Spanish Entrepreneurs and British Technology in Early XIXth Century Andalucia

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The picture of Andalucia conjured up in the mid-nineteenth century was of a wasteland inhabited by a carefree and merry people. 'In spite of a fertile soil and beneficent climate', wrote Ford, 'almost half Andalucia is abandoned to a state of nature'. [1] Viticulture was the major source of wealth and 'When we think of Malaga', noted another, 'it is generally in connexion with its wines'. [2] The rewards of the wine trade were enjoyed by a small group of magnates, who were moved to develop Malaga province into a metallurgical, chemical and textile centre. Labour was both abundant and cheap, while the hinterland was rich in mineral deposits. Capital was available for industrial projects from the wine and fruit trades,in which the Larios family and the 'wealthy and speculating house of Heredia' had already demonstrated their entrepreneurial ability. Among Spanish historians of Andalucia Montoro has highlighted the contribution of Manuel Agustin Heredia, in particular, as a prime mover in the commercial and industrial development of Malaga. [3] The emergence of this province as Spain's second industrial

[1] Richard Ford, *Handbook for Travellers in Spain* (Third Edition London 1855), Part. I, pp. 127-29.

[2] Henry D. Inglis, *Spain* (London 1837), 2 vols, II, pp. 104, 136-52.

[3] Cristobal Garcia Montoro (Universidad de Malaga), 'La Fortuna De Manuel Agustin Heredia. Contribucion Al Estudio De Los Niveles De Requeza De La Alta Burguesia Malaguena Del Siglo XIX', Andalucia Contemporanea (Siglos XIX y XX), Tomo I, *Actas Del I Congreso De Historia De Andalucia*, Diciembre De 1976 (Publicaciones Del Monte de Piedad y Caja De Ahorros De Cordoba 1979). Cristobal Garcia Montoro, *Malaga en los comienzos de la industrializacion: Manuel Agustin Heredia, 1786-1846*. Cordoba, 1978, Instituto de Historia de Andalucia.

region stemmed from the enterprise of a group of entrepreneurs, whose business activities he analyses from a study of documents relating to inheritance. Montoro contends that individual fortunes and the concerns of whole groups of businessmen can be reconstructed from research into personal estates. By reconstructing Heredia's wealth from the inventories, partitions and other legal documents relating to Heredia's assets, Montoro identifies an entrepreneur of the cross-entrant type, whose enterprise extended through commerce, industry and finance.

This article is concerned with Heredia's role as an entrepreneur in manufacturing and his efforts to exploit the expertise possessed by engineers and machine-makers in Britain, which led contemporaries to hail him as 'el primer capitalista espanol'. Heredia had already amassed a personal fortune from trade before he struck out in a new direction. Once manufacturing exercised his attention, however, it drew him into a lengthy investigation of the technical and organisational arrangements evident in contemporary British industry and the feasibility of their transfer to Spain.

At his death in 1846, Heredia's assets net of liabilities amounted to the immense sum of 60 million reals and included ships (2.4 million reals), commercial and factory premises (3.7 million reals), real estate in town and country (3.7 million reals) and goods, credits and cash (50 million reals). Heredia's fleet of 18 vessels — twelve of them brigantines — indicates his earlier activity in shipping. In the period of Latin American independence, Heredia contrived to maintain trading links with South America by employing British and American owned shipping. He subsequently played a pioneering role in the restoration of Spanish overseas trade with the Latin American republics, and in 1846 the House of Heredia was still a commercial concern, importing sugar, coffee and indigo dyes from South America. Other produce of the Americas was also stored in the extensive and valuable warehouses owned by Heredia in Malaga, from where wines and soaps were exported to his principal

markets in the Antilles and South America. After discharging cargo at ports such as Havana, Montevideo and Valparaiso, Heredia's vessels returned with cocoa, indigo and other commodities.

By far the most valuable goods stored by Heredia were wines, cocoa and soap, reflecting the main activities of Casa Heredia in Andalucia. The estate included four country haciendas, a vast tract of land in the Marbellan Hills and three farmsteads with vineyards, named 'San Jose', 'San Luis' and 'Don Timoteo'[4]. In Malaga itself, this 'Camerano' gentleman possessed three soap works in the Perchel district, not far from some of his warehouses in Calle de Cuarteles. Heredia was the largest soap manufacturer in the Peninsula, and held considerable stocks of barilla stored in Malaga's industrial districts. Barilla grown in Spain and elsewhere was a source of the soda required for soap boiling and Heredia was keen to learn of the methods of manufacture employed by soapmakers in Liverpool and London. Another valuable commodity was lead, which Heredia consigned in a variety of shapes to dealers in St Petersburg, Hamburg, Rotterdam, Lille, Le Havre, Lisbon, Marseilles, Leghorn, Trieste and Odessa. The pigs, rolls, slabs and bars of lead were produced at the 'San Andres' lead factory in Adra. Andalucia was rich in lead and graphite and Heredia had first begun to amass a fortune from mining them in the turbulent period between 1808 and 1814.[5] After 1823, when the exploitation of lead ores was

[4] It is likely that Heredia, in common with other members of Malaga's business community, advanced cash to farmers secured on their crops having beforehand established mortgages on their premises. 'Don Timoteo' was certainly purchased in 1826, as was 'Las Chapas', the tract of land in the Marbellan Hills, which was probably bought to secure the supply of wood for the Rio Verde plant in a period of deforestation. Heredia bought the land in 1846 from a retired cavalry colonel for 60,000 reals.
Cristobal Garcia Montoro, 'La Fortuna De Manuel Agustin Heredia...', op. cit. p. 370.

[5] Manuel Agustin Heredia originated from Logrono in the north and arrived in Andalucia in 1804. By the 1840s the Heredias were described by a visitor to Malaga as the 'Barings of this port'. As a leading exporter of wines and olive oil it was appropriate that he should become president of the Merchants' Guild of Malaga in 1826. His wife, Isabel Livermore, was half English and sister to the wives of Serafin Calderon, the writer, and Jose de Salamanca, the financier and gallant; Jordi Nadal, 'The Failure of

freed from state regulation Casa Rein y Compania set down a lead smelting and processing works at Adra. Heredia did not initiate this venture, but purchased the enterprise in 1837 when it had disappointed the hopes of the original promoters. Low yields had already persuaded the company to install English furnaces and additional machinery imported from abroad, fitted and operated by British workers. Heredia sensed that the lead factory possessed considerable potential if managed well and he set about overcoming the obstacles to profitability. One of these was the behaviour of Almerian customs officials, who mistakenly imposed the duty for unfinished lead on Adra's exports of sheet and tube lead. This misunderstanding was cleared up by a Royal Decree solicited by Heredia and framed to his satisfaction.

The turnabout in productivity at Adra was undoubtedly due to the use of British plant. This included a 14 h.p. blowing engine built by Rothwell, Hick & Rothwell in 1827, ten years before Heredia purchased the 'San Andres' foundry from Collman, Lambert & Co., London. At the time of the purchase, as Heredia himself pointed out in his tract, 'Reform in Customs Legislation, with a view to increasing import and export tariffs, demanded for the development of national industry, and of the navy, and the protection of trade', the lead-making plant was 'a large building, which, as a factory, possibly has no rival in England as far as reliability is concerned'. [6]

THE INDUSTRIAL REVOLUTION IN SPAIN 1830-1914', CARLO M. CIPOLLA (ed.), *The Fontana Economic History of Europe* (1973), p. 600; MARY FITTON Malaga. The Biography of a City (London 1971), p. 186. SERAFIN EATABAN CALDERON was a journalist who, 'under the entirely inappropriate pseudonym of El Solitario, was also an Arabic scholar, military historian, essayist, playwright and accomplished man of the world'. Salamanca 'made his first fortune in five years out of salt and railways and negotiated loans for the Government to make possible the continuation of war with the Carlists. Ruined by a quarrel... he was a millionaire again shortly afterwards, and survived three tremendous bankruptcies...'.

[6] M.A. HEREDIA, *Reformas de las leyes de aduanas con el objeto de acrecentar los aranceles de importacion y exportacion exigidas para el progreso de la industria nacional y fomento de la marina y protecicon del comercio.* Malaga (1841).

Technical excellence was embodied in the reverberatory furnaces for foundry work, the 'pavas' or open-hearth furnaces supplied with air from the blowing engine, and the lead-sheet and tube-drawing shops, as well as the powered machines and rolls that had also been imported from Britain. Under Heredia's control, the output of lead sheet and tube for overseas markets increased rapidly, rising from 8,872 quintal in 1839 to 15,589 quintal in 1840.[7] Heredia made grand claims for the lead foundry in his tract, arguing that 'San Andres' was not only capable of supplying Spain's foreign markets but also of competing with other free-trade suppliers in the Americas. In Heredia's opinion, the improved technology of lead manufacture afforded by the adoption of British machinery, would result in enlarged exports. He argued that prospects were equally encouraging in other trades, where the techniques and organization of manufacture first worked out in Britain could be applied by a new generation of industrialists. In Heredia's case, these techniques were successfully applied in soap, textile and chemical works modelled on those seen at first hand in Britain. Moreover, the ambition of Heredia was such that he also invested in costly plant for the smelting and puddling of iron, and for a time

[7] The destinations overseas were as follows:

Table 7

THE OVERSEAS DESTINATIONS WHERE AS FOLLOWS:

		Quintals	Tons
In 1839	Lisbon	1,117	50.89
	Marseilles	2,347	106.28
	Liorna	540	24.45
	St. Petersburg	4,868	220.45
		8,872	401.78
In 1840	Marseilles	5,430	245.90
	Odessa	2,959	134.00
	Kronstadt	6,390	289.38
	Trieste	810	36.68
		15,589	705.96

Note: 1 Quintal (100 Libras) = 101.442 Pounds.

his ironworks at Marbella and Malaga surpassed those of the Basque region, the traditional centre of iron manufacture in Spain.

II

Heredia was one of a group of promoters who, from 1826, exploited magnetic iron ore deposits at Ojen, near Malaga, with charcoal-fired blast furnaces erected on the bank of the Rio Verde. The Malagan businessmen behind the 'El Angel' and 'La Concepcion' companies, as well as the proprietors in Seville and Cadiz behind the 'El Pedroso' company in the province of Seville, were responding to the same stimuli. One was the interruption to Hispano-American commercial relations, arising from the extinction of viceregal Peru in 1824 and the authority of the Spanish Crown, that brought about drastic changes to established trading ties and a redirection of investment. Another stimulus to industrial activity in Malaga was the new mining legislation that promoted ore processing by granting licenses for the use of water and the supply of charcoal; a new Customs and Excise policy that was a protectionist instrument aimed at securing the development of the domestic iron industry; and the local demand for strap-iron on the part of Andalucian coopers whose demand was derived from the wine trade. This nascent iron industry in Andalucia was further encouraged by an increased demand for iron after 1830, at a time when the Basque region was technically backward and in decline because of the loss of colonial markets and the decay of the Spanish navy. Entrepreneurs in Andalucia also benefited from the First Carlist War (1833-40), which disrupted production in the north and directed demand to their works.

'La Concepcion' should have been a well organised enterprise, because Francisco Antonio de Elorza was numbered among the ten founder proprietors of the company and Elorza was a notable figure in Spain's metalliferous industries. Trained as an artillery of-

ficer, Elorza studied at close hand British, French and Belgian methods of iron making following his exile from Spain in 1823. On his return home Elorza established and later had charge of the 'El Pedroso' ironworks and enjoyed a demand for his services elsewhere in Spain. Between 1826 and 1830 Elorza set down the 'La concepcion' works, whose purpose was the manufacture of hoop and sheet iron for wine and olive-oil casks. 'La Concepcion' had an authorised capital of 2,050,000 reals, divided into 82 shares of 25,000 reals each and distributed among the founding proprietors, of whom three shareholders managed the concern through an elected Board of Governors.

The object of the company was to exploit the hard and rich iron ore in the Sierra Blanca to the north west of Marbella. To that end the managerial function of the Governors was explicitly stated in the document of incorporation. The Chairman had 'as his chief mission, the tasks of directing Company operations, finding sales for the processed ironwork items [and] sending these to the most suitable selling areas'. In detail, he had 'to attend to budgeting procedures in the purchase of coal'; to the 'transportation of minerals and (mining) implements'; to the 'efficient performance of subordinates; to set up an accountancy system at Marbella, befitting this type of concern; to similarly establish, at Malaga, an accurate and efficient book-keeping system'. [8] The Chairman had also to keep up a weekly correspondence with the Managing Director of the firm and the Executive Director at Marbella, as well as routine correspondence with consumers, or sales staff, at the sales outlets. Quarterly accounts had to be prepared by the Chairman, which it was the duty of the two Counsellors on the board to examine, in addition to a General Balance at the year's end. This rigorous attention to management reflected the desire of the founders to exercise

[8] It was also '... the responsibility of the Chairman to foment any activities that might lead to the Company's eventual succes...' Article 12 of the document of incorporation. Cristobal Garcia Montoro, en los comienzos de la industrializacion, op. cit. p. 60.

a firm grip over the concern's operations. Indeed, a preferential right to buy shares was conferred upon founder shareholders in order to forestall the appearance of interlopers. The precedence enjoyed by the founders and set down in the document of incorporation ultimately permitted Heredia the opportunity to gain a controlling interest in 'La Concepcion', once the subscribers took fright and became fearful of losing their capital.

From the outset, mining and smelting operations at 'La Concepcion' gave rise to considerable anxiety. A British visitor passing through the region in 1838 had an opportunity of inspecting the iron mines in the barren hills above Marbella. He 'was astonished by the ease with which the ore is procured, it being almost on the surface of the ground. About 500 donkey loads are daily sent to a smelting furnace near the town'. In contrast to the well defined managerial role of the Board of Governors, mine management was remarkable for the absence of any systematic planning and development of the ore site. Mining and dressing operations, not to mention the problem of transport, received scant attention with the aim of minimising long-run costs. The mining of ore was ill thought-out and, in the opinion of the District Engineer Francisco Sales Garcia, stemmed from the abundance of rich ore found close to the surface. Several times Garcia warned the proprietors that they had adopted poor mining procedures, that the ore was worked '... under appalling conditions, involving surface-trench-digging or open-cast methods', which wasted vast amounts of ore among the debris and rendered 'conventional, methodical workings' more costly to set in place than would have been the case at the outset. Garcia argued that it was inevitable that the miners would work the ore in a manner that suited them where no proper direction of labour was enforced. When the miners encountered difficulties in the extraction of ore

> they abandon those workings, and start afresh above or below. What then happens is that the debris from some diggings will fill others up; the

> mountainside in these parts gives the general appearance of a pile of stirred-up earth. Furthermore, vast amounts of the ore are wasted, being disposed of along with the debris and which are then washed down by rainwater, since they only send the large pieces weighing from one to two pounds upwards, to the factory. This is all due to the abundance of ore,...

The smelting plant itself sorely tested the subscribers. Under the direction of Elorza, an ore-reduction plant was built beside the Rio Verde and the main channel dammed to provide power. The site had been chosen with regard to the supply of ore and fuel. The wood for the furnaces was obtained from the surrounding hills and the ore brought by pack animal over a distance of 1 1/2 leagues from the workings at the rate of 40 reals per quintal. After four years of activity, the site was ready to smelt iron in 1830 by means of the Catalan method, a smelting technique based on charcoal blast furnaces. The use of this age-old technology was commercially sound, given the limited extent of the local market and Marbella's isolation from major European markets. Furnaces that could be shut-down and fired with ease suited the unpredictable nature of demand for Marbellan iron. Nevertheless, the traditional smelting technology set down on the Rio Verde proved a failure.

'La Concepcion' performance reveals that the ore was difficult to smelt with the limited heat from conventional furnaces. A combination of inconclusive tests and inexperienced personnel led to mounting costs, which sapped the spirits of the partners. With the exception of two or three partners, the partnership was seen to be self-destructive as far as personal fortunes were concerned and shares were relinquished into Heredia's hands. He willingly accepted the shares of his wavering partners in order to avoid the ruin of the company. Undaunted by the setbacks to the charcoal smelting process, however, Heredia embarked upon a thorough revision of iron making with Elorza as his adviser. The Catalan forges were replaced by charcoal-fired Belgian (Walloon) forges and two years later in 1832 English puddling furnaces were in use. The supply of charcoal-blast iron at Rio Verde for making cast-iron products was

not achieved until 1832, when it became possible to refine pig iron into wrought iron by means of coke forging. Success at Marbella encouraged Heredia to build a new plant, one that embodied the new technology of iron making.

Production at 'La Concepcion' was thus dependent upon old and new technology. The 'La Constancia' ironworks, built from 1833, at the seaside resort of Playas del Carmen, a short distance from the centre of Malaga, was intended from the beginning to match the most advanced plants of its kind abroad. The Marbellan works had from the start presented a costly fuel problem. Shrubs and pines from Ronda's sierra had fired the furnaces and forges at Rio Verde, but puddling required coal and this had to be brought from either Asturias or Britain. But the cost of transporting fossil fuel from the north was high, while imported coal was subject to a duty. If coal fuel was basic to the success of new technologies in iron and other industries, the dependence on coal was also the Achilles' heel to industrial enterprise in the south.

III

Heredia was only too well aware of the vulnerability of his ventures to low-cost producers and for several years he strove to modify Spain's protectionist tariff legislation to his advantage. Until 1832, coal imports were forbidden: Heredia won an exception for the lead foundry at Adra. High duties replaced the ban and four years later Heredia secured a personal reduction on the punitive duties levied on coal — extended in 1837 to all industrialists — because of the needs of his ironworks. At the close of the Carlist War tariff reform became an issue of state and Heredia articulated the desire of Malaga's ironmasters for a protectionist policy. In a paper submitted to the Customs Tariff Review Board, the 'La Constancia' company argued that their model ironworks enjoyed a 'right to pro-

tection' in order to 'establish a level in price-differentials as applicable to national and English fuels, and the higher costs in manpower'. Without protection, the company argued, manufacture at Malaga would be impossible.

The Andalucian ironmasters petitioned for a tariff that would have raised the price of imported iron to a level 8.3 per cent above that which the Review Board was prepared to sanction. Protected to this extent 'La Constancia's' promoters claimed they could face the future with equanimity, because they could turn out all manner of iron and compete 'from the quality standpoint' with the advanced economies. At some point in the future, 'La Constancia' hoped to overcome the problem of costly fuel. In the meantime, the venture required the support of the state:

> This mercantile concern, which currently needs the protection of the Government through its Customs Tariffs, sees before it the possibility — in the not too distant future — of exporting its products, and to place them on the American market in competition with those of England and Belgium boasting of the superior nature of the quality of its ironwork, and a similar degree of perfection in craftsmanship... Only one problem remains in abeyance, which can be surmounted by using two separate approaches already embarked on by the 'La Constancia's' partnership: either to acquire the fuel at prices in line with those abroad, or process the iron whilst using low amounts of it. [9]

Heredia had pursued the first approach since 1836 and as he was a member of the Customs Tariff Review Board the southern ironmasters could look with confidence to their interests being taken seriously. Andalucia's lack of anthracite and the high cost of inland transport was the greatest challenge facing the region and Heredia realised that this bottleneck threatened the existence of its iron industry with the return to production of Basque capacity. But the case for protection that Heredia advocated for Andalucia's

[9] *Empresa de la ferreria en Malaga titulada La Constancia.* Memoria presentada en la Junta Revisora de Aranceles acerca de los derechos de importacion que deben imponerse a las planchas y flijes extranjeros para proteger la fabricacion de estas clases en Espana. Madrid (1840).

iron ventures applied with equal force to the Asturian coal industry. Here Heredia had to modify his case to suit the iron interests, thereby conceding that his argument was no more than special pleading.

In 1832 the Asturian coalfield was so poorly organised that the government was successfully pressed into permitting the import of coal. Four years later, Heredia secured a Royal Decree granting him a unique exemption from the general system of regulations. Henceforth, all foreign coal destined for 'La Constancia' was subject to a reduced duty. But his triumph was short lived. The concessionary tariff — extended to all importers in 1837 — remained unchanged until 1849 and further efforts to reduce the cost of foreign coal during these years were successfully resisted by Asturian mining interests. Protection became the aim of the Asturian coal industry and Heredia himself accepted the case for a moderate coal duty. His need was anthracite supplied cheaply and reliably and he argued that the best possible protection calculated to stimulate domestic mining should take the form of improved roads and harbours, and the building of railways. By improving the infrastructure of the region external economies of scale would accrue to the coal industry, so that, in Heredia's words, 'not even a single quintal will be imported from foreign parts'. But he added that for so long as the Asturian coalfield remained in a 'state of infancy', it was imperative to import keenly priced coal in order to save factories from failure. The 'coal war' was ultimately lost in 1844, when the Review Board agreed by a majority of seven votes to six to maintain the existing tariff. This decision placed the burden of competitiveness squarely upon the shoulders of the southern ironmasters themselves.

By 1841, the smelting and refining of iron at Marbella and Malaga was a major enterprise of Heredia, who had chosen the provincial capital for the site of 'La Constancia' in order to reduce freight and haùlage costs. Freight rates had always been high and were

even higher in the case of ports which did not offer 'drawback' facilities (refunds on the duty paid). Marbella had little export traffic and belonged to this category of ports.

Moreover, the cost of transport inland to 'La Concepcion' by pack animal was heavy. Heredia was also drawn to Malaga by the capital's plentiful supply of cheap labour and his desire to exercise a firm grip on the business. [10] The erection of a new ironworks at Malaga meant that iron manufacturing was divided between two sites. At Rio Verde, the ore was smelted and the pig iron despatched for refining at Malaga, where wrought iron was produced by puddling and rolling. Contemporary descriptions of 'La Constancia' acknowledged that the imported plant represented the latest and most sophisticated innovations in iron refining. This was to be a characteristic feature of Heredia's manufacturing enterprises. He himself had travelled to Britain in 1840, visiting Butterley & Co. where anthracite was in use and ordering equipment from them that offered a saving in fuel.

Cast-iron and wrought-iron goods were intended to be produced on an ambitious scale at 'La Constancia', as Malaga's *Boletin de Comercio* reported in 1833:

> just outside the City limits, the foundations are being laid for the great iron-fining plant of the Marbellan Mining Group, and, as soon as the plant is operating, it is quite probable that besides being capable of supplying the entire Kingdom, we may still have some left to export overseas.

Best-practice equipment and skilled foreigh labour, too, were the means by which Heredia hoped to prosper as an ironmaster. The plant erected at Malaga was modelled on the ironworks found in Britain and by 1841 Heredia was regarded as the leading figure

[10] By splitting the iron enterprise between two sites certain losses were inevitably incurred. Cast-iron bars produced at the Rio Verde plant were carried by pack horse to Marbella from where the iron was shipped to Malaga. In addition to carriage charges by land and sea there were charges due to loading and unloading operations which pointed to the disadvantages arising from a split site: the high cost of haulage; the out-right loss of same consignments in storms and the increases in management and accountancy costs, as well as the greater scope for error.

in Spain's foundry trade, a position directly attributed to the latest technology and operating procedures which were constantly being improved. The *Boletin Oficial de Minas* of 15 June, 1844, noted that these improvements were due to the restless spirit of the directors, who through frequent visit overseas, kept up to date with all types of innovations and improvements. In 1841, 'La Constancia' possessed 19 puddling furnaces, six annealing furnaces, a cupola furnace and three reverberatory furnaces for foundry work. Three steam engines with a combined power of 100 h.p. had been installed, along with a ventilation plant for the cupola furnace. The increasing strength of demand eventually led to the erection of two additional blast furnaces in 1843, that made 'La Constancia' a truly integrated ironworks; one that was to dominate Spain's iron industry for another two decades.

IV

A visitor to the Malaga ironworks in 1845 noted that the changes introduced in the practices of this company were the finest example of the 'serious influence which, in future, the far-reaching industrial concepts of Don Manuel Agustin Heredia shall exert...' Heredia's ambition already extended into several enterprises at this time. The 'San Andres' lead foundry had become a model factory of its kind in Spain, while Heredia's interest in the manufacture of hard soap had moved him to urge custom reform for the benefit of the Spanish soap industry. Arising out of the interest in soap was a venture in industrial chemicals closely bound up with another industrial enterprise in textiles. The chemical factory was sited beside 'La Constancia' with the aim of stimulating the local soap industry through the manufacture of stearine, a commodity used in the production of soap and candles, and artificial Barilla in the form of sodium carbonate (soda), another ingredient of hard

soap. Six large lead-clad chambers were at the heart of the manufacturing process for sulphuric acid. While this gave rise to a useful bleaching agent, more significant was the manufacture of 'artificial Barilla' with sulphuric acid, an indication of the adoption of the Leblanc process. The production of Leblanc soda was yet another instance of Heredia's desire to overcome manufacturing difficulties by adopting proven technologies from abroad. In the case of the chemical factory, a contemporary Spanish commentator noted that no expense, nor effort, was spared to put it on a superior technical footing and to surmount the problems of a type of manufacture that was absolutely new in Spain. [11]

The chemical venture was associated with Heredia's other, final, initiative as an industrial capitalist: the manufacture of textiles. 'Industria Malagueña' was a mill adjoining 'La Constancia' built in cooperation with Paul and Martin Larios, for the spinning and weaving of cotton and the processing of flax and hemp. Registered in May 1847, 'Industria Malagueña S.A.' was the second limited liability company in the Spanish cotton industry. Ownership and control of the firm was retained by the families of the three principal entrepreneurs. The purpose-built mill that they commissioned included fuel and raw material warehouses, and workshops for machinery repairs. Homes were also provided nearby for the mill employees and their dependents. The nominal capital of 4,800,000 reals was raised to erect a mill in the 'English style', with spindles and looms driven by steam power in premises served by gas lighting. By 1852 'Industria Malagueña' was employing 1,400 adults and juveniles and the firm's success encouraged Carlos Larios to set up another firm, the 'La Aurora'. These industrial developments in Andalucia were achieved by adopting the capital

[11] V. Martinez Montes, *Topografia medica de la ciudad de Malaga.* Malaga (1852), p. 450.

equipment of the leading industrial economy and Heredia was by far the most important of a small group of entrepeneurs, who attempted to fulfil their ambitious schemes by exploiting the new technologies evolved in Britain. [12]

In order to emulate her manufacturers of textiles, iron and chemicals, Heredia was compelled to rely upon a knowledgeable and experienced British engineer, who could be trusted to give shape to his schemes. In 1827, the lead foundry at Adra had received a blowing engine from the Union Foundry of Rothwell, Hick & Rothwell of Bolton, Lancashire. Five years later, Benjamin Hick (1790-1842) retired from this partnership, where he had managed the steam engine department, and began to trade on his own account as Benjamin Hick & Son. The Soho Foundry of Hick & Son flourished by satisfying the demand for stationary engines and millwork. At the same time Hick's firm was organised to build steam locomotives. hydraulic presses, weighing machines, gas light apparatus and 'Fire Proof Buildings'. As well as equipping his shops with machine tools purchased from Nasmyth, Gaskell & Co. Hick also designed and built self-acting machine tools. Hick belonged to that pioneering group of British tool builders, who devised and developed distinct types of machine tools for specific machining operations. Planing and radial drilling machines were two of the tools associated with Hick.

Hick was both an inventor and a practitioner of the new technology who aimed to substitute self-acting tools for the craftsman's hand. He had acquired his skills as a pupil of Matthew Murray (1765-1826) at Fenton, Murray & Wood in Leeds, who rivalled Boulton & Watt in the market for millwork, engines and tools built to new principles. When Hick arrived in Bolton in 1810, the textile

[12] For a quite contrary assessment of the relative vigour of the Southern business community see C. Harvey & P. Taylor, 'Mineral wealth and economic development: foreign direct investment in Spain, 1851-1913,' *Economic History Review*, vol. XL, no. 2, May 1987.

industry had already stimulated the growth of machine and engine-making trades. Dobson & Rothwell (later Dobson & Barlow) had catered to the demand for textile machinery since 1790. The Union Foundry established a decade later by Peter Rothwell, a wealthy timber merchant and contractor, attracted first John Musgrave (foundryman) and then Benjamin Hick (draughtsman) from Yorkshire. In the 1830s, Musgrave was Hick's foreman and other members of his family were employed by Hick in the pattern shop and foundry, before John Musgrave & Son, engineers, millwrights and iron-founders, was formed in 1839.

In 1814-15 there were four iron foundries and five machine works in Bolton; a decade later Baines enumerated ten iron and brassfoundries and nine machine makers. [13] These firms had been brought into being by the market for power, which encouraged new entrants into an industry increasingly distinguished by product specialisation as the century advanced. In Hick's lifetime there were compelling reasons in the structure and extent of the market for the attention given by engineers to all classes of work. Hick & Son were active in the manufacture of stationary steam engines and steam locomotives, cast bevel wheels for power transmission and cast gate posts, presses for olives and hydraulic presses for bleaching, because demand was cyclical while no one class could cover fixed costs and allow the retention of skilled hands.

The Soho Foundry exhibited the fixtures and fittings of a keen mind focused on familiar practical problems. Robert Daglish, a friend of Hick, was 'fully aware you will have no difficulty in keeping pace with others in the trade', while it was publicly acknowledged that Bolton's extensive foundries were about to receive 'an important addition... by Messrs Hick & Co. adjoining the railway'. Hick's ingenuity expressed itself in his solution to the problem of

[13] EDWARD, *History, Director and Gazetteer of the County Palatine of Lancaster* (Liverpool 1824).

coping with heavy articles in the process of assembly, namely a branch railway running throughout the whole works with its separate and distinctive departments, and linked to the adjoining Bolton and Leigh railway. What Daglish referred to in 1833 as the 'large establishment' projected by Hick, was intended to be an improvement over neighbouring works and their practices of assembly and manufacture. By 1841 the large establishment was in being, equipped with machine tools adapted for slotting, cutting and planing. Hick had announced in 1833 that he was about to begin the 'general business of Engineer, Millwright and Ironfounder' at his new works 'now erecting'. He had also declared his intention to 'take every advantage of the most recent improvements in machinery'. At his death, the 'encouragement which he extended to talent of all kinds' was recognised by his peers, who also testified to the devotion he gave 'to almost all branches of mechanics'. [14] In Benjamin Hick, Heredia found more than a supplier of plant and machinery; he also found a capable collaborator, translating and interpreting Heredia's ideas for state-of-the-art structures in iron, textiles and chemicals' manufacture.

V

For Heredia Hick represented the experienced and skilful tool-user, the talented engineer and draughtsman,the respected and successful master of a machine-making enterprise, who could translate and transfer knowledge of those mechanised systems of manufacture which exerted an attraction on Heredia. He saw at first-hand the new technology of iron making at Butterley & Co. in 1840 and witnessed pig-iron production with coal. His interest lay in the potential saving in fuel that anthracite might afford and he

[14] Min. Proc. I.C.E. vol. 2 1842/3 p. 12.

stressed immediately: migrants reflect a young-adult selectivity bias (see also Williamson, 1985a, 1988). That is, the share of the migrants aged 15-49 was 58.2 percent while only 42.2 percent for non-migrants. Obviously, any attempt to assess differences in earnings experience between migrants and non-migrants must control for age given the size of the young-adult selectivity bias.

IV. Testing competing views of urban labour market absorption

Pollard (1981, p. 903) has suggested that

> Once the workers settled the cost of moving again and the ignorance of condition elsewhere inhibited... further adjustment...

Since the 1851 *Census* only reported place of birth, we have no way of learning the extent to which migrants were multiple-movers, so Pollard's thesis cannot be tested. Yet, the implications of Pollard's thesis are that lack of further mobility having once moved into a given city tended to weaken links between city labour markets. It suggests that city immigration was limited to pairwise migration from specific rural to specific urban locations with little inter-urban migration. The evidence presented in Table 3 suggests a rejection of that inference since almost a quarter of the migrants in Britain's cities were in fact immigrants from other cities. While the Irish were an additional tenth of all city immigrants in 1851, the vast majority were, nonetheless, immigrants from rural Britain (62.2 percent). Indeed, according to our 1851 urban subsample almost half of Britain's city population was born in rural Britain (48 pecent). The figure varies significantly across regions, of course, as the Irish seem to have crowded out potential rural emigrants in Scotland and the North of England, while not in the South of England.

Table 3

ADULTS (15+) IN THE URBAN SUB-SAMPLE BY REGION AND MIGRANT STATUS

Migrant Status	Current Location			
	South	North	Scotland	Total
Urban Migrant	1,518	732	193	2,443
Rural Migrant	5,038	1,257	405	6,700
Irish	144	582	371	1,097
Other Foreign	318	157	60	535
All Migrant	7,018	2,728	1,029	10,775
Non-migrants	1,761	834	585	3,180
Total	8,779	3,562	1,614	13,955

The Todaro model and Pollard both predict that the earnings of young, new immigrants were likely to have been less than they could have received at home. While the 1851 *Census* enumerators did not identify when an immigrant arrived in the current location, the data they collected certainly do not seem to support the view that young, rural emigrants earned less in the city than they might have made in the parishes from whence they came. Fully employed farm labourers in England earned about £29 in 1851 (Lindert and Williamson, 1983, Table 2, p. 4, assuming an implausibily high employment rate of 52 weeks per year), while rural migrants in their twenties earned almost £70 in the cities even after adjusting for the incidence of unemployment (Table 4: aged 20-29, rural male migrants). While young Irish males earned somewhat less (Table 4: aged 20-29, Irish males) than migrants from rural Britain, they certainly earned far more than they could have in Ireland (about £13 in 1836: Mokyr, 1983, Table 2.6, p. 26). While these comparisons fail to adjust for higher living costs and the greater disamenities of the cities, it seems to me unlikely that such urban-rural nominal earning differentials could be fully explained by such factors.

Table 4

1851 EARNINGS ESTIMATES: ADULTS FROM THE URBAN SUB-SAMPLE

(£s)

Age	Non-Migrants	Migrants, from				
		Rural	Urban	Irish	Other Foreign	Total
Males						
15-19	53.49	55.46	47.19	43.04	23.04	50.15
20-29	68.22	69.89	74.52	53.90	62.09	68.58
30-39	73.06	70.46	69.43	58.76	72.47	69.07
40-49	80.74	68.43	75.79	51.76	100.51	70.88
50-59	62.91	77.91	69.24	73.59	69.84	75.26
60 +	81.15	50.04	94.95	29.23	203.15	63.81
Average	68.22	67.09	70.19	53.17	82.23	67.22
Females						
15-19	29.46	25.62	28.00	34.59	20.67	27.02
20-29	29.62	24.20	27.90	27.63	22.85	25.39
30-39	25.91	16.69	18.88	15.38	19.11	17.19
40-49	19.77	13.83	19.55	12.22	16.60	15.06
50-59	18.51	15.90	14.97	14.20	14.85	15.56
60 +	20.41	16.35	30.58	13.43	7.67	18.44
Average	25.86	19.24	23.64	21.10	19.06	20.40

stone. [17] Heredia also asked if Hick's youngest son, Benjamin Hick Jnr., who had recently travelled to London, might have an opportunity of 'taking some information from Messrs Howarth & Co. of Cornhill, who are patentees for improvements in soap pans & others, by which they pretend to offer great economy in fuel — I understand that some soap pans in Liverpool are now heated by steam'. As Benjamin Hick Jnr. was resident there and engaged at George Forrester & Co., engineers, ironfounders and boilermakers, he was well placed to promote Heredia's mission by reporting on the Merseyside soap trade.

This soap-boiling centre had thrived with the expansion of the textile industry and the demand of Liverpool soapmakers for caustic potash had been satisfied with kelp shipped from Scotland and Ireland. Kelp was not as rich in soda as barilla, but until 1822 kelp enjoyed a price advantage over barilla which was subject to a customs duty. When the duty on barilla was halved in 1822, the economics of soapboiling underwent a profound change. The promised removal of the excise duty on salt also gave a stimulus to the use of artificial soda by Liverpool soap-makers. The first to set up the Leblanc process for making soda was James Muspratt in 1822, and within a few years the process had removed to St. Helens and formed the basis of the alkali industry there. Heredia's interest in soap led to a preferential contract with Hick for the supply of soda tanks. Heredia's son was careful to stress his connections with other and more competitive foundries. However, the rapport established between the two men conferred a unique commission upon Hick & Son as engineers to Manuel's father. The nature of this relationship is evident in a letter of Manuel's written in September:

> I have already advised you that my father wishes to set up also a Copper

[17] P.J. Riden, in Roy Church (ed.), *The Dynamics of Victorian Business* (London 1980), p. 66, 74; Alan Birch, *The Economic History of the British Iron and Steel Industry 1784-1879* (London 1967), p. 172.

> mill which is to be placed on one side of our old iron mill — As I should be very happy to leave this to your care in preference to any other, since, I believe you have not yet made any,I have thought it best to sent you at once the estimate of all what would be required as specified by the Neath Abbey Co., who have made the mill of Messrs Vivian & all the others i Wales, and who appeared very anxious to make me one...
> Messrs. Bush & Beddoe of Bristol have lately made some very good copper mills, I understand, near Bristol — I hope this may merit your attention, and beg you will make an estimate as soon as you can, as also if possible get up the necessary drawings, which my father wants to receive

Heredia's tour of the industrial districts and collaboration with Hick & Son enabled him to study at first hand the workings of the principal smelting enterprises, but also to read British technical journals, to the extent that he could even refer Hick to the performance of Cornish stamp-mill engines and the use of blast furnace gases. Hick's reward took the form of a succession of contracts, but these were not founded on friendship alone, as Heredia made clear. Butterley & Co. had built the last foundry roof and Hick's estimate for a new structure appeared to Heredia to be more costly, 'but perhaps my memory may not be correct'. He went on:

> I will hardly repeat what I have before told you, that I consider in the end, it is by far more profitable to put down things as low as possible, particularly in England where competition is so great, for after all, & friendship apart, persons are mostly allured by the lowest prices, and if an engineer is found upon any instance dearer than what he ought, the blow must produce upon himself a very bad effect for the future — My father writes now to me about some white lead works for Adra: a relation of mine thinks also of setting up glass works at Malaga etc — We shall soon be having an answer about the cotton factory so that I foresee between us a long correspondence in future. [18]

Hick's collaboration with Heredia extended beyond the supply of manufactures and included the knowledge of technologies. Their correspondence reveals that in addition to major items of ironwork, such as boilers, a foundry crane and smelting plant, Hick also provided minor items, such as mandrils, screw keys and a

[18] Correspondence of Hick & Son, 1841.

'portable vyce'. A drilling machine was ordered from the Soho Foundry, while Hick's opinion was sought on the maker of a 'planing machine of the best description'. Heredia asked 'whether I should take Whitworth's, Fox's or any other in preference'. He also turned to Hick when requested 'to take information for 2 fire-engines to send to Malaga, of the lightest & best description, to be worked one by 16 & other by 20 men... If I recollect right, London & Newcastle are the chief places of manufactures — I should be glad if you yourself make them, in which case let me know prices etc.'. These remarks underscore a crucial aspect of Hick's role as a translator and technician. In September, 1841, Heredia arrived in London 'to see Mr, Arthur Dunn the patentee for the process of soap boiling in a close boiler' and visit 'Mr. Hawes soap works'. [19] As Malaga was anxious to receive a new soap pan, Heredia was 'almost inclined to make you immediately the order, without waiting the further investigations I meant to make at Bristol, & Liverpool'. However, Heredia had been assured that the works of 'Messrs Th. H. Crofts & Messrs Martins Dale & F.' offered 'some peculiarity' of design, which 'it would be most convenient, if your son Mr. Benjn could learn the truth of it, so that we might an once come to a resolution'.

Writing from Merthyr Tydfil a short time later, Heredia surveyed the contracts entrusted to Hick & Son up to that date. The extent and scale of Hick's participation in the development of Spanish industry is immediately apparent and is a testimony to the regard in which British manufacturing practices were held by foreign manufacturers. The fixtures and fitting of model industrial works themselves emphasised the abilities of Britain's industrial-

[19] ARTHUR DUNN was the patentee of several improvements in the manufacture of soap between 1839 and 1843. Patents for Inventions. Abridgements of Specifications Relating to Oils, Fats, Lubricants, Candles and Soap 1617-1866, City Libraries, Liverpool.

ists in the eyes of overseas visitors. This was especially true of machine-tool makers and their establishments, and the uses to which mechanical tools were put in novel machine shops by Hick and other engineers. His 'beautiful establishment' attracted Manuel's cousin. Mr. Camara, and Mr. Larios, who appeared at the Soho Foundry with a letter of introduction from Manuel, entreating Hick to show the bearers his 'engines and machinery'.

In October, the Soho Foundry was preparing the rolls, shears and gearing to complete a copper mill built to the specification of the Neath Abbey Ironworks. [20] A drawing and estimate for a stamping mill was also under preparation by Hick & Son. Heredia was pleased that a small boiler, with pipes and cocks, intended for soapmaking had been despatched to the merchants in Liverpool; another soap boiler would be contracted for once information was available from Liverpool and Bristol. A foundry crane with a lift of 10 tons was required 'as soon as possible, of course it is good that the drawing may go before, so that they may know what to expect'. Heredia believed the crane should be accompanied by a planing machine procured at a moderate price and of the 'best principle — I had heard that such was Whitworth's patented one, but you know better the kind that would suit us'.

Heredia was 'glad to see you are going on with' the engine for the ironworks and was grateful to Hick for his 'remarks regarding the foundations: those of the engine house & stamping mill, will be piled'. Heredia's second tour of South Wales meant that he had 'been again through all these iron works, and gathered all the information I have been able towards my purpose'. He also wanted to hire some puddlers and would soon 'want to take from your neighbourhood a good moulder for fancy castings'.

From Derby, Heredia wrote that in Wales he had engaged a 'forge manager with 5 puddlers, & also I slitter & I moulder — I

[20] Correspondence of Hick & Son, 1841.

think still of getting another moulder for fancy castings such as balustrades & Kitchen articles, etc, concerning which I shall much esteem your opinion, as to whether I should take him from Coalbrook Dale, or from your neighbourhood'. On Hick's recommendation Heredia called at the Coalbrookdale Foundry 'to fix for another moulder'. Writing from Shrewsbury in late October, Heredia invited Hick 'to purchase for me if you have a good opportunity in the sales you speak of to me, a small drilling machine, with 3 speeds — Messrs Fox offered me one to drill up to 3/4 in. diamr for £ 40, — but I have wished to consult you about it'. Only a few days before Heredia had visited Derby, where James Fox was a pioneer manufacturer of machine tools.

By the middle of November Heredia was in London, expressing the hope that Hick was now 'very forward in the castings for the soap pan, and reverbatory furnace'. Aware of Hick's interest as an ironfounder in the classes of foundry pigs for casting. Heredia noted that he had spent some days in the company of one I.I. Lamlin, a 'very agreeable & practical man', whose 'process' had 'succeeded to complete satisfaction at Mr. Hills of the Plymouth Works' in Merthyr Tydfil. At the end of the month, Heredia was principally concerned that Hick's 'tracing drawings' of the blast engine's foundation should reach his father and they were forwarded to Malaga via the Malta packet after a cursory examination. 'I have few remarks to make on said drawings', he wrote, 'more than that I consider them very complete, and well prepared: however should you yet find any new improvement to make you will please not fail to advise it'. [21] Hick had offered to make a model of the foundations, illustrating the form the piles should assume beneath a foundation of common brick or small stone. Heredia accepted the offer of a model and thought that the foundations would prove 'very economical'. He also thanked Hick for purchasing a drilling ma-

[21] Ibid.

chine from Whitworth for £ 67.16.0 and confirmed the 'planing machine will be £ 127.5 — without the cases'.

Machine tools, moulding sand and a 'good moulder for fancy castings' were destined for Malaga, as well as soap pans built to Howard's patent and iron-making plant on a large scale. Shipment to Malaga was undertaken by Charles Stuard Middleton & Son, merchants, of Liverpool. Over 57 cwt of moulding sand had already been despatched to the port from Manchester and Hick was asked to order 'another equal quantity' should he hear that none had been sent by the Coalbrokdale foundry. It had to be of the '*very best*, though the price may be high'. Hick was also asked whether he knew of any moulding sand imported into Britain from either Portugal or France.

The good moulder found by Hick was one Thomas Vickers and he sailed from Bristol in a vessel laden with Stourbridge bricks. Heredia desired Hick to assure Vickers that

> so long as he behaves with us in the good manner he has done with you, he will always be treated with the best consideration — Although you recommended him as a sober man, I have added the last article, because we do in all our contracts — Another moulder is going from Coalbrook dale by the same vessel from Bristol, (which is a first rate fast sailor) and takes also his wife, (of course on his own account) [22]

Heredia was pleased to relate that the 'Welsh Puddlers that lately went out, arrived quite safely, with a very short passage'. In early December, the visitor pressed Hick for the early completion of the castings and urged him to sent a 'memorandum of acct. currt.' to Malaga. On 16 December, Heredia wrote:

> I had this pleasure on the 3rd and have since continued deprived of yours favours, though in daily expectation of them — I am very anxious to

[22] The 'El Pedroso' foundry in Seville under Elora also relied upon skilled labour imported from Britain. An English visitor found the chief departments of the foundry managed and operated by Englishmen, who received four pounds sterling each week and were allowed paid leave to avoid the summer fever 'when the tercianas prevail'. Captain S.E. Widdrington, R.N., *Spain and the Spaniards in 1843* (London 1844), 2 vols, I, p. 220.

> know that all the castings may have been completed, and it is painful to see the shipment so long postponed, as some of the articles were very much wanted. I shall thank you for a note of all what goes — If Mr. Whitworth & Cos lathe is finished would you beg him to sent it to Messrs Middleton without delay.

He was, however, grateful to Hick for recommending Vickers and he asked Hick to procure 'another moulder as clever as possible in fancy light work', who might be 'willing to go upon similar terms, or a little less if possible'. The voyage to Malaga provided no difficulty as the Heredia's were 'sending out other vessels every day almost'.

Hick was invited to reply 'by return of post, so that I may communicate the news to Malaga — and I should think to answer my former letters, and give me any explanations you think proper about the forward state of the machinery'. In a remark characteristic of Heredia's correspondence with Benjamin Hick, the visitor believed the engineer might wish to send a responsible man into North Wales, because 'it would be suitable for him to see the Stamping mill at Aberistwith, and I shall have no objection to have amount of expenses charged to our acct'.

VI

To be successful, the industrial tchnologies and practices introduced into Malaga required entrepreneurial skills to realize their potential. Landes' comment that 'Business is cruel to spenders and dreamers' is thus singularly appropriate in the light of the decline of Malaga's industrial ventures in the years following Heredia's death in 1846. [23] The proprietors who succeeded him were confronted by adverse circumstances that highlighted the shortcomings inherent in his enterprises, and which stemmed from the handicap that had hindered Heredia from the outset. For the promotion of infant

[23] David S. Landes, *The Unbound Prometheus*. London (1969), p. 450.

industries and the acquisition of a wide range of technical knowledge was largely the work of Heredia alone. He was by far the most outstanding member of the 'Alameda oligarchy', that group of Malaga capitalists whose business activities embraced commerce, industry and finance. In 1844, for example, as vice-chairman of the local Junta de Comercio, Heredia was instrumental in promoting a commercial bank modelled on the Banco de Isabel II, which he had helped finance along with his brother-in-law and protégé, the flamboyant financier Jose de Salamanca, later Marquis of Salamanca. Heredia's effort to float a bank in Malaga proved fruitless 'in the face of cold officialdom' and Malaga had to await the liberal banking law of 1856 before the Bank of Malaga was formed. A further scheme for a steamship company proved similarly unsuccessful. In 1845 Heredia persuaded the most prominent businessmen and financiers in Malaga, including Larios Brothers & co., to form the Sociedad Anonima de Vapores de Malaga, operating between Cadiz and Marseilles, and Malaga and Abre de Gracia. At once the company 'started to take retrograde steps' and operating losses obliged the House of Heredia and Larios Brothers to advance loans on the security of the ships. With the failure of the company its two steamships were sold by auction to the Heredia and Larios concerns in order that the claims of creditors could be met.

The steamship company was managed through a managing director, two deputy directors and two advisers, who were appointed for fixed terms of office and guided by detailed company regulations. Such a structured approach to the management of business was absent from Heredia's early commercial operations. The scale of the later enterprise in iron called for the creation of a financial partnership, which as Heredia saw proved a fragile structure of control when tested by adversity. Montoro's work has shown the sheer magnitude of Heredia's wealth, one of the largest fortunes in mid-nineteenth century Spain, with assets amounting to more than 60 million reals. The structure of this capital reflects the activities

of an outstanding entrepreneur as well as the manner in which he conducted business. Montoro notes that in 1846 'The greater part of this wealth is still in circulation; many factories are under construction; rural properties amount to a small proportion of the estate; the fixed assets figure is five times lower than that in circulation'. [24]

The high proportion of circulating capital and the multiplicity of activities undertaken by Heredia, compelled a decisive entrepreneurial attitude to ensure the continuity of a dynamic business, where risk was ever present. The iron, chemical and textile ventures, represented new industrial investment financed from Heredia's trading profits, and he recognised that decisive control would be required by his heirs to ensure continued success. He also saw that without his guiding hand the business might come to a standstill and decline. Hence the instructions that Heredia left in his will that all items 'belonging in the fields of commerce, manufacture and shipping' should be excluded from the winding-up of his estate and that the business should continue to operate for a further four years under the management of his brother and two sons. Heredia wished to preserve intact the interrelated and mutually supporting assets of a large and diversified commercial and industrial estate.

Although Heredia's instructions were not adhered to by his executors, the estate retained some coherence for several years.

It is clear, however, that the control established by Heredia was not upheld by his second generation successors with the same enterprising spirit of the pioneer. Arguably the crisis which overtook the promising industrial ventures arose from the baneful grip of the later custodian. Yet the basic shortcoming of the industrial ventures was probably the inflated cost of coal in Malaga and

[24] Cristobal Garcia Montoro, "La Fortuna De Manuel Agustin Heredia...", op. cit. p. 373.

Heredia's loans to the iron companies are indicative of the deteriorating trading position of 'La Concepcion' and 'La Constancia'. Their golden period was between 1833 and 1843 when the northern foundries were closed down. Once the Basque foundries began to manufacture iron the southern works were placed at a disadvantage because of their high-cost structure, which spurred Heredia to carry out modifications and tests for which capital was essential. An extension of credit on Heredia's part would have placed the principal and sole share holder at a disadvantage should the venture fail. Therefore a prudent course for Heredia to take was to make loans to companies in which he was already the principal owner, thereby becoming the principal creditor and minimising the risk of loss in the event of bankruptcy.

Why were Heredia's industrial ventures, particularly his enterprise in iron, destined to become uncompetitive when Heredia enjoyed such a close tie with Hick that he could draw upon this technician's knowledge of best-practice techniques? And why should the Andalucian ironworks fade into obscurity 'owing to a lack of coal', when as a merchant Heredia enjoyed direct access to cheap fuel in the shape of Welsh anthracite? By 1840 Heredia ranked among Spain's leading industrial capitalists. His title as 'Spain's very first hardware dealer' arose from the operations of a highly capitalised large-scale ironworks at a uniquely propitious time. Heredia knew that for Malaga to continue to dominate the national market required a combination of technical innovation and tariff protection. For the employment of advanced and economical fixed capital, he looked to Britain. By seeking competitive advantage Heredia had originally been persuaded of the merits of mechanised manufacturing processes, but the iron and the other corporate enterprises built on the British factory model were crucially dependent on coal. This problem of fuel costs did not, however, weaken the strong appeal of British industrial practices and inventions. In his paper, 'Reforms in Customs Legislation', Heredia

pleaded the case for cheaper coal, arguing that Asturian coal failed to satisfy demand because the mines were remote from markets and the coal costly to transport. Hence, 'it becomes imperative to bring cheap, foreign coal, so that the nation's factories do not become extinct'. [25]

Heredia's voice was just one of many discordant voices canvassing the support of government in the wake of its avowed intention of going ahead with a far-reaching reform of customs tariffs. The ironmasters of Malaga desired a protected home market for domestic iron — Basque as well as Malagan — and sought an increased import duty. Bound up with Heredia's argument that the state should intervene in order to promote modern enterprises organised and financed by private capital, was a recognition that the market was already distorted by the state. He aspired to compete in terms of quality with foreign producers whom he knew could undersell him and he looked to the government for a tariff barrier that would permit his model enterprises to prosper. [26] Cost differences between British and Basque producers and the Malagan ironworks arose from the higher prices of skilled labour and coal in Andalucia. No matter how technically advanced the ironworks were, British manufacturers could undersell them within a free market. [27] To Heredia, the cost of coal was more crucial to his success as an ironmaster than perhaps even he appreciated. A protective tariff, while limiting external competition, would do little to lessen the competitive handicap carried against internal competition. The accepted solution to this problem of high prices in the face of keen competition was an internal tariff for the benefit of the privileged producer. Heredia's solution was to invite the intervention of the state to reduce his costs of production. The high cost of fuel arose from the government's financing of expenditure by

[25] M.A. Heredia, *Reformas de las leyes de aduanas*, *op. cit.*, p. 16.
[26] Richard G. Lipsey, *An Introduction to Positive Economics*. London (1974), p. 627.
[27] R.A. Church, "Problems and Perspectives", Roy Church (ed.), *op. cit.*, pp. 29-31.

means of customs duties. He hoped to persuade government that duties were not only a way of raising revenue but a means of stimulating private enterprise. His adult life coincided with the ruinous reign of Ferdinand VII and the troubled rule of the regency, when government by absolute monarchy was contested by supporters of a liberal constitution. Consequently entrepreneurial talent had to contend with the concessions and exemptions, prohibitions and restrictions, of the old autocratic government.

The challenge before Heredia was at once daunting and promising, because of three major constraints that inhibited government: the chronic dependence of the state's finances on borrowed funds and the high interest rates required to fund the national debt; the recurrent crises of government itself with faction and intrigue at the Cortes and court; and the influence exerted upon the administration by conservative groups in society who enjoyed a vested interest. [28] The contest with the Carlists made the regency dependent upon the support of liberals, who were conciliated in 1836 with the revival of the constitution of 1812. Heredia himself was elected to the Cortes in 1846 as provincial deputy for Malaga, some years after he had begun to claim privileges and exemptions as a magnate in his own right. He appears to have judged that the controversy over free trade was not likely to yield far-reaching commercial reform, but that the debate over tariffs might permit a redirection of government intervention to stimulate industrial development. What Heredia urged upon Ministers of State was intervention to release Malaga's iron industry from a major cost constraint, namely the tariff on coal, which by distorting the market for a basic raw material was jeopardising the opportunity for capital-intensive enterprise to compete in domestic and foreign markets. The power of the state could either help or hinder innovatory entrepreneurs and he had

[28] Jordi Nadal, "The Failure of the Industrial Revolution in Spain 1830- 1914", Carlo M. Cipolla (ed.), *The Fontana Economic History of Europe*, 4 (2) (1973) p. 540.

no difficulty in identifying an institutional barrier to the development of his manufacturing, as costs in the south had been inflated at the Adra leadworks by the measures of the old monarchy intended to develop the coal industry.

For Heredia the creation of the Customs Tariff Review Board offered more than a fresh opportunity to lift this handicap from the south's iron industry. In addition arguments over commercial policy provided him with scope to focus the state's attention on the new economic interest he had brought to the fore and that needed tangible support from the state to ensure future growth. But Heredia's need for cheap coal brought him into conflict with the coal industry of Asturias and led to the two interests bidding for favours from the state. Exemptions calculated to promote the working of coal dated from 1780 and had been followed by the granting of privileges intended to encourage the coal trade: the crown royalty on mines was lifted; duties payable on coal were removed and export subsidies introduced. A School of Mining was even established in Asturias, again with the aim of encouraging promoters to mine coal. Unfortunately, the high cost of inland transport and the absence of demand frustrated a policy which like so much of the state's renewed interest in trade and industry sprang from the pursuit of national aims. [29] A specialised bureaucracy was regarded as the appropriate instrument for industrial expansion by the Spanish

[29] Ibid p. 584. Railways provided the states of western Europe with a major opportunity to further economic development. Spain's internal communications had attracted the attention of Charles III, but the deficiencies of internal trade and poverty of the interior markets continued to confine industrial development to the provinces of the periphery. A national railway system planned by the state, such as that created in Belgium, might have stimulated industry in Spain through the creation of a national market. In Spain, however, no national and systematic railway network emerged that bound industrial producers with consumers. See BARRY SUPPLE, "The State and the Industrial Revolution 1700-1914", CARLO M. CIPOLLA (ed.) 3, op. cit. p. 326; JOSEPH HARRISON, *An Economic History of Modern Spain*. New York (1978), pp. 15, 53; and ALAN S. MILWARD and S.B. SAUL, *The Economic Development of Continental Europe, 1780-1870*. London (1973), p. 442.

Bourbons in view of the extent of provincial self- government and internal barriers to enterprise in the shape of provincial taxes and customs duties. The value of entrepreneurial talent guided by personal opportunities for reward was recognised by Charles III and his ministers, but was judged to fulfil a subordinate role to that of a reforming absolutism. [30]

Heredia was remarkably successful in overcoming the problems associated with technical and organisational innovation in ironmaking, when Spain had reverted to the absolute rule of the worst of her Bourbon kings. Ferdinand VII restored the old despotism, suppressed liberalism and squandered the finances of the state on military adventures. Before his death he sowed the seeds of further division and instability by abolishing the Salic Law in Spain. It was against this background that Heredia chose to promote industrial activity after consciously considering the likely balance of rewards and penalties inherent in such an enterprise. Quite unlike those who encouraged economic activity as Secretaries of State or anonymous administrators, Heredia financed the iron ventures from his own resources. The risk he bore was a personal one and explains a resolute approach to the use of costly capital-intensive processes. Having been drawn towards the exploitation of ironstone by the prospect of reward, Heredia was impelled to succeed by the quantifiable cost of failure at any point along the arduous path to profitability. The major obstacle was the inflated cost of domestic and imported coal in Malaga and from an early date Heredia was successfully contending for concessions from the crown in order to lift the burden imposed by state policy on his industrial ventures. On the one hand, the new tariff of 1825, a protectionist instrument calculated to develop the iron industry, prohibited the importation of coal and, on the other, the mining legislation offered concessions to those prepared to extract and make iron. The min-

GEORGE RUDÉ, *Europe in the Eighteenth Century.* London (1974), p. 143.

ing legislation of 1825 did little to promote coal-mining enterprises and largely explains why Heredia was conspicuously successful in circumventing the ban early on. Coal entrepreneurs were either late in pressing their case upon the government or slow to sense the danger in Heredia's lobbying of policy-makers. When the debate over tariff reform was initiated by the government at the conclusion of the Carlist War, Heredia had arrived at the point where he could press for a free market in coal. Barely two years had elapsed since Royal Orders had lifted tax and other obstacles from nascent coal undertakings in Asturias. A liberalisation of the market for coal now would have utterly frustrated the hopes entertained for the Asturian coalfield.

This threat arose from the appointment of the Customs Tariff Review Board with Heredia as a member. The purpose of the board was to give expression to the government's desire to recast the tariff law of 1825, following repeated and contradictory amendments. Heredia was bound to endorse the view of the southern iron industry which the 'La Constancia' company expressed to the board in the form of a document, setting out the firm's aspirations and how these might be secured with a discriminatory tariff. More contentious was the claim of the Andalucian iron industry to imported coal free from customs duty. Thus the fears of the Asturian coal operators were well founded. Coal accounted for a major share of input costs at 'La Concepcion' and 'La Constancia', as a result of the adoption of 'English' smelting and forging processes. The adoption of several industrial processes dependent on energy derived from coal explains why Heredia more than any other manufacturer brought confusion upon the state's commercial policy, by securing personal rebates on British coal. In 1832 the San Andres lead company had won an exemption to the ban on foreign coal. Henceforth, an onerous customs duty was levied on coal intended for the Adra lead works. But after four years Heredia gained a rebate on the punitive duties — extended the next year to all industrialists —

because of the needs of his ironworks. Heredia was alert to the fundamental importance of coal to the price of southern iron and tenaciously pressed his case for a tax concession. According to Nadal, Heredia reacted to the granting of a favourable order by 'snatching the Royal Decree of 28 October 1836' from the hands of officials, so that he could apply the concession without delay. [31]

At the outset of the 'coal war' in 1840, Heredia could present an even more cogent argument for the state's encouragement of the southern iron industry. His private initiative and capital was by then yielding a reward commensurate with the risk inherent in any business enterprise that required heavy fixed investment. The dislocation wrought by the First Carlist War certainly helped Heredia to capture much of the domestic market, but his stature in the 1840s as Spain's greatest ironmaster was founded upon the entrepreneurship displayed a decade before, when Heredia sought state support in order that his venture might grow. Now he held out the vision of an Andalucian iron industry capable of competing with foreign producers in overseas markets as well, provided that it was favoured by adjustments to the tariff structure. But in reality he was petitioning for a share of the limited home market, in anticipation of the Basque producers' return to production. He would have been the first to explain his success in terms of innovation and doubtless expected that the diffusion of new technology would extend to the north. [32] Yet in his anxiety to minimise costs Heredia seems to have exaggerated the pace of change and the likely onset of severe price competition from northern ironworks. Furnaces fired with charcoal continued to be put up in Vizcaya after Heredia's death and coke-smelting did not appear there until 1865; it was a further twenty years before Vizcaya dominated pig-iron

[31] Jordi Nadal, *Industrialization y desindustrialization del sureste espanol, 1817-1913.* "Moneda y Credito", num. 120 (marzo de 1972), p. 44.

[32] Alan S. Milward and S.B. Saul, *op. cit.* chp. 3 p. 171.

production. But Vizcayan pre-eminence was founded on that of iron undertakings in the Asturian coalfield, which suggests that Heredia's concern was not misplaced in the longer term.

Coke-smelting appeared in Asturias two years after Heredias' death in 1846. By 1864 Oviedo was poised to displace Andalucia as the leading province for iron manufacture. In 1844, Heredia and another ironmaster in Malaga had accounted for 72 per cent of Spanish pig iron; in 1861 Rio Verde alone produced half of the iron cast in Spain. But by the close of the 1860s, the provinces of Seville and Malaga together retained only 4.7 per cent of the market for casting. The sudden decline of the Andalucian iron industry stemmed from the adverse cost conditions in the south, where the 'difference in fuel costs was the decisive factor in the final price: 158.2 pesetas per ton of pig iron in Malaga, as compared with 103.8 in Oviedo'.[33] High fuel costs imperilled the prosperity of Heredia's iron ventures. by exposing them to the low-cost competition of technologically advanced producers abroad and leaving the south vulnerable to the challenge of a coal-iron industry elsewhere in Spain. A remedy lay with the reform of tariffs that took account of the needs of manufacturing industry, as well as the requirements of the Spanish Treasury. Heredia made out the case for the state's encouragement of industry in Andalucia in his 'Reforms to Customs Legislation', which was addressed to the Secretary of State and the Office of the Chancellor of the Exchequer, and which cited the difficulties impeding manufacturing ventures in lead and soap, as well as iron, arising out of onerous taxes levied on exports as well as imports. These obstacles might have been set aside had not other interests, most notably the Asturian coal enterprises, not pressed their claims on government. Heredia's failure in March 1844, to win the 'coal war' on the Tariff Review Board meant that his suc-

[33] Jordi Nadal, *The Failure of the Industrial Revolution in Spain 1830- 1914*, op. cit. p. 600.

cess in lifting the institutional barriers to competitive advantage was superficial and short-term and that 'contrary to all outward appearances', as Nadal says, the 'southern iron and steel industry had, in its finest hour, received a mortal blow'. [34]. Within two decades of Heredia's death the full consequences of this failure for Andalucian development were clear.

[34] Jordi Nadal, *Industrialización*, op. cit. pp. 43-45.