250,000 – photo-lithography – classified.
Production dates: 1917-18

No. 23 – *Samaria*, 01.12.1917 + No. 108, 15.04.1918 + No. 108a, 29.05.1918 + No. 108b, 17.07.1918
No. 27a – *Palästina-Karte Nördl. Teil*, 15.12.1917
No. 57 – *Hauran*, 12.01.1918 + 31.01.1918 + No. 57a, 03.04.1918 + No. 57b, improved 2nd edition, 16.07.1918 – see **figs. 10 & 11**
No. 70 – *el Maschatta*, 01.02.1918 + 04.02.1918 + 23.02.1918
No. 75 – *ed Dschafar*, 10.02.1918 + 27.02.1918
No. 87 – *Damaskus*, 27.02.1918 + No. 87a, 19.07.1918
No. 100 – *Hermon*, 20.03.1918 + 03.07.1918
No. 108 – see under No. 23
No. 130 – *Galiläa*, 06.05.1918

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Municipal Imperialism and Cartography: The Maps from the *Société de Géographie de Lyon* at the End of the 19th Century

by

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Keywords. — *Société de Géographie de Lyon*; Mapping; Late 19th Century; Municipal Imperialism.
Summary. — Like many other geographical societies, the *Société de Géographie de Lyon* founded in 1874 had implicit interests with the idea of "promoting commercial and geographical progress". A study of the maps published during the first twenty-five years of the society helps to determine the efforts of the local elite to promote colonial expansion by praising possible 'exploits' overseas. The society's cartographic archives show the extent to which its members attempted to keep themselves well informed about affairs relating to European expansion in different parts of the world in the last quarter of the 19th century, and how geography was used as a means of attracting support to the projects being developed there. The combined forces of the Chamber of Commerce, a powerful missionary organization and the military classes active in foreign territories were often linked to one of the city's main commercial interests: the silk trade.

Mots-clés. — Société de Géographie de Lyon; Cartographie; Fin du XIX[e] siècle; Impérialisme municipal.
Résumé. — *Impérialisme municipal et cartographie: les cartes de la Société de Géographie de Lyon à la fin du XIX[e] siècle.* — Comme beaucoup d'autres sociétés géographiques, la Société de Géographie de Lyon, fondée en 1874, avait des intérêts implicites liés à l'idée de «favoriser le progrès commercial et géographique». L'étude des cartes publiées au cours des vingt-cinq premières années de la société aide à déterminer l'effort de l'élite lyonnaise à promouvoir l'expansion coloniale par l'éloge des «exploits» possibles outremer. Les archives cartographiques de la société montrent à quel point ses membres tentaient de se tenir au courant des affaires touchant à l'expansion européenne dans différentes parties du monde dans le dernier quart du XIX[e] siècle et comment la géographie était utilisée comme moyen d'attirer des adeptes aux projets qui s'y développaient. Les forces combinées de la chambre de commerce, d'une puissante organisation missionnaire et des classes militaires actives sur les territoires étrangers étaient souvent liées à l'un des principaux intérêts commerciaux de la ville: le commerce de la soie.

An Analysis of French Colonial Efforts at Municipal Level

France is known for its political centralism, but not all of its colonial involvement in the late nineteenth century could be summed up in the actions of the central government in Paris. In fact, as Laffey (1974) pointed out, it would be difficult to understand the formation of one of the most important international colonial domains without understanding the role of provincial merchant communities in its creation and development between 1815 and 1914.

A closer analysis of a multitude of activities on a municipal scale highlights the continuities and discontinuities of actions in a particularly eventful moment — the last quarter of the

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19th century. It also offers a more nuanced look at the mosaic of interests and relationships behind what was known as the French 'civilising mission' abroad [1]*. Cities such as Bordeaux, Marseilles and Lyon had the opportunity, especially at the end of the century when a certain amount of municipal autonomy prevailed, to provide support for the overseas expansion of the time. And, as part of the drive to conquer new markets and territories, geographical societies sprang up in the provinces. The first of them was founded in Lyon in 1874, ushering in what Broc (1974) described as the "golden age of these associations" between 1870 and 1890 (Broc, 1974, p. 550). Such an institution could provide local elites with the documentation they needed to better understand and exploit markets abroad.

A number of studies have already been carried out, whether on some of Lyon's agents participating in the colonialist boom at the end of the 19th century (Klein, 2006) or the important development of the city's African missions (Vasquez, 2011). Clout (2009) produced a very interesting work on the *Société de Géographie de Lyon* (SGL) as a whole, from its foundation in 1874 to its last years in 1970. All the previous works propose an interesting examination of how local elites embraced geographical approaches discussing the idea of an existing "municipal imperialism". However, no in-depth analysis has dealt with one of the major ways in which the geographical ideas of the time were displayed: its mapping agenda. Maps published and edited by the *Société de Géographie de Lyon* still count as major landmarks in local geographical production [2], and their analysis should lead to a more critical history of the colonial endeavours in the city, following recent research (Driver, 2013).

Our aim in this paper is to analyse some of the maps produced and sponsored by the *Société de Géographie de Lyon* during the first twenty-five years of its foundation, a moment when most mapping covered land overseas. An analysis on how and what is shown through mapping may help bring to light some of the debates on the values of these images and its "imperial drive". At the same time, we can develop a better understanding of the city's geographical traditions during the late quarter of the 19th century and the role local mapping had in the approach of foreign territories.

Supporting Commercial Interests: Colonial Geography in Lyon

The process of founding the *Société de Géographie de Lyon* began in the wake of the French defeat by Prussia in 1872, bringing together members of the local elite [3]. On March 5th 1874, a general meeting of two hundred and fifty people included silk merchants and other members of the Chamber of Commerce, members of the military and Catholic missionary classes, and leaders of the various levels of public education (from primary studies to university). The local *Union syndicale des marchands de soie* traded in "the most important points in the world" (Christophe, 1875) and joined forces with missionaries from the *Société pour la propagation de la Foi*, whose ambition to cover the whole planet was also clearly stated. They could also count on the participation of members of the regional military staff, whose topographical knowledge was valued.

This initial group of men (women were excluded) formed the basis of a society at a time when the institutionalization of academic geography was still struggling to make headway [4], searching a concrete basis for the broadening of commercial horizons at the end of the nine-

* Numbers in brackets [ ] refer to the notes, pp. 245-247.

teenth century. They adopted the statutes, which were adjusted in 1878 and again in November 1897 of what was to become the *Société de Géographie de Lyon et de la région lyonnaise.* Their aim was to comply with the conventions of a society recognized as being of "public utility" (Chambeyron, 1900) not only in the city but in the region around it, including near industrial centres like Saint-Étienne or Roanne. With the aim of achieving "intellectual decentralisation" in relation to the Parisian *Société de Géographie*, the local interest was to "encourage the study of geography among the middle classes" who would later be hired to serve as representatives in the overseas trading posts. If its ambitions were those of a "more modest framework of a provincial association" [5] (Christophe, 1875, pp. 16-17), the choice of works, conferences and contests reflected the institution's specific interests, monitoring scientific explorations of the world and ways of popularizing new geographical knowledge.

Although academic representation later took on greater importance in the development of the *Société de Géographie de Lyon*, it was above all in the initial period, from the years of its formation in 1874 to 1901, that we can associate it with a certain vision of expanding colonialism. The first three chairmen, Louis Desgrand, Jules Cambefort and Eugène Chambeyron, were all members of the local chamber of commerce, either silk merchants or bankers [6]. Clout (2009), in his detailed study covering the entire lifespan of the *Société de Géographie de Lyon* (1874-1970), identified a number of moments and dynamics in the society's publications. He stated that between 1875 and 1904 most works were focused on actions beyond European borders. It is on this period that we will concentrate our study, when the first series of the *Bulletin de la Société de Géographie de Lyon* was published in twenty volumes, attempting to understand the cartographic production carried out and what it expresses about the aims of the institution.

Applied Geography through Visual Displays: Mapping "Unknown" Land

The *Société de Géographie de Lyon*'s applied and practical aims would clearly involve map publishing from the outset:

> To contribute to the development and popularisation of geographical knowledge through public courses, competitions, conferences, publications of maps and works covering the whole of the geographical society and its applications (Chambeyron, 1900, p. 6).

As part of a 'geographical reform' occurring in the late 19th century and particularly present in some provincial towns in France, the use of a variety of visual elements was meant to attract the public's attention to the development of geography at that time. Without participating directly in the funding of explorations, the *Société de Géographie de Lyon* disseminated news about the state of European involvement beyond known borders through texts and images, inviting "men in the field" to come and show their exploits in conferences or by sending letters and maps from their outposts. These activities were published in a quarterly journal, the *Bulletin de la Société de Géographie de Lyon*, appealing to local readers to join in actions or projects for the creation of new roads and means of communication often associated with new settlements abroad. In the words of its first president:

> Everything has been said about the importance of the role that geographical societies are called upon to play in the modern world. This role is no longer as exclusively scientific as it was in the

> past. Nowadays it is more of an economic nature. You know the cause of this change. It stems from the application of steam and electricity to international relations (Desgrand, 1889, p. 7).

An analysis of its cartographic production provides a better understanding of the mechanisms at work in this "geographical endeavour" (Schneider, 1990). Maps produced by the *Société de Géographie de Lyon* were an important part of ensuing a look beyond known borders: from 1875 to 1903, sixty-nine out of the seventy-three maps published in the *Bulletin de la Société de Géographie de Lyon* covered foreign territories. Most volumes had original drafts and they often included a detailed description of which commercial maps were available. Changes in the leadership of the institution would often have the effect of relaunching cartographic publication (fig. 1). The value given to maps, either new or old, could equally be seen through the efforts to collect a substantial cartographic library and in the prizes awarded by the institution through its many 'mapping contests'. It is even conceivable that the cartographic production contributed to the institution being awarded one of the two gold medals at the Universal Exhibition in Paris in 1900 (the other medal being awarded to the University of Lyon):

> In addition to several unpublished maps, our society exhibited a survey of a map of Africa dating from 1701, discovered on the globe now kept in the Lyon municipal library. The publication of this map caused a sensation because it indicated the great lakes of central Africa, which modern explorers have rediscovered. An interesting notice on the situation of our Society and on the works published by it in its fifteen volumes since its foundation in 1874 was attached to this mailing (Galle, 1901, pp. 598-599).

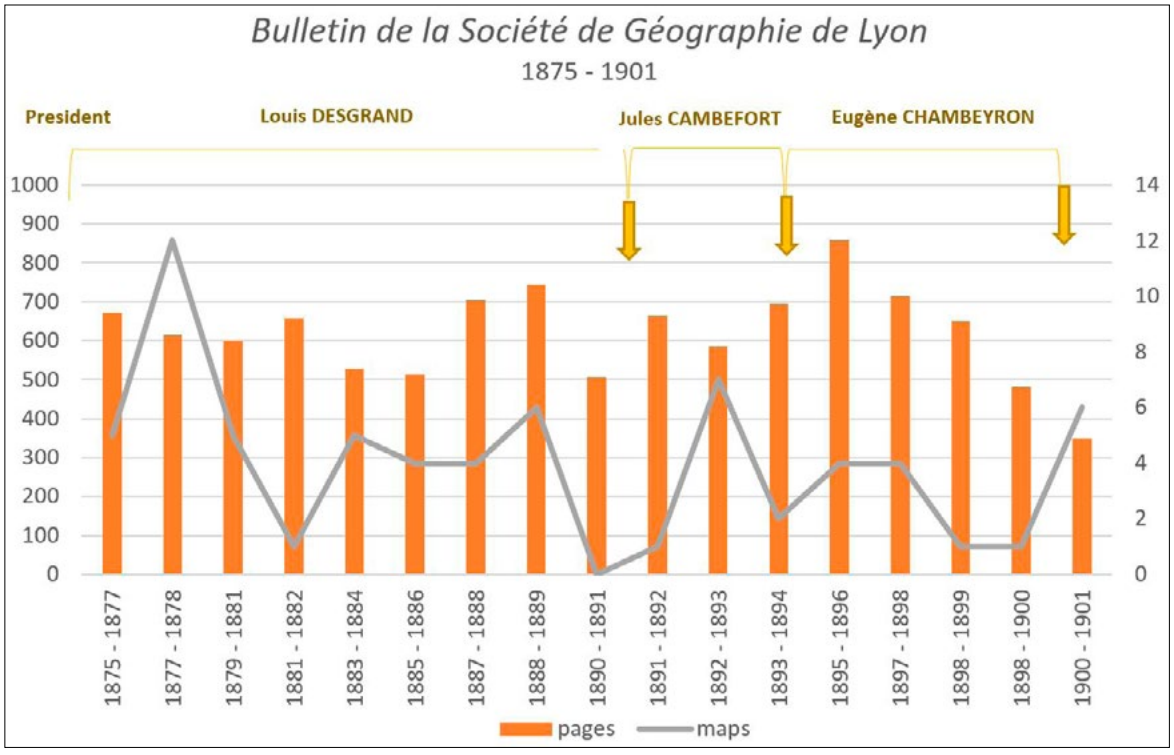

Fig. 1. — Analysis of the publications of the *Bulletin de la Société de Géographie de Lyon* with the number of pages and maps included; maps are particularly important in the first years, and their publication improves at the arrival of a new president (database created by the author in 2023).

Lyon's Interests through Mapping Contests

In its early years, some of the *Société de Géographie de Lyon*'s mapping projects were published outside the local *Bulletin*, as part of an editorial thrust. This was the case for the maps that won prizes in the mapping contests organized by the society. Between 1874 and 1880, the largest prizes were for the presentation of a map accompanied by a dissertation to help create a 'sericultural atlas', with maps depicting silk activities in the world, especially in Italy, Turkey, Greece and France, before engaging in exploratory mapping of the other themes and places. The authors of these maps were rewarded by having their works printed in large format, so that they could then take part in geography congresses and international exhibitions. These coloured wall maps would also be displayed on local institutions, as a reminder of Lyon's primary place in the European silk markets.

The first contest in 1875 proposed a prize for those who could draw up a map of "the places in the world producing silk cocoons, the domestic markets of each region as well as the import and export markets" (Christophe & Desgrand, 1875). The second edition of the contest in 1877 would aim the best sericulture map of the Italian region (a major competitor in silk production) and only in 1900 a map of sericulture in France was submitted. Most of the authors of the prize-winning maps were very close members of the local action committee: Léon Clugnet, author of the map of the sericulture regions in the world, was a founder member and librarian at the Chamber of Commerce; Marius Morand, author of the map of sericulture production in the Italic region (fig. 2), was a librarian at the Chamber of Commerce and assistant secretary of the Lyon's *Union syndicale des marchands de soie* (as well as being a member of the society, of course); Valérien Groffier taught geography at the *École supérieure de Commerce* in Lyon while being secretary of the Catholic Missions — this explains his two publications: one on sericulture in France and the other as a planisphere of religious beliefs and Christian missions.

The rules set out for mapping contests were given in the local *bulletins*, insisting on assembling 'major summaries' of the available data. Made mostly by librarians who would follow mapping techniques in use at the time, most prized maps were in fact full of details coming from different sources and could be considered as cabinet or office mapping. As can be seen in figure 2, such wall maps would carry many inserts and statistic tables, along with well-developed texts made to explain the main figures presented, creating a whole made of different parts. They differ from the maps published in the issues of the local journal, where only occasionally more accomplished examples of coloured maps would be included. In the *bulletins*, most maps would come in annexes, far from the texts as black and white sketches, corresponding to the category of 'field maps'. They were proposed by authors sometimes working in distant places, less trained in mapping techniques, following the gradual and sometimes contradictory construction of some of the colonial projects they portrayed.

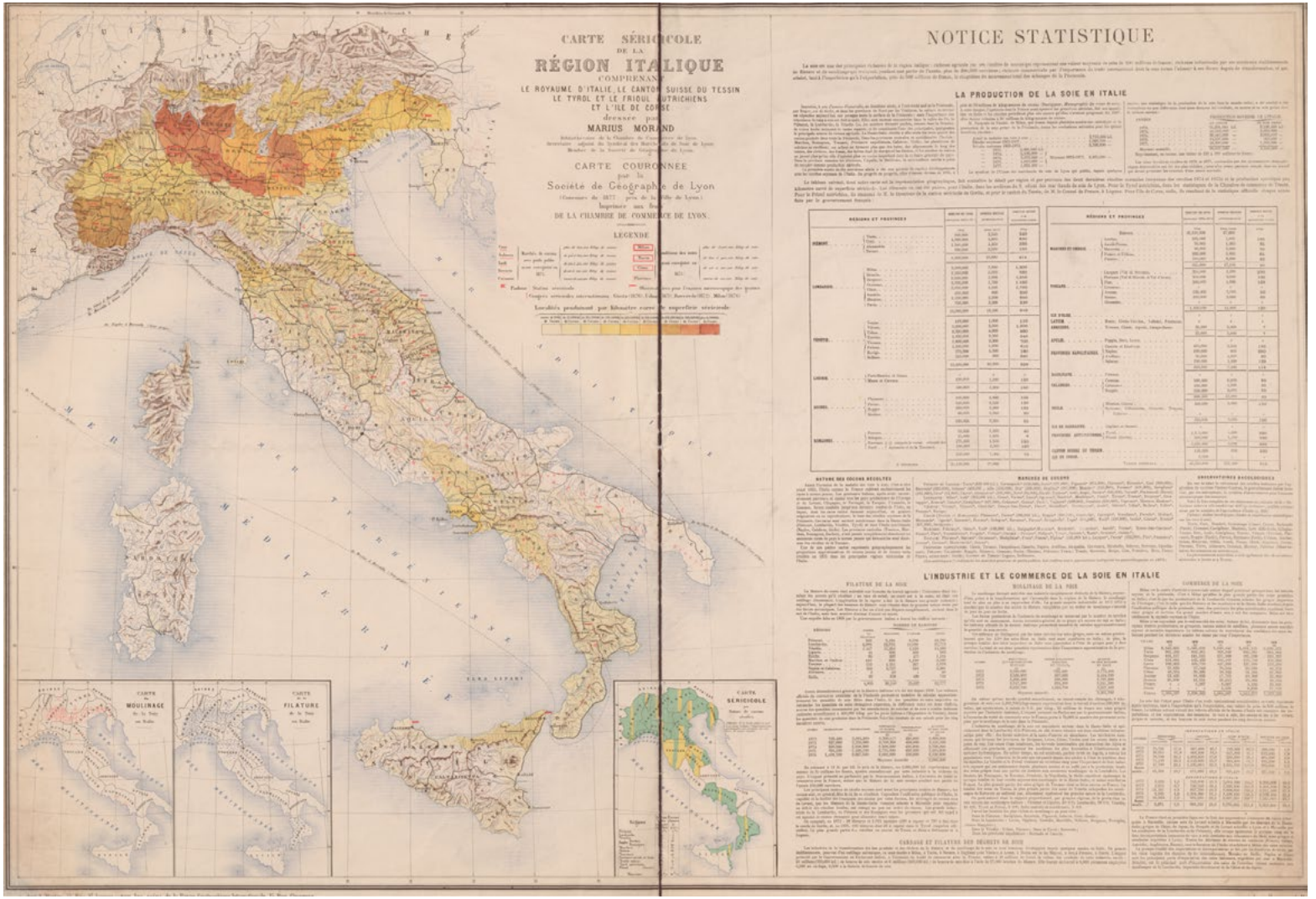

Fig. 2. — One of the most elaborate examples of mapping produced by the *Société de Géographie de Lyon*: "Carte sériciole de la Région Italique – carte couronnée par la Société de Géographie de Lyon – concours de 1877, prix de la ville de Lyon – imprimée aux frais de la Chambre de Commerce de Lyon" (Lyon University archives).

Records of New Ambitions: Outlines of Territorial Projects

The maps added to the first editions of the *bulletins* follow some of the lectures given as part of the society's activities, portraying travelogues to the local public [7]. Merchants, military doctors and missionaries were travelling abroad and bringing new knowledge of what could be achieved in remote areas. Most maps showed new itineraries penetrating blank spaces among toponyms that were supposed to be guide points in new French settlements or protectorates. In this sense, they are the expression of what Surun (2004) identified as the dialectic of fullness and emptiness, in which they attempt to partially fill local ignorance of distant territories, while erasing a large part of the already well-established presence of resident communities. The study of two particular regions can give us a glimpse of the conditions in which mapping occurred and how they were conceived: the new settlements in the south of Indochina (French *Cochinchine*) and maps of the Congo region in Africa. Mapping associated to these regions was carried out either at the beginning or at the end of the period under study, making it possible to verify changes in the way they were created. They focus on two different centres of interest abroad: if the first region is of particular interest regarding silk markets in Asia, the second covers wider colonial endeavours in Africa [8].

The *Cochinchine Française – Carte schématique pour servir au voyage de Mr. Le Docteur A. Morice de 1872-1874 – Par C. Morice* (fig. 3) is an example of how the author left away most of the journey (forty-five days to get to the Mekong Delta) to concentrate solely on "this short study, to provide some precise information on our colony that has not been given before" (Morice, 1876, p. 196), insisting on fresh knowledge. Dr. Morice, a naval doctor assigned to the hospital in 'Saigon' (today Ho Chi Minh), was regularly sent on medical inspection tours to the rest of *Cochinchine,* a region in southern Vietnam known locally as *Nam Kỳ*. His map and conference give little space to local culture — most local place names are transcripted in Latin alphabet with no effort to respect local annamite scripts and to introduce diacritical accents [9]: the main villages or towns (for example, *Cholon, Tanan, Chaudoc, Mytho, Vinhlong, Hatien*) are described in relation to their market opportunities and economic activities within the borders of colonial *Cochinchine*. Although some of the main rivers appear (the Mekong stops brutally somewhere in southern Cambodia), large blank spaces seem to ignore the "immense plains as far as the eye can see, intersected by streams, marshes, peanut fields and rice paddies" described in his text (Morice, 1876, p. 199). Some hills and mountains deserve to be pictured thanks to the fact that the author particularly appreciated them as places of refreshment, closer to European standards of well-being, but they appear as simple points, not as structures to the global landscape. The text from the itinerary portrayed on the 'schematic map' nevertheless produces tales of mostly eventful journeys through those places where the doctor could play his role as a naturalist and give wing to his main interests: collecting new specimens for French zoological collections [10]. Although the scale and even a grid of coordinates are given, there is no information on the major sources used to produce the map [11], but the accompanying text refers to possible French relations established locally, inviting the reader to join them.

In fact, thanks to the various networks that were being set up in Asia and Africa, maps soon began to indicate, albeit in very schematic form, more commercial opportunities offered by these expanded horizons for merchants with the intention of founding new trading posts. The *Carte des productions du Royaume du Cambodge – Srok Nokor Khmer* (*d'après les renseignements de Mr. Aymonier, administrateur de 1ère classe, professeur de langue cambodgienne au*

Collège des Administrateurs à Saigon – par Dr. Gilbert Tirant, administrateur stagiaire (Juin 1875) (fig. 4) was published a little later than the previous one by a trainee administrator for indigenous affairs in Thù-dâù-môt (north of 'Saigon'). His map is much more detailed and takes the time to correct some of the assumptions made by Dr. Morice in figure 3, despite the fact that it covers a much larger area on a smaller scale. Dr. Tirant had another approach to what he was mapping, after spending a year studying the Chinese, Annamite and Cambodian languages. The author noted all the possible ways to write place names so as to respect local knowledge in the *Srok Nokor Khmer (*Khmer Country*)*, criticizing works with "names written in all sorts of bizarre or vicious ways because of the difficulty Europeans have in grasping the sounds sung in this country" (Tirant, 1876, p. 436).

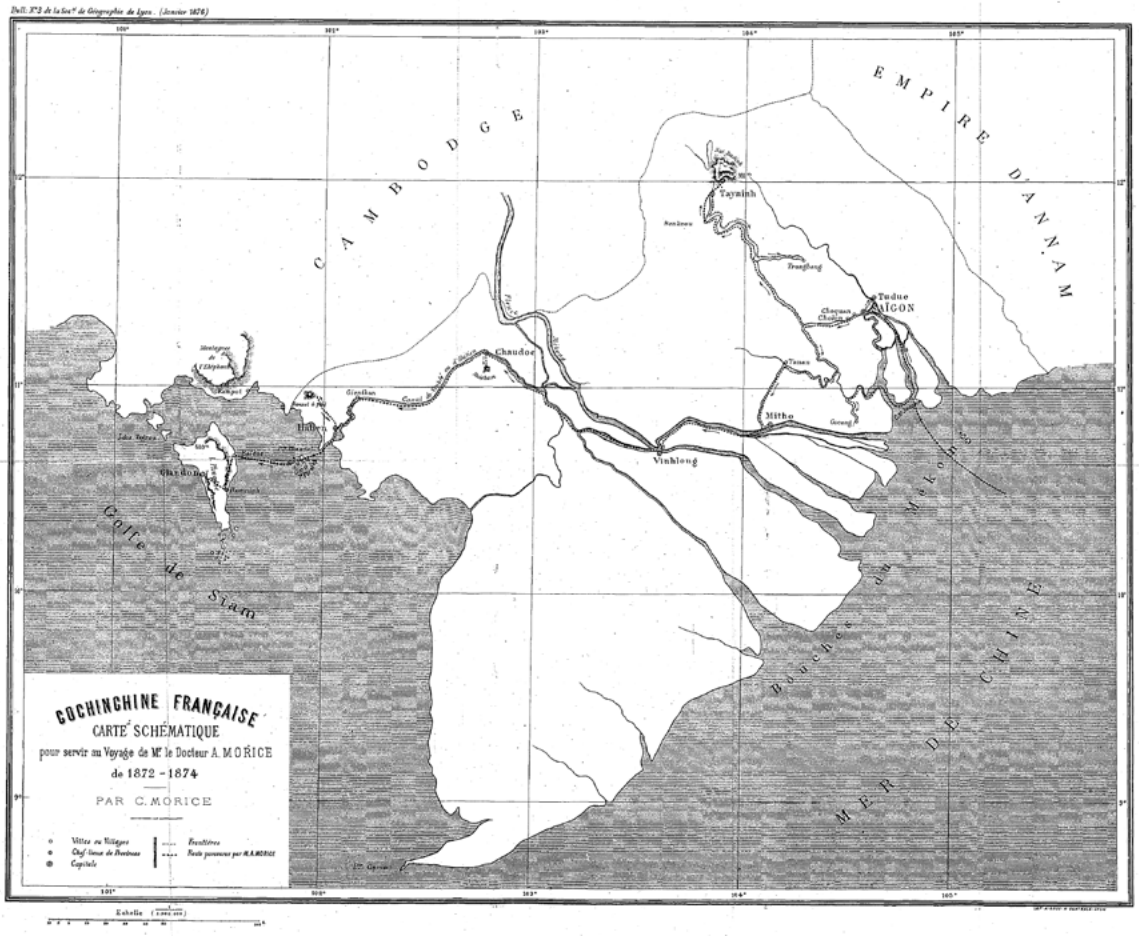

Fig. 3. — An example of map used to accompany travel and exploration accounts: "Cochinchine Française – Carte schématique pour servir au voyage de Mr. Le Docteur A. Morice de 1872-1874 – Par C. Morice", in *Bulletin de la Société de Géographie de Lyon*, 1(1-1876), p. 289.

He tried to conform European knowledge (the projection is that of Mercator, the hydrography is according to the work of the French Navy) and interests revealing the main products, population and trade centres, missions, sericulture stations and telegraph lines on this sketch created especially for the *Société de Géographie de Lyon.* This original map on tracing paper was to be read on a sheet of white cardboard as the author criticized previous mapping accounts:

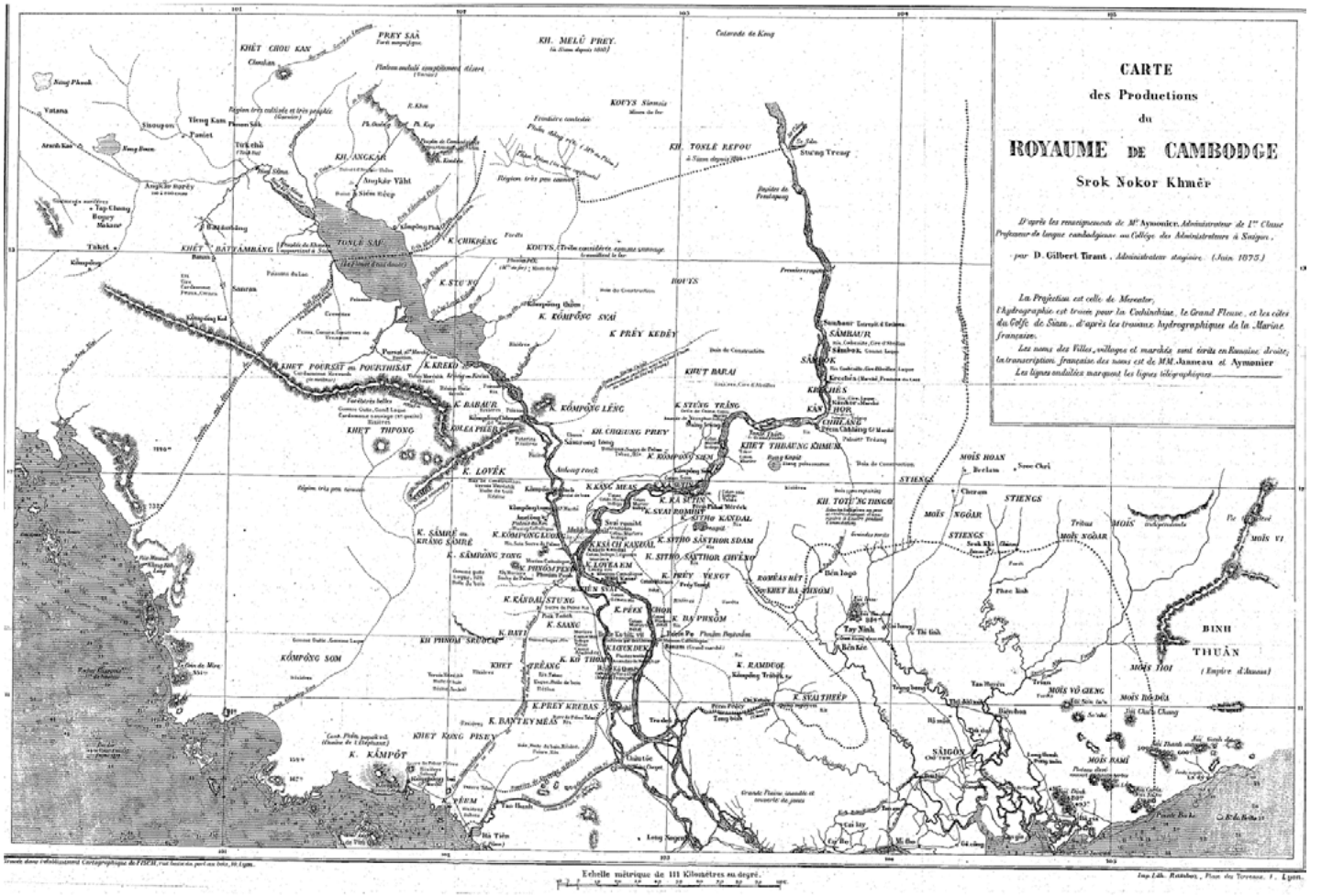

Fig. 4. — Another approach of French Indochina: “Carte des productions du Royaume du Cambodge – Srok Nokor Khmer (d’après les renseignements de Mr. Aymonier, administrateur de 1ère classe, professeur de langue cambodgienne au Collège des Administrateurs à Saigon – par Dr. Gilbert Tirant, administrateur stagiaire (Juin 1875) – La projection est celle de Mercator, l’hydrographie est tracée pour la Cochinchine, le Grand Fleuve et les côtes de Siam, d’après les travaux de la Marine française. Les noms des villes, villages, marchés sont écrits en Romaine droite, la transcription française des noms est de MM. Janneau et Aymonier. Les lignes ondulées marquent les télégraphes”, in *Bulletin de la Société de Géographie de Lyon*, 1(3-1876), p. 480.

> Most cartographic charts in the naval depot are useless for anything to do with the geographical location of names and places, and the eminent hydrographic engineers who drew them up could only have been mistaken in their ignorance of the Cambodian language and sounds (Tirant, 1876, p. 434).

Dr. Tirant took the time to notice in intermediate spaces "une grande plaine inondée et couverte de joncs*"* describing in detail not only the significance of local names, but also the dynamics of the populations living there. His map frames the most important rivers with some mountain ranges, indicating the crossing points to be surveyed, as for Kompong Chhnang, on the Tonle Sap River. The result is an image of the means of penetration from this river (the Mekong still stops abruptly, but much further north than on the previous map) towards adjacent areas, broadening the possible landmarks in a wider zone. In his text, Dr. Tirant indicated that "no Cambodian mandarin, and His Majesty Noraudôm (Norodom I) himself" would be able to trace the frontiers between provinces [12]. Still, he aimed to be much more complete, rectifying toponymic errors and previous delimitations, paying special attention to the names of towns, villages and markets written in 'right' Roman script, according to the French transcription of the names by Messrs Janneau and Aymonier, teachers in colonial studies in Saigon. The author [13] questioned even the name 'Saigon' itself, a French invention created as the 'occupation' began (Tirant, 1876, p. 436). His map shows how French colonial presence developed from the south in *Cochinchine* to include the Kingdom of Cambodia as a protectorate, moving on to Tonkin in the north before a final treaty would favour, in 1885, French authority over China in the eastern part of Indochina (de Rugy, 2018a,b).

Throughout the publications we can only detect stronger local roots in maps produced by Catholic and Protestant missionaries, considered in Lyon to be the first to explore non-European lands, "before the soldiers, merchants and other explorers". Especially in Africa [14], members of the church produced numerous maps that paved the way for a vision of what would be accessible beyond France's borders (Vasquez, 2011). Their settlements could be footholds from which to exploit new markets, supply new raw materials and build new communication routes, before organizations were set up to structure the colonization process at the end of the 19th century [15]. In Africa, as the years went by, the *Bulletin* reflected the shifts of French interests from North Africa [16] to the 'slave coast' (considered to be the region from Ghana to Benin), before insisting on praising the account of the conquests of the Brazza mission between 1883 and 1885 in the Congo Basin. Most of the pages in the *Geographical Chronicles* during the 1880s and 1890s cover the successive missions to West and Central Africa, where imperialist rivalries would increasingly welcome lecturers capable of showing on the maps the various interests at stake. The discussion of various routes and liaisons between North and West Africa prepared the way for the establishment of colonies and protectorates later [17].

The *Carte de la Convention Franco-Anglaise du 21 mars 1899 et du Transsaharien* (fig. 5) is an example of how the journal would try to summarize the state of affairs where some of the colonial disputes were concerned and still propose ways (routes) to make local management more effective. It follows a multitude of geographical chronicles, many of them written either by correspondence with major actors in the field or by secondary members of the major exploration missions in Africa at the end of the century. Therefore, while Émile Gentil himself sent a letter to describe his mission between 1895 and 1897 to find the most practicable route between Gabon and Chad, it was Charles Michel, a member of the Bonchamps Mission, who gave a lecture on 29 December 1898 on the exploration of the Upper Sobat, the most northerly of the tributaries of the White Nile, with the subtitle "Towards Fashoda" [18].

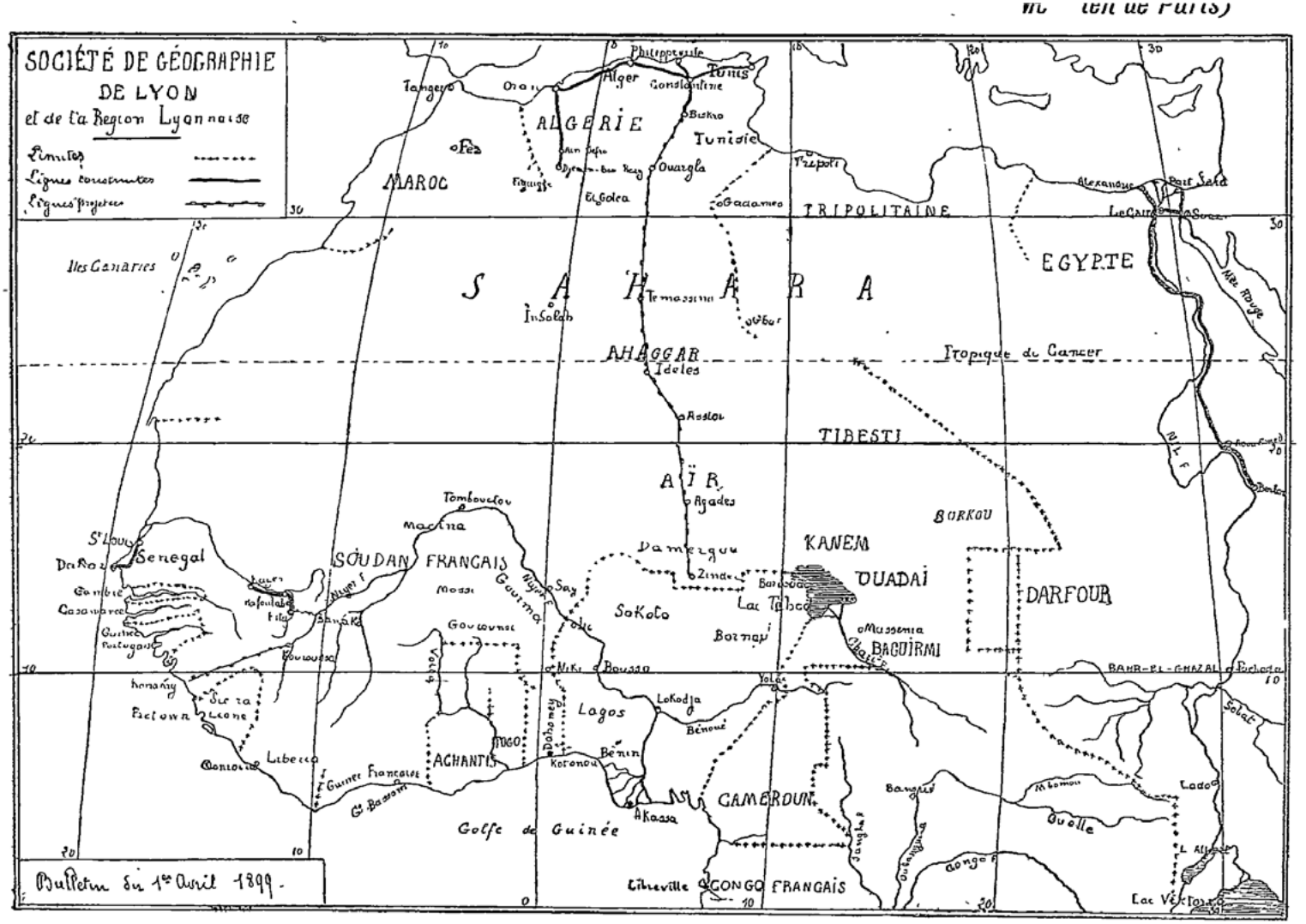

Fig. 5. — “Carte de la Convention Franco-Anglaise du 21 mars 1899 et du Transsaharien”, in *Bulletin de la Société de Géographie de Lyon*, XV(1898), p. 529.

Most maps depicting Africa were similar to the handwritten sketches seen above in Asia: simple outlines of the moving strategies that were being built, following the tradition of initial exploratory missions. But, if necessary, more elaborate maps would be borrowed from other publications, such as the *Carte du Congo Français au nord du coude de l'Ubangi – dressée par A.-J. Wauters* (fig. 6) published in the 1895 edition of the *Bulletin*. This map was first published in the Belgian newspaper *Le Mouvement Géographique* in 1886 for "Belgian and French audiences" before being reprinted in the 13th issue of the *Bulletin* in 1895. In Lyon, only a few extracts from the text by Alphonse-Jules Wauters were published and they were followed by a lengthy account by the squadron leader Decazes (former senior commander in upper Ubangi) of a speech made to the *Comité de l'Afrique française* on the movements of French forces in the region in 1894 [19]. The French military officer could nuance the authorities and sources explicitly cited in Wauter's map which insisted on the precision of coordinates and multiple scientific measures, conveying to show the accomplished nature of Belgian information on the region. In this particular case, the purpose of publishing a more refined map to local audiences was to keep in touch with the commitments of other colonial powers in territories considered to be the most strategic. This map of French Congo also portrays possible, almost 'natural', extensions to the colonial installation by the overflow of the lines beyond the main frame.

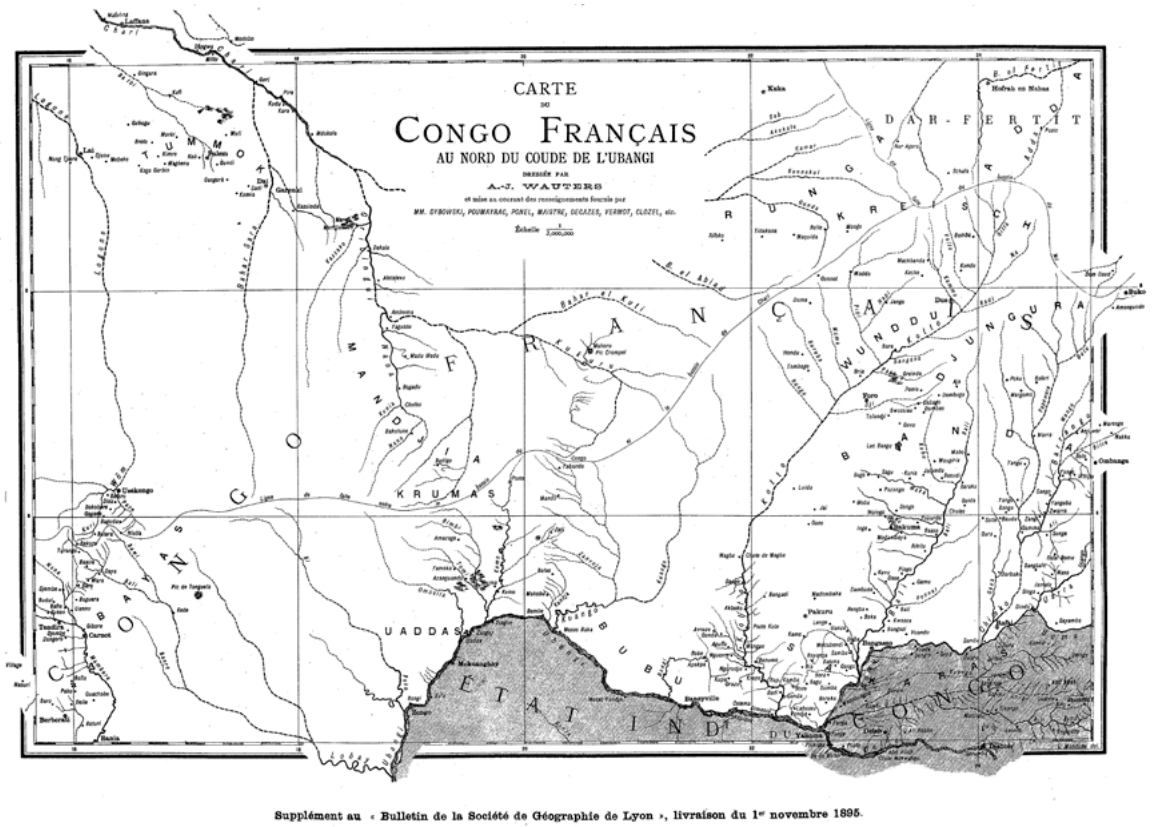

Fig. 6. — "Carte du Congo Français au nord du coude de l'Ubangi – dressée par A.-J. Wauters et mise au courant par des renseignements fournis par MM. Dybowski, Poumayrac, Ponel, Maistre, Decazes, Vermot, Clozel etc.", in *Bulletin de la Société de Géographie de Lyon*, XIII(1895), p. 320b. Map published in the Belgian newspaper *Le Mouvement Géographique* for "Belgian and French audiences" and reprinted in the Lyon's *Bulletin*, followed by an account made by the squadron leader Decazes, former senior commander in *Haut-Ubangi*, during a session of the *Comité de l'Afrique française* on the movements of French forces in the region in 1894.

A Measured Development of Narratives and Actions

Most of the maps published in the *Bulletin* include a reference to the *Société de Géographie de Lyon* on their borders or in the title as a mark of its members' endorsement. A careful analysis not only of the place names included but also of the other components of the maps such as scales and coordinate grids, show how the *Société de Géographie de Lyon* tried to seize a diversity of sources, wishing to keep its members well informed. Coordinate grids sometimes refer to Greenwich with the use of non-metric scales, but when French possession is at stake the Paris meridian and other French trademarks are present. References to a contribution of vernacular knowledge are practically non-existent and appear in a veiled manner, as in the example of Dr. Tirant, simply by including a better translation of local languages.

From 1902 onwards, the *Bulletin* included a new section devoted to listing all new maps produced and/or published in different European countries. The first extensive note on cartographic production was devoted to recent maps of Africa, mentioning maps of the Belgian Congo before the French maps of the continent (Zimmermann, 1903). The *Bulletin*'s columns repeatedly reiterated the need for French efforts to closely follow the success of other European powers, and although some criticism would apply to the central government, it soon gave way to praise the continuing action for the work of some French citizens assuring interests abroad. Considerations on applying mapping to more local issues would only appear much later, for instance in 1905, when colonel Raymond (a member of the action committee) proposed a critique and ideas for further publications of the map of France by the dedicated military services (Raymond, 1905). A greater concern to consider regions close to Lyon would only become more present in the twentieth century, as in 1906 the *Bulletin*'s chronicle hinted at changes in its activities, proposing, in addition to lectures, informal "talks" (*causeries*) and excursions to Lyon's neighbouring regions. These actions would be capable of adjusting "to modern needs" and "eager to join the movement that is renewing geographical science" (Anon., 1907). In fact, this relates to a greater involvement of members of the local university, who would favour a more academic and locally-based approach [20], while colonial matters would develop elsewhere.

The quality of most of the mapping production analysed from the twenty-five first years of the *bulletins* partly confirms Clout's analysis (2009) when he questioned the idea of Lyon's municipal imperialism as capable of acting as assertively as that of other larger geographical societies (London, Berlin, Paris). Most of the maps produced locally were simple sketches, barely able to situate the projects they were trying to promote. They could be handwritten and lacked what we could call appropriate scientific sources; sometimes we don't know whether the Greenwich or Paris coordinate system is used, and in some cases the two systems mix. It is difficult to assess the value of these productions without reading the accompanying texts. They work as stages in a line of reasoning that develops over the course of organized conferences, without concern for precision but mainly to prove that local members were 'part of the game'. A large part of the maps produced at that moment portrayed very limited space, and it was only at a later stage that location insets were included to help assess the global view of the places depicted. They mostly reveal well-targeted actions and interests, bringing 'distant places to life' along with new or other accessible reports through the networks that were being built. Even in this way, they were able to describe how, even further away from Paris, the various local elites sought to contribute to the development of French interests, covering ever larger parts of the regions from an initial settlement, either from southern Indochina or from the northern or western regions in Africa.

Looking at the subject and characteristics of most maps, it would be futile to assert that imperialist aims were absent. As Laffey (1974) argued, there is a clear link with economic interests in the choice to illustrate some of the conferences, particularly those of explorers and missionaries in territories where new settlements could be deployed: the cartographic approach prevailed in areas where members felt local actions would be worthwhile. Maps functioned as visual elements capable of drawing the eye to the beyond, contributing to encourage a local audience to the idea of 'exploits'. They gave life to the commercial and colonizing impetus of Lyon's elites, convincing the local youth to 'join in' even if the risks were important. Although mapping would later become increasingly 'academic' and more sophisticated over the years, the first publications of maps, particularly in colour, were invaluable communication tools before other forms of expression took over, such as films and photographs [21]. They show that this first role of geography as an imperialist science at the end of the nineteenth century was not limited to the major national centres (Surun, 2018), but spread further afield to justify and promote the colonial idea in other regions of France. In the local quarterly journals published between 1875 and 1900, mapping was as varied and individual as the different influences of its members: it included embryonic productions, sketches drawn on tracing paper by missionaries or other people who had not been trained in cartographic creation. If that partly explains the simple aspect they assume, they show how mapping could be a tool for spatial appropriation. As working documents by commercial agents or travellers who used annotations on existing maps to act as a record of encounters, travel impressions and ideas, they call attention to projects seeking financial support for an action beyond national borders.

The 'exploits' they portray are rarely cited as 'occupations', and even the few texts that mention a certain consideration for local cultures always end up expressing the possibility of exploiting resources. Indisputably, if most maps produced by the *Société de Géographie de Lyon* are fairly schematic publications, with approximate scales or uncertain toponyms, they still refer to European models or languages, trusting mainly other European sources if French documentation was not available. The choice of elements used in the legend, when it exists, often record possible tracks before new routes, canals and railways could be created. Their creation shows the gradual appropriation and even the superimposition of new territorial logics where European names replace the original toponyms and where the penetration becomes more and more deep-rooted. These modest attempts to create simple images of what would later become systematic cartography describe one of the elements that helped to present colonization in a 'natural' or even heroic way, helping to anchor it in the different local contexts in France. While certain approaches may seem more critical of the scant consideration given to local people and players, they are nonetheless embedded in a broader set of colonial cartographies [22], creating the basis for domination locally.

In this sense, during the first years of the *Société*, mapping had been an argument to illustrate the formation of a multitude of imperialist projects that appeared in Lyon before a more structured colonial approach took form in the last years of the nineteenth century. Other institutions, such as the *École coloniale de Lyon* founded in 1899 (Klein, 2006) [23], or the local participation in the French Colonial League in the early twentieth century, would then take the lead in colonial matters while Lyon's geographical society and its map production turned into depicting more local themes. Further away from the *Société de Géographie de Lyon*, a geographical approach continued to call attention to areas of economic interest outside France as long as they were associated with the development of Lyon's factories.

NOTES

[1] The secretariat of the *Societé de Géographie de Lyon*, when it announced the publication of a new colonial atlas in 1887 insisted on the fact that "Les colonies sont un champ commercial qu'il importe d'exploiter aussi bien dans l'intérêt de la métropole que dans celui des populations indigènes qui nous sont redevables de la civilisation" (Ganeval, 1887, p. 80).

[2] Many of the latest exhibitions in the local archives refer to the maps cited in this text, such as *Du Rhône au fleuve Bleu*, an exhibition that ran from 17 September 2021 to 26 February 2022 and retraced the role of the Lyon Chamber of Commerce and Industry in international trade and commerce in the "Far East" (the "blue river" being the French name given to the Yangzi Jiang).

[3] By the time the local geographical society was founded, Lyon had overtaken Marseilles in controlling the trade networks with Asia, and even a few merchants from the south, such as Ulysse Pila (Klein, 1994), had settled there, despite the fact that the Lyon business bourgeoisie was not very open to 'foreigners'. Ulysse Pila, one of the best-known silk merchants, considered as the *vice-roi* in Indochina (Klein, 1994), was a long-standing vice-president in the *Société de Géographie de Lyon*.

[4] See how difficult were the attempts to change the only chair of geography to exist at the Sorbonne in Paris since 1804. Auguste Himly, in charge since 1862, continued to favour a historical approach and the proposal to adopt an *agrégation* in geography was rejected in 1886. It was only with the arrival of Paul Vidal de la Blache in 1898, after the launching of the *Annales de Géographie* in 1892, that the renewal of academic geography began in France (Schneider, 1990, p. 98; Laboulais-Lesage, 2004).

[5] In fact, the prizes offered by the *Société de Géographie* from Paris reached several thousand francs, while the prizes offered in the first competitions launched in Lyon ranged from 300 to 500 francs.

[6] Dr. E. Chappet, who was the fourth president of the *Société de Géographie de Lyon* and a doctor, proposed papers on health in the tropics, another way of positioning himself in the colonization effort (Chappet, 1906). His notes were based on publications by colleagues in Bordeaux who were also involved in "hygienism and social economics" ("medicine saves individuals, hygienism saves the masses", quoted Dr. Polinière, another doctor in Lyon's medical schools).

[7] The first volume included the following travelogues : "Carte sur le voyage dans la régence de Tunis par MM. Tirant et Rebatel", "Cochinchine Française – Carte schématique pour servir au voyage de Mr. Le Docteur A. Morice de 1872-1874 – Par C. Morice", "South Africa – voyage du R. P. Guillet".

[8] Possible connections with the work of the *Société de Géographie de Lyon*, which aimed "intellectual decentralisation" from Parisian standards, can be made by the availability of in-depth studies of slightly near or adjacent zones from the areas mapped here: the works of Marie de Rugy (de Rugy, 2018a,b) on the mapping of the north of the Indochina peninsula and Isabelle Surun (Surun, 2018) on Western Africa are important contributions to a broader approach to the mapping dynamics underway in these regions.

[9] Many systems have been proposed for transcribing and transliterating the various local Annamese languages, and even at the beginning of the 20th century (see text from the *École française d'Extrême-Orient* dating from 1912) the question was still being debated. However, Dr. Morice did not seem to have made any effort to include characters and accents in his transliteration of local place names, unlike other authors, such as Dr Tirant (1876).

[10] His zoological collection can be seen at Lyon's Natural History Museum. He returned to Saigon in 1875, but was rushed home with tuberculosis and died in Toulon in 1877. His death is mentioned in the third issue of the *Bulletin* in 1880 by his brother, C. Morice, while giving another conference on a trip to Indochina.

[11] We believe that the map on which this plan is based is probably the *Carte générale de la Cochinchine française*, drawn up by M. Brossard de Corbigny, lieutenant de vaisseau in 1874, available at the *Bibliothèque nationale de France*, *département cartes et plans*, GE SH 19 PF 1 QUATER DIV 21 P 9 (ark:/12148/btv1b53169703f).

[12] The question of possible incorporations of vernacular knowledge, as in the case described by de Rugy (2018a), remains open to further studies of his interaction with local officials.

[13] Gilbert Tirant held various administrative posts in the northern areas of Annam and Tonkin and, in 1894, became Director of Political Affairs and Protectorates in the General Government of Indochina. On his return to France in 1898, he died of malaria. As Dr. Morice, he sent a very interesting collection of birds, fish and other animals from *Cochinchine* to the natural museum in Lyon.

[14] In 1879, Father Charmettant, a missionary from Algiers, proposed a partial map of the Catholic missions in equatorial Africa and the routes taken by the missionaries according to their travel diaries, while in November of the same year, Paul Soleillet gave a lecture on his plans for the construction of the *Transsaharien*, the rail link between Algeria and Senegal and the interior of Sudan (see *Bulletin de la Société de Géographie de Lyon*, vol. III). They both showed the gradual expansion from North to Central Africa in French interests.

[15] The 1905 law on the separation of church and state also had an impact on the association between "the cross and silk". The number of articles by members of Catholic missions or other clerical representatives in the *Bulletin de la Société de Géographie de Lyon* decreased considerably after that date.

[16] Regarding the cartography of French colonial Algeria, the work of Hélène Blais (2014) provides a detailed overview of the different moments of French cartography in the region.

[17] In this respect, the accounts given here confirm Surun's (2018) description of the explorations as a preparatory and technically useful phase for the conquest and control of the territory that would follow.

[18] The serious diplomatic incident between France and the United Kingdom in 1898 at the advanced military post of Fashoda in Sudan (now South Sudan) showed the strong nationalist currents in these countries at the time. Apart from the strategic interest of this position, the vacuum created by the British departure occurred at a time when the division of Africa was almost complete and opportunities to acquire new territories were scarce. For example, French plans to expand eastwards (to link the Atlantic – Dakar – with the Red Sea – Djibouti) and British plans to extend the Cape Town-Cairo railway, in accordance with the wishes of Cecil Rhodes, collided at Fashoda on 19 September 1898. The incident took place against a backdrop of extreme nationalist fervour on both sides, leading to fears of open conflict.

[19] In 1893, the *Union coloniale française* was created as a business lobby, leading to the creation of an independent *Ministère des Colonies* in 1894. The colonial party, originated from the *Comité de l'Afrique française*, founded in 1890, was not a political party, but "a movement of opinion, which brings together various groups with colonialist tendencies". The *Bulletin de la Société de Géographie de Lyon* published many accounts on colonial matters, as the formation of a 'French colonial league' announced in 1906.

[20] When Emmanuel de Martonne was vice-president of the *Société de Géographie de Lyon*, he declared that "the period of exploration was over and that it would be useful to modernise the contribution of geography to Lyon". Between 1908 and 1909 he tried to revitalize the *Société* and the *Institut de Géographie de la Faculté des Lettres*, undertaking excursions and producing more scientific work. However, it should be pointed out that after his departure in 1909 some members were considered 'academic' with a strong penchant for exploration and the imperialist colonization of the period, such as Maurice Zimmermann. He too was trained by Vidal de la Blache, arrived in Lyon in 1899 and from 1902 began writing articles for the magazine, in particular the 'geographical chronicle' section, as secretary of the *Société de Géographie de Lyon* from the same date. He remained very active in the *Société* and took up this more traditional approach again after 1909, playing an active part in its activities until the 1930s (Clout, 2009).

[21] It's worth remembering that the Lumière brothers' film industry was founded in Lyon.

[22] Without claiming to be exhaustive, see the numerous works dedicated to colonial cartography produced by military classes where the more advanced concern for a topographical restitution of space is present (Blais, 2014; Surun, 2018), deconstructing the geographical codification in Europe.

[23] The *École coloniale de Lyon* was founded in 1899 in order to assert local elites "while remaining part of the Republic" (Klein, 2006) — it is indeed a response to the founding of the *École coloniale* in Paris in 1890. So, the argument for a degree of independence and decentralization from the Parisian establishment is relative. Rather than standing out from the Parisian dynamics, it would seem that it was more a question of relaying locally the actions initiated in the capital.

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