The steamship: a key driver in the socio-ecosystemic transformations of the Port of Marseille

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Les outils de l'activité portuaire maritime en Europe méditerranéenne et atlantique (XVII^{e}-XX^{e} siècle)

sous la direction de
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The steamship

A key driver in the socio-ecosystemic transformations of the Port of Marseille

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In the period between the 1830s and 1850s, Marseille's merchant navy experienced major change: a progressive transition from a free, clean and renewable but irregular energy source —the wind— combined with a tried-and-tested technology and well-developed training system, to a costly, cumbersome and polluting fossil fuel —coal— relying on a high-potential, complex and expensive converter, the steam engine. We have chosen to revisit this key moment in the long history of the Port of Marseille in light of recent historiographic contributions to economic, maritime and environmental literature. Who were the stakeholders in this transition? What circumstances led them to take an interest in this new mode of maritime transport? With what investments? Which technological sector provided support? What kinds of resistance did they encounter? In addition to these questions, we also wanted to determine the consequences of these choices for traffic, practices, tools, operating areas and the environment of the Port of Marseille.

Emergence and structuring of a new market

In the 1830s, Marseille's economy was more receptive to steam engines, both in the processing industry and maritime transport.[1] However, this was not because the city's entrepreneurs suddenly became aware of the potential and advantages inherent in the new energy source. These had been known for several decades already, but local economic leaders still hesitated before taking the plunge, as did other French ports, particularly in navigation.[2] The first steamer —the *Ferdinando Primo*— did eventually

1 Xavier Daumalin, Olivier Raveux, "Marseille (1831-1865) : une Révolution industrielle entre Europe du Nord et Méditerranée", *Annales Histoire, Sciences sociales*, nº 1, 2001, p. 153-176.

2 Dominique Brisou, "Les débuts de la navigation à vapeur en France au XIXe siècle", in Christiane Villain-Gandossi (dir.), *Deux siècles de constructions et chantiers navals (milieu XVIIe – milieu XIXe siècles)*,

enter the Port of Marseille though, in 1818. Built and charted by the Compagnia privilegiata per la navigazione a vapore Pierre Andriel & Cie,[3] it even succeeded in winning over local elites invited aboard to participate in various manoeuvres.[4] Despite this outward enthusiasm, Marseille shipowners were slow to invest in purchasing steamships, for a time leaving the way open for Neapolitan, Genoese and Sardinian companies. This wait-and-see approach may seem surprising given the significance of maritime operations to Marseille's economy, but it was not unfounded. There were multiple advantages to introducing steam to ship propulsion: it overcame the natural limitations associated with irregularities in the wind and headwinds; it saved time; trips were more regular and trade operations were thus more predictable; and there was a potential increase in the number of rotations. But the economic viability of operating such ships from a private economic perspective (not always the situation with Italian companies) raised many additional questions.[5] Their purchasing and maintenance costs, people's apprehensions (in the 1840s Rostand & Cie steamers were dubbed *cratères ambulants*[6] ('mobile volcanoes'), their frequent breakdowns, their coal consumption which had the double disadvantage of being more expensive and taking up a lot of room in ships' holds, the need to recruit British on-board mechanics with high salaries to handle the engines and to establish a whole network of coal depots across the Mediterranean Basin made the first paddle steamers seem ill-suited to common freight transport with uncertain profitability.[7] At best, they may have been suitable for transporting passengers and packages of high commercial value over short distances. Except in certain rare cases, Marseille shipowners' caution was thus the result of a detailed reading of the markets in the economic and social context in which they found themselves, and involved waiting for the 'optimal moment' to be sure of a profitable return on an investment that was, after all, estimated to be worth several hundreds of thousands of francs.

Paris, Éditions du CTHS, 2002, p. 166; Bruno Marnot, *Les grands ports de commerce français et la mondialisation au XIXe siècle*, Paris, PUPS, 2011, p. 340-341.

3 Partnership limited by shares with a capital of 200,000 ducats. A former navy officer, Pierre Andriel was engaged by Lieutenant General Pajol in 1815 to go to England to buy steamers for navigation along the Seine. When this failed, he went to Naples where, on 14 January 1817, he obtained a 15-year concession of a monopoly on steam navigation in the Kingdom of the Two Sicilies from King Ferdinand I (Pierre Andriel, *Coup d'œil historique sur l'utilité des bâtiments à vapeur dans le Royaume des Deux-Siciles*, Naples, 1817; Antonio Formicola, Claudio Romano, "L'industria navale nel regno delle Due Sicilie sotto Ferdinando II", *Rivista marittima*, No. 4, 1986, p. 68-86; *id*., "Il periodo borbonico [1734-1860]", in *La fabbrica delle navi. Storia della cantieristica nel Mezzogiorno d'Italia*, Naples, 1990, p. 111 ff).

4 *Journal de Marseille et des Bouches-du-Rhône*, 25 November 1818.

5 These shipping companies were often subsidised by states eager to attract the latest technological novelties, whether this was based on a real desire for economic development or simply seeking political prestige. This was the case for the Compagnia privilegiata per la navigazione a vapore Pierre Andriel & Cie subsidised and protected by King Ferdinand I.

6 Michel Barak, "Quelques tentatives marseillaises d'organisation de la navigation à vapeur (1832-1854)", *Provence historique*, 1971, p. 46.

7 For example, across 88 journeys undertaken between May 1836 and February 1837 by the Marseille steamers *Rhône* and *Hérault* on the Marseille–Agde line, coal consumption accounted for 31% of expenditure, far higher than for the entire crew's salaries and food (20%, 4.5% of which was for the mechanics' salaries alone). See *Histoire de la Compagnie Faissinet*, Marseille, 1976, p. 20.

The turnaround happened at the dawn of the 1830s, when no fewer than six new companies were proposed in quick succession: Edouard Blaquière & Cie;[8] Auguste Anthoine, Rambaud & Cie;[9] André Ferrier & Cie;[10] François Rougemont & Cie;[11] Aynard Frères[12] and Charles & Auguste Bazin.[13] Only the Aynards' and Bazins' companies succeeded in becoming established, and very soon their rivalries intensified. *Le Sémaphore de Marseille* sided with the Bazins, convinced that their project would strengthen Marseille's role as the *entrepôt général des productions de la Méditerranée et de l'Océan* ('general warehouse for production in the Mediterranean and the Ocean') and would stimulate activity in the only Provençal shipyard capable of constructing steamers, i.e. the company belonging to the American Edward Church founded in 1818 in La Seyne-sur-Mer.[14] The Aynard brothers were strong competitors. Former cloth manufacturers from the Lyon region, they became interested in steam navigation in the 1820s, collaborating with Parisian mechanic Raymond.[15] Between 1822 and 1828, they financed and ran a company on the River Saône with up to

8 *Exposition rétrospective de la navigation à vapeur à Marseille (1818-1900)*, Marseille, 1930, p. 65.

9 Proposed partnership limited by shares with a capital of 700,000 francs. Anthoine and Rambaud wanted to create a Marseille–Naples line with 80-horsepower ships. They were also considering establishing a steam-powered towing service in Marseille (Archives of the Marseille Provence Chamber of Commerce and Industry [hereafter 'MPCCI'], MR 4.4.6.4.).

10 Proposed partnership limited by shares with a capital of one million francs. André Ferrier planned to create a Marseille–Naples line and Marseille-Cádiz service (Bouches-du-Rhône Departmental Archives [hereafter 'BdR DA'] 548 U 2).

11 Proposed partnership limited by shares with a capital of one million francs (*id*., 548 U 2).

12 Partnership limited by shares with a capital of 1.2 million francs. The capital was largely from Lyon sources (*Service de paquebots à vapeur sur la Méditerranée*, Marseille, 1829).

13 Partnership limited by shares with a capital of 800,000 francs. Charles and Auguste Bazin were the sons of banker Charles-Samuel Bazin and leather dealer Jean-Auguste Bazin, respectively. In 1827, Charles-Samuel Bazin created Compagnie pour l'exploitation des Houillères sur les Côtes de Provence, a company with a capital of 600,000 francs founded with William Haldimand, a banker in London, Etienne Cagniard, a banker in Toulon and Jean-Gabriel Eynard from Geneva. The company's share capital amounted to 5 million francs in 1853 (BdR DA, 548 U 2 and 7).

14 *Le Sémaphore de Marseille*, 25 February 1830. Edward Church was one of the pioneers of steam navigation. As the appointed United States' consul posted in Lorient (1817), he travelled across Europe disseminating the invention of his compatriot Robert Fulton. In 1818, with the help of engineers John Barnes, Henry and Charles Evans, he founded a shipyard for constructing steamships in La Seyne-sur-Mer. In 1819, he sent the *Triton* (30-horsepower steamer built in La Seyne-sur-Mer) to his colleague Beasley, United States consul in Le Havre, for the Le Havre–Honfleur route. In 1822, he sent other steamers for the Nantes–Paimbœuf line which had just been created by his compatriots Fenwick, consul in Nantes, and Strobel, consul in Bordeaux and Church's brother-in-law. After a brief stay in Switzerland and Würtemberg, he settled in the Lyon region where he founded no fewer than four steam navigation companies with the help of various partners: Church, Mathieu & Cie (250,000 francs), in 1826; Société de navigation de la Saône par la vapeur (one million francs), in 1827; Compagnie des transports de marchandises sur la Saône par gondoles à vapeur (one million francs), in 1829; Compagnie des bateaux à vapeur pour la navigation du Rhône (1.6 million francs), in 1830. All his travelling led Edward Church to delegate the management of the La Seyne-sur-Mer shipyard to British engineers Henry and Charles Evans. It was they who supervised the construction of the *Henry IV* and the *Sully* with steam engines ordered from Barnes & Miller in London (Bernard Escudié, Jean-Marc Combe, Jacques Payen, *Vapeurs sur le Rhône : histoire scientifique et technique de la navigation à vapeur de Lyon à la mer*, Lyon, CNRS, 1991; Olivier Raveux, "Les ingénieurs anglais de la Provence maritime sous la monarchie de Juillet", *Provence historique*, vol. 44, 1994, p. 301-320).

15 Patent taken out on 23 October 1818. Raymond, director of the Dumoulin & Cie workshops, had the idea of building a boat in two sections, with the rear holding the machinery and the other end loaded

six steamers. In 1826, they founded Compagnie de navigation du Rhône par la vapeur, a public limited company with a capital of 4 million francs.[16] Despite their undeniable experience with the various limitations of this new mode of transport, they were still far from being able to draw on the same technical expertise as the Bazins. Their ships —ordered from the Guilbert Frères shipyard in Chantenay, near Nantes— were undoubtedly cheaper than Edward Church's, but they were equipped with Raymond engines, with machinery that was less powerful and less reliable than the British engines ordered by the Bazins. Furthermore, choosing a construction workshop in Paris and a shipyard in Nantes did not make life easy for the Aynard brothers. This combination would soon prove to be inefficient. Thanks to two wooden steamships with copper sheathing constructed in Edward Church's shipyard —the *Henri IV* and its sister ship the *Sully*— Charles and Auguste Bazin succeeded in launching their service to Naples on 26 March 1831, two months before the departure of Compagnie Aynard's *Scipion*, whose boiler exploded on its maiden voyage.[17] Due to its significant trading with France, as well as the crowds of foreigners attracted by its climate and antiquities, Naples was one of the Italian ports that offered the best prospects for this type of transport at the time.[18]

The early days of the first steam-powered maritime service departing from Marseille were no less difficult. Departures did not always occur on the dates published in the press; there were too few coal refuelling points —which sometimes meant resorting to firewood— the estimated quantities of coal needed for a crossing were often thwarted by headwinds and opposing swells; and the quality of service was not always in line with the social standing of the targeted clientele. Recriminations against the captains of the *Henri IV* and the *Sully* were so frequent that Henri Beyle (aka 'Stendhal') French consul in Civitavecchia, was regularly obliged to write to the Bazins —the service of their steamboats was inciting 'unanimous' complaints; passengers' passports had gone missing or did not bear the required visas; the captains' lack of respect was extreme; passengers were being forced to pay everything in francs, with their Roman currency only being accepted in exchange well below the going rate.[19] To make matters worse, on 12 December 1834, the *Henri IV* ran aground off the coast of Porto Ercole with 18 passengers and 20 crew members aboard.[20] Captains' marine incident reports filed with the registry of the Marseille commercial court have also revealed that paddle steamers become difficult to manoeuvre with rising swell, so were regularly submerged by waves. Of all the

with cargo. Propulsion was provided by a single paddle wheel placed at the rear of the vessel (Félix Rivet, *La navigation à vapeur sur la Saône et le Rhône [1783-1863]*, Paris, PUF, 1962, p. 73).

16 *Bulletin des lois*, 8th series, vol. V, No. 102b.

17 BdR DA, 531 U 63, Marine incident report of the *Scipion*, 1831.

18 NA, MFA, 218CCC/48, Naples, 18 March 1836. For all references to Ministry of Foreign Affairs (MFA) national archives (NA), the sources are consular and commercial correspondence.

19 Letter to Bazin, 16 November 1831, Stendhal, *Correspondance*, Paris, Gallimard, 1967, vol. II, p. 365-366. Two months later, the *Sully* sustained significant damage to one of its paddles after being struck by a Neapolitan brig in the middle of the night (NA, MFA, 82 CCC/7, Civitavecchia, 4 February 1835).

20 Letter to the Comte de Rigny, 17 December 1834, Stendhal, *op. cit.*, p. 754.

incidents recorded for Marseille's merchant navy steamers between 1831 and 1845, 77% were related to submersions that caused significant water intake in the engine room, breakdowns and damage to transported packages, despite the intensive —and expensive— use of pumps.[21] The cost of the crossings began to limit the market. In 1836, the price of a journey between Naples and Marseille on Compagnie Bazin steamers was 198 francs in first class and 130.50 francs in second class. To address their difficulty in attracting sufficient passenger numbers —the main source of income for steamers at the time— captains were often compelled to accept negotiations and agree to discounts of 20 to 30%. They would sometimes even tolerate a third class of passengers, who would make do with a mattress on the floor and pay only a very modest sum for the crossing.[22]

Aside from these shortcomings relating to the operation of the first steam navigation companies, other difficulties stemmed from the resistance offered by the Kingdom of Naples, which sought to defend its position in this new market. Fearing that steamers from Marseille were competing too strongly with the Neapolitan line or sail-based merchant navy, it used a variety of methods to try to penalise them.[23] At times, it would refuse to exempt the space occupied by the steam engine and its coal store from tonnage tax[24] —which was France's practice for all steamers to encourage this mode of transport— sometimes the Naples health authorities would use the slightest pretext to impose longer quarantines,[25] and still other times the Neapolitan government would prohibit Marseille steamers from organising outings to islands in the Gulf of Naples (Ischia and Capri) or connecting with Sicily.[26] This latent resistance intensified in 1835–1836 when the Kingdom of Naples ordered two steamers from the Glasgow shipyards —the *Ferdinand II* (180 hp) and the *Neptune* (120 hp)— and acquired two others to form a national company to provide a service between Sicily and Marseille.[27] Armed with canons and administered by the military navy, these steamers were considered to be warships by the state, and as such, qualified for duty-free admission to foreign ports, even though they would also be transporting passengers and goods. Strongly opposed to this project, General Fardella, Minister of War and the Navy, managed to have it scrapped. The Neapolitan government then turned towards another solution: controlling and regulating the steam navigation market through a *Delegazione Reale* specially created for the Kingdom of Naples to monopolise steam navigation (Decree of 17 November 1836). The future

21 BdR DA, 531 U 78-127. These issues would be considerably reduced with the adoption of marine propellers.

22 NA, MFA, 218CCC/48, Naples, 18 March 1836.

23 In 1836, six steamers were in operation on the Marseille–Naples line. The oldest —Sicard et Cie— was from Naples and used two 120- and 160-horsepower steamers; the two others were from Marseille: Bazin (with the *Pharamond*, replacing the *Henri IV*, and the *Sully*); Cartairade & Cie, with two 60-horsepower steamers, the *Océan* and the *Méditerranée* (NA, MFA, 218CCC/48, Naples, 18 March 1836).

24 NA, MFA, 218CCC/47, Naples, 13 May, 23 June and 30 June 1831.

25 NA, MFA, 218CCC/47 and 48, Naples, 29 September 1831, 8 May 1832, 19 September and 22 October 1834, 5 January, 2 February and 24 February 1835.

26 NA, MFA, 218CCC/47, Naples, 23 June 1831.

27 NA, MFA, 218CCC/48, Naples, 8 March 1835, 26 April and 29 May 1836.

entity would gather together all the Neapolitan and foreign steamers (the latter on a voluntary basis) and would be open to all private capital intended for the construction and acquisition of *navires de cette espèce* ('ships of this species').[28] Article 4 of the decree states that each steamer managed by the *Delegazione Reale* would be considered a ship of the royal navy and consequently entitled to all the privileges and exemptions associated with the status,[29] which would give them a competitive advantage over those that remained outside the planned organisation. It also stated that investors and steamer owners who had entrusted assets to the *Delegazione Reale* would receive a share in the company's profits in proportion to the value of the ships and capital invested.[30] Summoned to the government palace to discuss the terms of his company joining the planned scheme, the Bazins' administrator rejected the proposals made without the least hesitation. The *Delegazione Reale* eventually dissolved on 23 September 1837,[31] and all ensigns were granted 'freedom of navigation' in the kingdom's ports in 1839.[32]

Despite these difficulties, the trips made by the Bazins' steamers were profitable. In April 1833, the *Henry IV*'s Marseille–Naples round trip left a net profit of 20,500 francs;[33] in 1834, operation of all the company's ships brought in around 30%, and the average net profit from a single trip reached 20,000 francs;[34] in 1836, operation of the Civitavecchia agency cost 26,341 francs, while passenger traffic alone yielded 33,120 francs.[35] These figures confirm that the maritime transport market for steamships was economically viable —with or without protection— and promising. The trend to create shipping companies then gained momentum: in 1836, three new companies specialising in cabotage between Agde and Nice were established: Simon Théron & Cie,[36] Auguste and Guillaume Chancel Frères & Cie[37] and Théophile Périer & Cie.[38] In 1839, steam navigation accounted for 8.5% of the total number of vessels entering and leaving the Port of Marseille and 20% of tonnages.[39] With a fleet of 18 ships, Marseille became the leading base port for regular steamship services in the Mediterranean, now possessing more steamers than all the ports in Italy,

28 NA, MFA, 218CCC/48, Naples, 8 June 1836.

29 *Ibid.*

30 *Ibid.*

31 NA, MFA, 218CCC/48, Naples, 12 January 1838.

32 Tomaso Gropallo, *Navi a vapore ed armamenti italiani dal 1818 ai giorni nostri*, Cuneo, Instituto Grafico Bertello, 1958, p. 29.

33 NA, MFA, 82CCC/7, Civitavecchia, 2 July 1833.

34 Letter to the Comte de Rigny, 3 September 1834, Stendhal, *Correspondance*, Paris, Gallimard, 1967, vol. II, p. 686.

35 NA, MFA, 82CCC/7, Civitavecchia, 20 February 1836.

36 Partnership limited by shares with a capital of 450,000 francs. In 1837, it absorbed the shipping company Chancel before being in turn taken over by Marc Fraissinet in 1843 (BdR DA, 548 U 3; Paul Bois, *Armements marseillais. Compagnies de navigation et navires à vapeur [1831-1988]*, Marseille, MPCCI, 1988, p. 16).

37 Partnership limited by shares with a capital of 500,000 francs (BdR DA, 548 U 3).

38 Partnership limited by shares with a capital of 900,000 francs (BdR DA, 548 U 3).

39 Jules Julliany, *Essai sur le commerce de Marseille*, Marseille, 1842, vol. 1, p. 163 and 191.

Spain and Greece combined.[40] There was a frenzy of new companies being created: Adolphe Chappon & Cie (1839), André & Abeille (1841), Lafon & Cie (1842), Marc Fraissinet & Cie (1843), Baragnon, Gillet, Plasson, Deloutte & Cie (1844), Rostand & Cie (1845), Sicardo & Cie (1848), Louis Arnaud Touache Frères & Cie (1850), Bossy, Jourfier Fils & Cie (1851), Cohen & Cie (1852), Léon Gay & Cie (1852), Henry Fraissinet & Cie (1852), Taffe, Rébufat, Caffarel Frères & Cie (1853), Bazin, Gay & Cie (1853) and Pastré Frères (1854).[41] Extracts from company deeds held in the registry archives of Marseille's commercial court show that between 1830 and 1855, a total of over 30 million francs were invested in merchant navy steam, which does not include the traditional shipping companies that were also starting to take an interest in this mode of transport or the state's postal service ships.[42] In 1855, which marks the limit of our review, 11,403 ships entered and left the Port of Marseille with a tonnage of 2,248,426. Of these totals, steamers accounted for 20% of units and nearly 40% of tonnage. 95% of these steamers were used in trans-Mediterranean trade with Italy (46%), Turkey (19%), Algeria (18%), Spain (7%) and the Black Sea (4%).[43] The steam engines, their propulsion system and coal store no longer occupied the majority of available space,[44] so freight transport became the main source of income for shipping companies from then on (Table 1).

During the 1850s, Marseille's shipping companies entered a new phase in their history. Propeller propulsion became widespread, ships became more powerful, faster and safer, and their transport capacity increased. A number of mergers were also seen, such as shipping companies Bazin and Gay in 1853, and Compagnie Rostand with Messageries nationales which in 1851, supported by the state, created Services maritimes des messageries nationales, the future Compagnie des services maritimes des messageries impériales.[45] The pioneering days of steam navigation were over for Marseille's merchant navy.

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40 The 65 Mediterranean steamers were distributed as follows: Toulon: 20, 17 of which were exclusively reserved for transporting troops to Algeria (the three others, from Compagnie Gérard, provided a service to and from Bastia); Marseille: 18; Bastia: 1; Piedmontese ports: 2; Tuscan ports: 4; Naples: 6; Gibraltar and Malta: 5; Trieste: 4; Barcelona: 2; Constantinople: 2; Athens: 1 ("Relevé des bateaux à vapeur employés à des services réguliers sur la Méditerranée", *Annales maritimes et coloniales*, 1839, vol. 1, p. 309-310; *Le Garde national*, 5 November 1839; *La Gazette du Midi*, 28 June and 5 December 1840).

41 Of these 15 new companies, 12 were *sociétés en commandite par actions* (partnerships limited by shares) and 3 were *sociétés en commandites simples* (limited partnerships) (BdR DA, 548 U 3-8).

42 The Levant postal service leaving from Marseille began operating in 1837 with 10 steamers built by the French Royal Navy. Some propulsion systems were however ordered from Great Britain.

43 Casimir Bousquet, Tony Sapet, *Étude sur la navigation, le commerce et l'industrie de Marseille pendant la période quinquennale de 1850 à 1854*, Marseille, 1857, p. 130-131 and 249-267; Octave Teissier, *Histoire du commerce de Marseille pendant vingt ans (1855-1874)*, Paris, 1878, p. 85-87.

44 In 1829, for a vessel with a tonnage of 300, a 120-horsepower steam engine only left a net tonnage of 25 (8%) for transporting freight and passengers; in 1850, this was 60% on Compagnie Valéry steamers (Tourasse, François Noël Mellet, *Essai sur les bateaux à vapeur appliqués à la navigation intérieure et maritime de l'Europe*, Paris, 1829, p. 50; Charles Finidori, *La compagnie Valéry frères & fils, armateurs cap corsins, 1840-1883*, Ajaccio, Éditions Alain Piazzola, 2008, p. 32-34).

45 Public limited company with a capital of 24 million francs (4,800 5,000-franc shares) comprising three entities: Messageries nationales (1,500 shares), which up until this point specialised in transport via stagecoach; Rostand & Cie (180 shares); the postal service between Marseille and the Levant,

The new reality for maritime economies

The adoption of this new mode of transport upset a number of economic, social and environmental parameters. Firstly, it changed the very conditions of maritime travel, which no longer bore much resemblance to those of sailing ships. In addition to the cost of the crossing, there were safety issues —it was not uncommon for an engine to cause a fire or break down, or for coal to run out so the journey had to be completed under sail or towed by another steamer— some passengers were quick to use terms like *navigation triste* ('sad navigation') and *fort peu poétique* ('far from poetic'), and talked about the significant discomfort caused by smoke, the deafening noise of the engine and *exhalaisons fétides* ('foetid fumes') of the boiler vapour.[46] The introduction of steam also had serious effects on the health of new crew members, namely firemen, boilermen and stokers. These had to light the fire, shovel coal into the furnaces and scrub the grates in a confined space saturated with dust and coal at temperatures varying between 35 and 40°C in winter and from 50 to 60°C in summer. Not only were their bodies exposed to exhaustion and premature ageing, burns caused by the ship rolling or accidental steam release and a risk of lead poisoning due to the use of red-lead-based filler for repairs, these men also faced chronic diarrhoea linked to the abrupt cooling of body temperature when they emerged from their inferno to get some fresh air on the bridge or when they went to the 'head' (bathroom). An on-board doctor remarked that after a while, many firemen were disembarked and many firemen-deckhands were relocated to the bridge. Despite frequent renewal of this personnel, and even though the men employed in the engine room only made up a quarter of the crew (excluding higher-ranking officers), two-fifths of mortalities were from their ranks.[47]

The rapid rise of steam in the merchant navy also had a profound economic impact. Two years after operations commenced for the three companies created to provide steam cabotage services between Agde and Nice (Simon Théron & Cie, Chancel Frères & Cie and Théophile Périer & Cie), Saint-Simonian economist Michel Chevalier was passing through Marseille and noted the decisive influence of this new mode of transport on trade volumes, consumption and even health. He glowingly described steamboats as a revolution across the Mediterranean and its impact on Marseille in particular, giving an example in the modest service linking Marseille to the ports of Cette (now Sète) and Agde. Cattle apparently used to be brought in from far away via the roads, at great cost to consumers, who had nothing but tired and expensive meat. Steamboats from Cette and Agde resolved that drawback overnight. Each month, they would transport thousands of heads of cattle and countless sheep from the Languedoc to Marseille, independently of other foodstuffs of any kind.

operated by the French state since 1837 (Paul Bois, *Le grand siècle des Messageries maritimes*, Marseille, MPCCI, 1991, p. 10-18).

46 Antoine-Claude Valéry, *Voyage historique et littéraire en Italie*, Paris, 1832, vol. 3, p. 287.

47 Dr. Renault, "Mémoire sur une entérorrhée muqueuse observée sur les bateaux à vapeur chez les chauffeurs, les aides-chauffeurs et les soutiers", *Gazette médicale de Paris*, 1841, p. 726-724. Dr. Renault was a surgeon aboard the *Minos*, a passenger ship on the Levant postal line.

Chevalier asserted that meat quality had since improved in Marseille and that prices had dropped by a third or a quarter.[48]

Steam navigation was competition for land transport and even more so for sail-based shipping. This is what was observed in the transport of fine oils between Nice, Marseille and Arles, where since the commissioning of the *Hérault* and the *Rhône* of Compagnie Théron, merchants had been abandoning *tartanes* and other bomb vessels, in spite of protests from their captains.[49] Merchants in Nice found this mode of shipping oils highly advantageous. Shipping with French steamships meant being able to accurately calculate the duration of the voyage, in the same way you would post a letter. Goods were then sold according to the hour and minute to destination, whereas before the use of this method, speculators calculated it should take three or four days, but this could stretch to two or sometimes three months after departure. Such a disadvantage obviously compromised the shipper's interests, as the goods were often headed for inland France, and delays often led to disputes between the sender and consignee.[50]

Merchants favoured steam navigation for its speed, which made it possible for fragile products with a high market value to be transported faster —and therefore further. They were even more approving of its regularity and predictability, as it reduced the uncertainties inherent in sail-based transport. Steam navigation finally began to reconfigure traditional flows by attracting oils produced in neighbouring regions to Nice. This preference of Nice merchants for French steamers found imitators amongst oil merchants along the Sardinian continental coast, who, given that these steamers were physically unable to reach them and so they could benefit from the same advantages, took to shipping their oils here via Sardinian ships, accompanied by certificates of origin. These oils were then transferred to steamboats, under the supervision of consulate-appointed expert clerks.[51]

The steamship thus became a key instrument in competition between maritime port economies. Rejecting the new technology meant risking missed opportunities for growth, experiencing a form of economic decline and witnessing the recomposition of trans-Mediterranean trade dynamics from the sidelines. The structuring effects were such that few port communities chose not to embrace this new reality for maritime economies.

The steam option also opened the docks up to the rationale of an industrial economy, calling into question the centuries-old port system built around the port's original calanque, which could be measured with *des bras et du pas de l'homme* ('the arms and feet of Man').[52] The costs of purchasing, maintaining and operating

48 *Journal des débats*, 10 December 1838.

49 On 14 December 1837, 21 French sailing ship captains working out of the Port of Nice signed a petition against the competition from Marseille steamships which was seen as unfair (Roland Tresse, "Les débuts de la navigation à vapeur au port de Nice, 1830-1840", *Recherches régionales*, 1965, p. 37-55).

50 NA, MFA, 225CCC/24, Nice, 18 February 1840.

51 *Ibid.*

52 René Borruey, *Le port moderne de Marseille. Du dock au conteneur (1844-1974)*, Marseille, MPCCI, 1994, p. 4.

the steamers, as well as their logistical limitations, made their use incompatible with the overlapping role of sailing ships and dockers. Docking facilities needed to be improved, transshipment operations made faster, stopovers made shorter, regularity promoted and rotations increased. The connection of these steam shipping lines to the railway that would soon connect Marseille to Lyon and Paris also needed to be facilitated. In short, the Port of Marseille needed to be reinvented. The solution came in two phases: on 5 August 1844, a new law authorised the construction of a dock specially reserved for steamers —La Joliette— work which initiated the port's expansion northward from the bay and changed the shoreline; in 1858, Paulin Talabot, managing director of PLM and Louis Benet & Cie shareholder since 1839, obtained a concession for the construction and operation of a dock & warehouse at La Joliette, similar to the one in London, a technical commercial facility connecting trans-Mediterranean steam shipping lines to the railway, which introduced a fundamental departure from traditional practices.

The features of these establishments were all virtually the antithesis of what the people of Marseille were accustomed to: uniting all port facilities —docks and warehouses— into a single dedicated space; mechanical equipment for fast handling of large quantities; an establishment structure governed by a single authority in the form of a logistics and warehousing company accountable to its stakeholders; not to mention the issuing of warehouse receipts guaranteeing the nature, weight and condition of goods. These receipts were made out to the depositary and were accepted as security by banks and transferable by simple endorsement.[53]

Centralisation, rationalisation and optimisation of the port area, mechanisation of tasks… industrial thinking was needed both on the docks and at sea. But not without environmental impacts. Paddle steamers were heavy coal consumers —5 kg per hour per horsepower[54]— and released black smoke containing carbon dioxide (CO_2) and sulphur dioxide (SO_2) into the atmosphere. The four Compagnie Bazin steamers operating in 1845 with services to Italy and Algeria —the *Sully* (180 hp), the *Pharamond* (180 hp), the *Charlemagne* (200 hp) and the *Philippe-Auguste* (190 hp)— thus had an overall theoretical consumption capacity of 3.7 tonnes of coal per hour, 90 tonnes per day or 2,700 tonnes per month. Extended to the hundred odd ships leaving Marseille each month —and although it is impossible to quantify the CO_2 and SO_2 emissions given the variety of different coal used— we can imagine that the amount of pollution produced by these fumes would have been significant. Nearly two centuries before the ballet of ferries and fuel-oil-powered cruise ships, the Port of Marseille and its environs were already suffering the effects of the pollution generated by the socio-technical decisions of its port community.

53 *Ibid.*, p. 83.

54 *De la navigation à vapeur dans la Méditerranée. Approvisionnement en combustible*, Paris, 1832, p. 5; *Journal des économistes*, vol. 10, Paris, 1845, p. 91; MPCCI archives, Messageries impériales general assembly, 30 June 1854. The use of the marine propellers managed to reduce consumption to 1.5 kg per horsepower per hour.

But it was not just the docks that were shaken up by the rise of the steam-powered merchant navy; all port operating areas were affected. It caused powerful, radical transformations in the local industrial fabric, starting with the shipbuilding industry, which had to rethink its structures and production according to changes in demand in this emerging market. Several individuals experimented with this. The most original attempt, though not the first, was that of former ship captain Georges Sicardo. In the 1840s, he filed several patents for the invention of a rotary steam engine[55] and a paddle-wheel system with pivoting blades.[56] After having a prototype built in the workshop of mechanical manufacturer Dominique Demange at a cost of 129,000 francs, in 1847 he founded a company with a dozen partners to test his engine's performance. As the results obtained were satisfactory —the prototype was faster, cheaper and less cumbersome than most marine engines of the time— on 3 November 1848, Sicardo founded a new test company worth 300,000 francs to construct a second engine, two boilers, two wheels with pivoting blades and a hybrid steamer —the *Précurseur*— with a tonnage of 120 and equipped with his various inventions. The ship left the Benet shipyard in 1849, but production stopped there: no others would be made. Was Georges Sicardo disappointed by his inventions' performance once they were installed on a ship? Whatever the reasons, the fact is, just two years after its launch, his steamer was still in dock. Money was in short supply; the crew's salaries were no longer being paid, and the repairs needed to return to sea could not be undertaken. Sicardo tried to revive his business by taking out a bottomry loan of 12,000 francs,[57] but as he was not able to make the repayment in time, the ship was seized then sold at public auction in 1854 for 6,000 francs.

Other initiatives came from entrepreneurs already involved in constructing stationary steam engines and steam boilers. On 9 September 1837, Elzéar Degrand —who specialised in developing boilers for cooking sugar in a vacuum— filed a patent for a 50-horsepower swing motor able to drive a commercial vessel carrying 350 tons of cargo.[58] However, it is unlikely his invention would have been used on an industrial scale. At around the same time, Jean-Baptiste Falguière, a well-known manufacturer and exporter of steam engines for flour mills and oil mills, succeeded in manufacturing his first 12-horsepower marine engine (1836); in 1842, he developed a new 8-horsepower prototype;[59] in 1853, he obtained a patent for a vertical compound engine featuring a direct reciprocating propulsion unit and valve, which could drive a steamship without using the traditional paddle wheels, or even a propeller![60] With the help of thirty partners, including some big names in local trade like Aquaronne, Reymonet et Pascal Fils and Chantiers & Ateliers Marseillais, Falguière lost no time in

55 Patent dated 1st March 1839, subsequently improved on 4 September 1840 and 7 March 1850 (Xavier Daumalin, Marcel Courdurié, *Vapeur et révolution industrielle à Marseille [1831-1857]*, Marseille, MPCCI, 1997, p. 138 ff).

56 Patent dated 7 October 1842 (*ibid.*).

57 Loan over 12 months, at 6%, taken out on 6 March 1851 (BdR DA, P 6 b, 54 A).

58 *Brevets d'invention, d'importation et de perfectionnement*, vol. 79, Paris, 1837, p. 153-154.

59 Jules Julliany, *Essai sur le commerce…*, *op. cit*., 1842, t. III, p. 384.

60 *Brevets d'invention, d'importation et de perfectionnement*, vol. 32, Paris, 1853, p. 11.

founding a partnership limited by shares with a capital of 3 million francs specifically to build wooden or iron steamships equipped with a new maritime engine of his invention.[61] Shortly afterwards, he developed a fourth prototype —a direct-acting engine with V-shaped cylinders— which this time could be applied to a propeller.[62] The results would probably have been unconvincing as, according to current knowledge, Falguière does not appear to have been able to operate these engines on steamships in the long term.

Not all the initiatives were doomed to fail, however, and it was with Louis Benet that Marseille's steamer construction entered its industrial phase. Son of a wealthy shipping family who also owned a sail factory in La Ciotat —the port where they habitually ordered their brigs and three-masters from the Vence family shipyard— Louis Benet first became involved in metallurgy when he opened an iron foundry in 1833 with father-and-son blacksmiths, the Martinys.[63] Interested in the potential of the emerging steamship market, in 1835 he decided to try his hand at shipbuilding, producing his first steamer.[64] As he had no experience in this area, the vessel's plans and propulsion unit were directly imported from England.[65] Construction of the wooden hull with copper sheathing and installation of the propulsion unit —a 140-horsepower beam engine purchased for 110,000 francs from manufacturer Miller & Ravenhill[66]— were carried out by Vence, under the guidance of one of the Evans brothers, who had already supervised these operations on the *Henry IV* and the *Sully* at the Edward Church shipyard in La Seyne-sur-Mer. With the *Phocéen*'s launch approaching, on 23 March 1836, Benet officialised his project by creating a limited partnership with a capital of 300,000 francs —Louis Benet & Cie— with the help of wheat merchant Jean Luce,[67] banker Jacques Fraissinet, Antoine Benet and Toussaint Benet Fils. Each partner invested 60,000 francs in the business. The company, whose registered office was located in La Ciotat, was founded specifically for manufacturing steam engines and any other machinery, establishing one or more foundry workshops and constructing steamships.[68] As the technical aspects remained a weakness for the company —none of the partners had the required skills— Louis Benet & Cie was restructured on 16 November 1836. The Schneider brothers then contributed to the capital, bringing it to 450,000 francs.[69] The head office remained in La Ciotat,

61 Jean-Baptiste Falguière owned 50% of the capital invested, i.e. 500,000 francs (BdR DA, 390 E 484).

62 Patent dated 11 April 1854.

63 BdR DA, 548 U 3. In 1827, at the age of 22, Louis Benet was already running the family spinning mill in La Ciotat. While he does not appear to have undertaken any studies as such, his father did take care to send him to England so he could familiarise himself with the latest trends of the time. He returned from this experience highly impressed by the Buckley shipyards, in Liverpool Bay, where the first steamers were assembled.

64 Musée du Vieux La Ciotat, handwritten journal by Joseph Édouard Vence, 31 May 1835.

65 *Ibid.*, August 1835-March 1836.

66 Olivier Raveux, *Marseille, ville des métaux et de la vapeur au XIXe siècle*, Paris, CNRS éditions, 1998, p. 152.

67 Jean Luce belonged to the family circle. In 1824, he married Louis Benet's cousin, Anne-Marie Benet.

68 BdR DA, 548 U 3.

69 They hoped that this partnership would mean new prospects for them for sheet metal and forged parts produced in Le Creusot (Olivier Raveux, *Marseille, ville des métaux et de la vapeur…*, *op. cit.*, p. 134).

but the company opened a second site in Marseille, in the district of Les Catalans.[70] After Edward Church's initiative in 1818 in La Seyne-sur-Mer, the Provençal coastline boasted two new shipyards for constructing and repairing steamships.[71]

As the work was nearing its end, Benet and his partners decided to give the *Phocéen*'s construction a great deal of publicity to raise their company's profile and try to attract the first orders. They also set themselves an ambitious objective intended to impress: to circumnavigate the Mediterranean Sea in a steamship.[72] The bet was a bold one and applauded by the *Revue des Deux Mondes* with some rather Saint-Simonian emphasis on the achievements of steam navigation as a symbol of new ties between the Holy Alliance and the people.[73] The price of joining the cruise was set at 3,000 francs, including meals —the equivalent of more than six years' wages for a day labourer or three years' salary for a worker employed in a Marseille soap factory.[74] The meals served on board would comprise a buffet-style breakfast, lunch and tea in the evenings. Each passenger would be able to bring their servants —as special lodgings were reserved for them at the front of the vessel— at a cost of 1,000 francs per person. A doctor was also proposed for the entire duration of the trip with *médicaments convenables* ('appropriate medication')[75]. After various adjustments, the *Phocéen* made its way to Marseille on 27 May, attracting 40,000 curious visitors in the lead-up to the scheduled departure of 31 May.[76] The crew —who had received two months' salary in advance— comprised Captain Auzet, Second Captain Charles Raynaud from La Ciotat, a lieutenant, an English mechanical engineer (Charles Halton), a bosun, six seamen, a ship's boy, a ship's apprentice, a locksmith, a carpenter, six firemen, a first and a second waiter, a first and a second chef, six servants and a hairdresser. But contrary to what had been indicated in the brochures published in the press in mid-March, there was no doctor. The itinerary had also changed: Benet had advertised that the first stopover would be in Algiers, yet the journey commenced via the more conventional Italy. The *Phocéen* arrived in Civitavecchia on 14 June, Livorno on the 15th, Malta on the 23rd, Constantinople on 7 July where it remained until the 23rd, Malta again on 25 July, Algiers on 2 September, Mahón on 10 September, Barcelona on the 17th and Marseille on 18 September. The challenge of circumnavigating the Mediterranean Sea in a steamship had been achieved.

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70 BdR DA, 548 U 3 and 373 E 435.

71 Philip Taylor should not be forgotten here, even if he was not yet building steamboats at this time. Originally from Norwich, he arrived in Marseille in 1834 to install steam engines in a flour mill, before opening a construction workshop for stationary and marine steam machinery in the Menpenti district in 1835. In 1845, Taylor created a shipyard for constructing steamships in La Seyne-du-Mer (Olivier Raveux, "Un technicien britannique en Europe méridionale : Philip Taylor [1786-1870]", *Histoire, Économie et Société*, n° 2, 2000, p. 253-266).

72 Xavier Daumalin, "Le tour de la Méditerranée en bateau à vapeur. Arrêt sur image", in Xavier Daumalin, Daniel Faget, Olivier Raveux (eds.), *La mer en partage. Sociétés littorales et économies maritimes, XVIe-XIXe siècle*, Aix-en-Provence, PUP, 2016, p. 241-253.

73 *La Revue des mondes*, vol. 6, 1836, p. 372-373.

74 *Compte rendu des travaux de la société de statistique de Marseille*, vol. 4, 1840, p. 52-53.

75 *Le Sémaphore de Marseille*, 19 March 1836.

76 *Le Sémaphore de Marseille*, 29-30 May 1836.

Bolstered by this success, Benet received his first orders and initiated other constructions: the *Rhône*, the *Hérault* and the *Saumon*, in 1837; the *Vésuve*, the *Utile* and the *Phénicien*, in 1838. Each time, the engines were ordered from England, and the role of the workers in La Ciotat was limited to hull construction. The company's restructuring and increase in capital in 1839 —the Schneiders withdrew to be replaced by Baron James de Rothschild, a major representative of the network of the Grands'Combiens[77]— then the subsequent contact with John Barnes, James Watt's godson and specialist in marine engines,[78] allowed Louis Benet & Cie to overcome several technological hurdles. In 1841, it was Barnes who produced the two 70-horsepower steam engines for the *Phocéen II*, the first vessel to be equipped with marine engines constructed in the La Ciotat workshops. Together with the Frenchman Frédéric Sauvage, Barnes also took an interest in propeller propulsion. In 1842, he was working in the Augustin Normand shipyards in Le Havre, where he contributed to the construction and launch of the first French iron-hulled propeller-driven vessel, the *Napoléon*.[79] He definitively settled in La Ciotat in December 1844, which boosted the shipyard's technical capabilities. Under his leadership, the workers experimented with new prototypes. In 1846, Benet thus had a new steam engine model patented, one that was specially designed for propeller propulsion; in 1847, Benet and Barnes launched the *Bonaparte*, their first iron-hulled propeller-driven passenger ship.[80] During testing, the vessel exceeded twelve knots. This not only significantly surpassed the *Napoléon*, beating its record by one and a half knots, but it outdid even the *Philippe-Auguste* of Compagnie Bazin, the fastest ship on the Mediterranean.[81] With the arrival of John Barnes, Marseille's shipbuilding industry elevated itself to the cutting edge of technological modernity.[82] In total, between 1836 and 1851, the year Louis Benet & Cie was taken over by Messageries nationales, 37 steamers emerged from Louis Benet's shipyards. Nine of these were bought by the French state;[83] 14 were ordered by Marseille shipowners Périer, Thérond, Fraissinet, Bazin, Sicardo and

77 The capital amounted to 900,000 francs, and later 1,350,000 francs (1843). In 1839, Louis Benet & Cie also became involved in the construction of locomotives (Xavier Daumalin, Olivier Raveux, "Aux origines de l'industrie moderne marseillaise : l'œuvre de Louis Benet et de Philip Taylor [1830-1850]", *Rives méditerranéennes*, n° 45, 2013, p. 19-35; Xavier Daumalin, "L'atelier de construction ferroviaire Louis Benet & Cie à La Ciotat [1839-1848]", *Revue d'histoire des chemins de fer*, No. 28-29, 2003, p. 27-43).

78 John Barnes was born in Newcastle in 1798. After working for a time in the workshops in Soho, in 1822 he founded a marine machinery construction company in London together with Joseph Miller, an associate from his years of being apprenticed to James Watt. Around 1835, Barnes left this company and opened a mechanical engineering firm, again in London.

79 120-horsepower ship intended for the postal service between Marseille and Ajaccio (Jean-Louis Maillard, "La construction navale au Havre de 1830 à nos jours", *Études normandes*, No. 3, 1980, p. 41-68).

80 Built for the Corsican company Valéry Frères for its Livorno–Bastia line, the *Bonaparte* sank just a few weeks after its launch following a collision with the steamboat *Comte de Paris*.

81 *Le Peuple souverain*, 15 May 1847.

82 In 1850, Barnes even received the Legion of Honour for the construction of the *Charlemagne*'s engine. It was the first time in France that a propeller-driven engine with four horizontal cylinders had been produced (Alfred Ledieu, *Traité élémentaire des appareils de navigation*, Paris, 1862, t. I, p. 598).

83 Benet also produced several machines for Toulon's naval base: two 160-horsepower boilers (1843 and 1854); two 120-horsepower machines for the *Salamandre* (1846) and the *Ariel* (1847); a 450-horsepower engine for the *Castiglione*, 1849 (Archives of the Service historique de la marine, Toulon, 1 G^4 131).

Rostand; and 14 others were built on behalf of shipowners from Lyon, Corsica and Italy. Not to mention all the maintenance and repair work carried out in collaboration with the numerous Marseille smithies and boilermaking workshops or larger mechanical construction companies, like Philip Taylor's in the district of Menpenti.[84]

A key instrument in controlling time factors and trade, recomposing trans-Mediterranean trade dynamics and differentiating maritime port economies, the steamship was a disruptive innovation that had major structural impacts. Its widespread implementation in Marseille's merchant navy in the 1830s to 1850s thrust the whole port community into industrial economy reasoning and resulted in a lasting reconfiguration of practices, tools, flows, operating areas (docks and shipyards) and its relationship with the environment. It was a sort of second foundation of the Port of Marseille. The innovation was largely financed by local entrepreneurs through partnerships limited by shares[85] (nearly 85% of company deeds found), with an average share capital of around 900,000 francs at the time of creation[86] and an imported technology through Anglo-Saxon specialists, who in under twenty years helped Marseille elevate itself to the forefront of modernity in this area. Steam power gained ground, but wind power held out and did not disappear. The first steamers still had sails and were ultimately composite ships, hybrids, sometimes using steam, sometimes sails, and sometimes even both propulsion methods at the same time. In fact, up until the late nineteenth century, clippers remained competitive on long distances outside the Mediterranean.[87] Finally, within the Mediterranean Basin, not all ports were able to accommodate steamers, whether this was because they lacked sufficient depth, their equipment and infrastructures were unsuitable, or there was simply no market for freight, these points all contributed to leaving the sail-based merchant navy a reprieve and in the end a niche. The energy transition in Marseille's merchant navy initiated under the July Monarchy was therefore more concerned with diversifying the energy supply than finding energy alternatives, with various socio-technical systems coexisting in line with the variety of needs of trans-Mediterranean trade at the time.

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84 Olivier Raveux, "Un technicien britannique…", art. cit.

85 The status of *commandite par actions* (partnership limited by shares) helped attract more capital than would a general partnership, without the constraints of a public limited company, which is subject to prior investigation by the state. Limited partners are only liable for company losses up to the amounts invested (limited liability), which reassures prominent citizens, finding themselves more easily persuaded to invest than in a partnership where all partners are liable and risk their personal assets (unlimited liability). In addition, shares are transferable without the consent of the other partners, unlike in a limited partnership where partners cannot sell their shares without the prior consent of the other partners.

86 Figure calculated based on the foundation deeds for 18 steam navigation companies founded in Marseille between 1831 and 1855.

87 Jean-Louis Lenhof, "Voile ou vapeur. Étude sur le travail à bord des cargos long-courriers français de la fin du XIXe siècle (1880-1920)", *Revue d'histoire maritime*, nº 5, 2006, p. 99-102.

Vessels	Revenues	Share of freight	Share of passengers	Share of mail	Expenditure	Share of coal	Profits
Bosphore	51,180	88%	10%	2%	47,346	39%	3,834
Hellespont	45,269	82.5%	16%	1.5%	47,035	45%	-1,766
Bosphore	52,817	73.6%	25%	1.4%	47,099	43%	5,718
Hellespont	55,258	77.4%	21%	1.6%	53,747	43%	1,511
Bosphore	63,397	68.3%	23%	8.7%	50,401	45%	12,996

Table 1: Extract from logs for journeys 43 to 48 undertaken in 1849 by the Compagnie Rostand paddle steamers *Bosphore* and *Hellespont* on the Levant line (in francs). Source: MPCCI archives, MR 4.4.6.2.1., 1849.