The HISTORICAL METALLURGY Society

Historical Metallurgy

ISSN 0142-3304

Volume 22 Part 2 1988

Original Research Paper

Two Brazilian ironworks of the early 19th century

Author(s): Friedrich Toussaint

Pages: 73–80

Published online: 19/02/22

Stable URL: https://doi.org/10.54841/hm.638

Two Brazilian ironworks of the early 19th century

Friedrich Toussaint

It is not generally known that iron making started in Brazil as early as the 16th century; this was the first production of iron in the Americas in the southern hemisphere. Brazil was discovered in the year 1500 by Pedro Cabral at a place called Porto Seguro in the state of Bahia. The major point of interest after the discovery was the export of Brazil-wood, which became an important dye stuff all over Europe. Leaving apart the question whether economic interests or the desire for Christianisation was first, it was a matter of fact that Jesuits accompanied the adventurous sailors, conquerors and traders. In the year 1559, on the 27th of January, the town of Sao Paulo was founded by the Jesuit father Manuel da Nobrega, who climbed the tableland of Piratininga from the coastal colony of Sao Vincente (actually the port of Santos) to build a college for the convenience of Indians. He was soon joined by Padre Anchieta, known as the Apostle of Brazil. The American Indians dominated the metallurgy of gold, silver and copper, but strangely enough, never the metallurgy of iron, though the major iron deposits of the world are today in South America. So iron technology had to be imported from "the old world". The first iron smith in the "new world" seems to have been Father Mateus Nogueira, born in Europe, and the first priest ordained in America according to the document of the "arquivo dos orfaos" (the orphan's archive) in Sao Paulo, at least since 1561. Probably he first worked "scrap-iron" but we know today from excavations that already in the 16th century "virgin iron" was produced in Sao Paulo from ore. The history of ironmaking in the area of the city of Sao Paulo is still very vague, but we know some facts about iron making in another place, the Capitania of Sao Vicente in the state of Sao Paulo. In the year 1589 a certain Afonso Sardinha ("reinol", that means born in the kingdom of Portugal) and his son "mameluco" (which means that his mother was Indian) discovered the iron deposits of Aracoiaba. This fact motivated Father Archieta to send a letter to the Court of Lisbon announcing the fact and the possibility of the discovery of gold. Gold was not discovered, but a bloomery was constructed to produce iron from virgin ore. Though the history of iron making in the area "Serra de Aracoiaba" (located about 15 miles from Sorocaba, some 70 miles north east of Sao Paulo) is most fascinating and varying, this is not the place to tell the story in detail.It was a great pleasure to the author to discover in the dense woods of the serra the relics of the second attempt of iron making in the 17th century, which are now researched by archaeologists of the Sao Paulo University.But in other parts of the large country of Brazil iron-making was also introduced at least

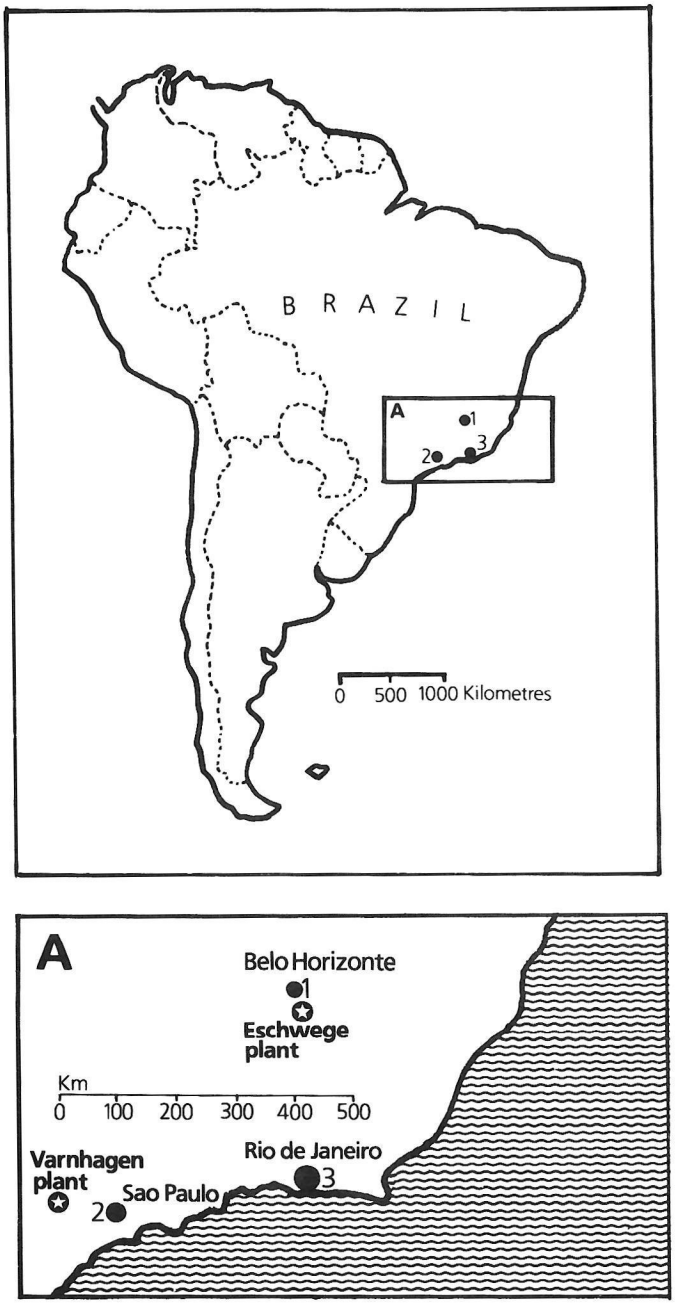


Fig. 1

during the 17th century, if not earlier, according to a citation in a book of the 16th century "Tratado descritivo do Brasil" by Gabriel Soares de Sousa. But certainly the slaves imported by force from Africa introduced their iron-making knowledge to their sugar

cane producing landlords in Bahia and Northern Minaes Geraes for the production of agricultural tools, a fact possibly first commented on by the famous Brazilian sociologist Gilberto Freyre.

The history of iron-making in Brazil from the 16th century to about 1800 requires the attention of another author. It is certainly not a matter of technological development (it just reflects the European development) but is a matter of eminent importance for the explanation of the social and industrial development of the country. The foregoing only tries to explain a little of the background of the main theme.

In the early years of the 19th century two young German metallurgists, both students of the famous Mining Academy of Freiberg in Saxony entered as officers of the Portuguese army. They worked for some time in Portugal as metallurgists. In 1810 they were sent to Brazil. Baron von Eschwege first became director of the mineral collection in Rio de Janeiro, and then he became head of the administration of mines (mainly gold and diamonds) of the province (today State) of Minaes Geraes (=general mines). His colleague and friend Varnhagen was asked to find the best means to exploit the iron-making capacity of the iron ore deposits of the Serra de Aracoiba in the province of Sao Paulo.

The arrival of these two Germans in Brazil may certainly be considered as the laying of the foundations of modern iron-making in South America.

In 1872 was founded the first academy of mining and metallurgy of South America in Ouro Preto, the first professor of university level of "metals science" being a Frenchman, Claude Henry Gorceix. This Academy is still today the major educational centre for mining and metallurgy at university level in all South America.

The two friends Eschwege and Varnhagen followed different paths in Brazil, but never lost contact. Eschwege as chief director of mines, improved considerably the technical state of the mines in the province, and thus the income of the Crown. To prove his knowledge of metallurgy, he founded, mainly with

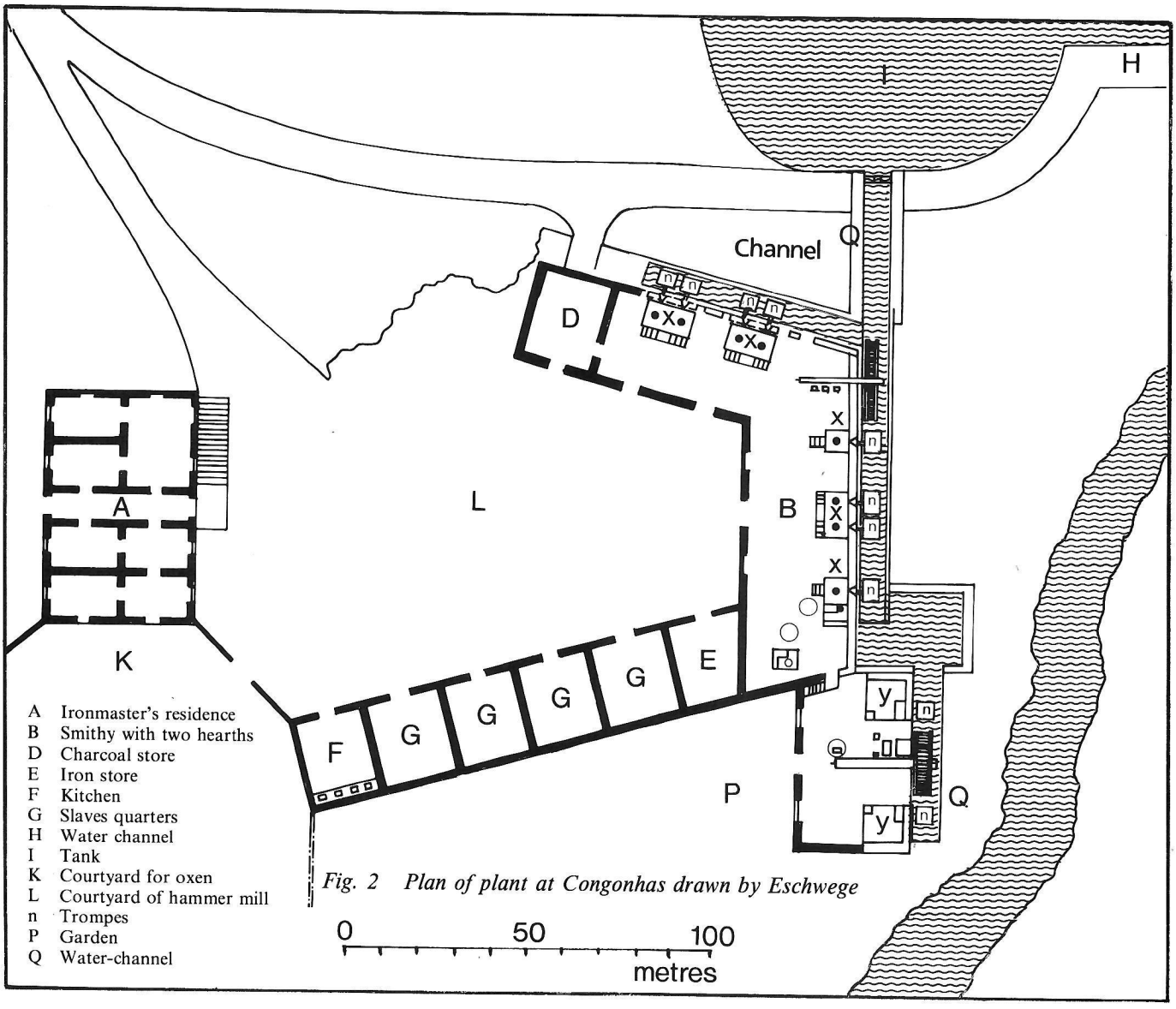


Fig. 2 Plan of plant at Congonhas drawn by Eschwege

his own money, an iron producing plant at "Pratta", in the actual community of Congonhas do Campo to the south east of Belo Horizonte (Figure 1). He called his enterprise "Fabrica Patriotica" certainly in homage to his host country. He followed the traditional way of bloomeries, or low shaft furnaces, to produce iron implements for agricultural or mining use. His production was small, but profitable. He was against the blast furnace technique, not for technical reasons but for economic ones.

Due to the huge difficulties of transport in this tropical country he favoured small production units to supply the local environment. It is a matter of fact that European steel in Rio de Janeiro was cheaper than steel produced in the interior of Brazil, due to transport costs. Nowadays we still find important relics of his plant. We can still see some aspects of the plant: the iron master's residence, the stores for production of raw materials (charcoal and ore), the smithies and mainly the bloomeries, are still extant; a few examples of this type surviving in the world. Even pieces of wrought iron produced in the furnaces, and iron stamps for crushing the ore are still in existence. Some of the four furnaces are more or less decayed, but they still today offer the impression of activity more than 150 years old. Every year the abundant Brazilian vegetation tries to cover these important ruins but fortunately the management of the Thyssen Mines (Ferteco) which surround the site, tries to clear the place, sometimes contrary to the wishes of the Brazilian authorities.

Eschwege's plant at Congonhas

The plan (Figure 2) shows Eschwege's project, the four bloomeries (x) next to the charcoal store D were not built, in their place a smithy was built. The outer walls of the building B (bloomery house) are no longer existing, but the furnaces themselves are pretty well preserved. The main reason for the excellent conservation of the plant is certainly due to the fact that after Eschwege's return to Germany in 1821 the activity at the Riberao da Prata (= silver river) soon stopped and no industrial activity was ever carried on again in this area.

What is interesting is that the low bloomeries were blown with the aid of "wassertrommeln" or **trompes** like Catalan hearths. This is not believed to be a result of Portuguese influence in this case but a German one, the idea of applying them here being Eschwege's own. Certainly the conditions at Congonhas were right and a fall of 5-6m was available. The ore was broken with a stamp mill driven by a waterwheel.

The bloomery hearths had a height of 1.5m and were 0.2m square in plan with the tuyere 45cm above the bottom, and either horizontal or slightly inclined downwards. Initially the tuyeres were made of iron sheet 4.0cm square, but later they were made of clay. There were two tuyeres side by side set 8cm from each other.

A smelt took 4 to 5 hours and the resulting bloom weighed 15kg. This was probably in a condition suitable for the smiths with adhering slag and charcoal removed. The hearth area of the furnace was said to be 0.2 square metres which would be equivalent to 45cm square. This seems very small compared with the height of 1.5m and almost unworkable. Therefore it has been drawn a bit larger in Fig. 3 assuming that the area applied to the bloom rather than the hearth itself. The sloping inwall is unusual and contrasts markedly with the Catalan hearth.

Between 1813 and 1820 production was 142 tonnes of finished wrought iron, giving an output of 18 tonnes per year. This went mainly into nails and horseshoes. The slag was not tapped but remained in the furnace forming a "furnace bottom".

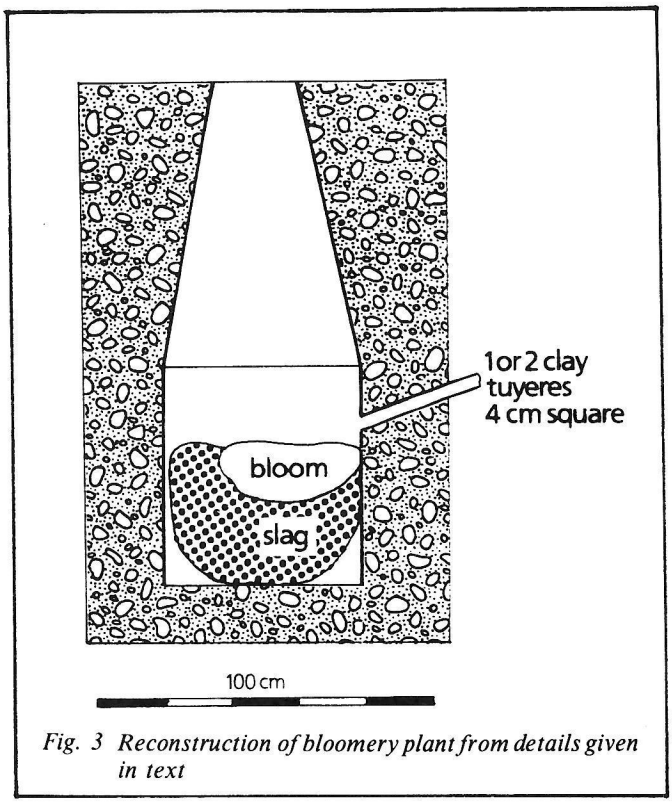


Fig. 3 Reconstruction of bloomery plant from details given in text

Detailed accounts of the trompe are given in German mining journals of 1848 and 1876 and the output is shown in Table 1, which shows more than adequate air for a bloomery. (Figure 4) is from Swedenborg (1734) and was designed for blast furnaces.

Table 1 Output of a **trompe** (After J von Hauer, 1876)

Fall m	width of tube cm	Air l/min	Pressure cm Hg	Water consumed m^3/sec
4.8	21	2700	4.7	0.080
6.3	26	4200	3.1	0.120
8.9	21	3600	4.7	0.064

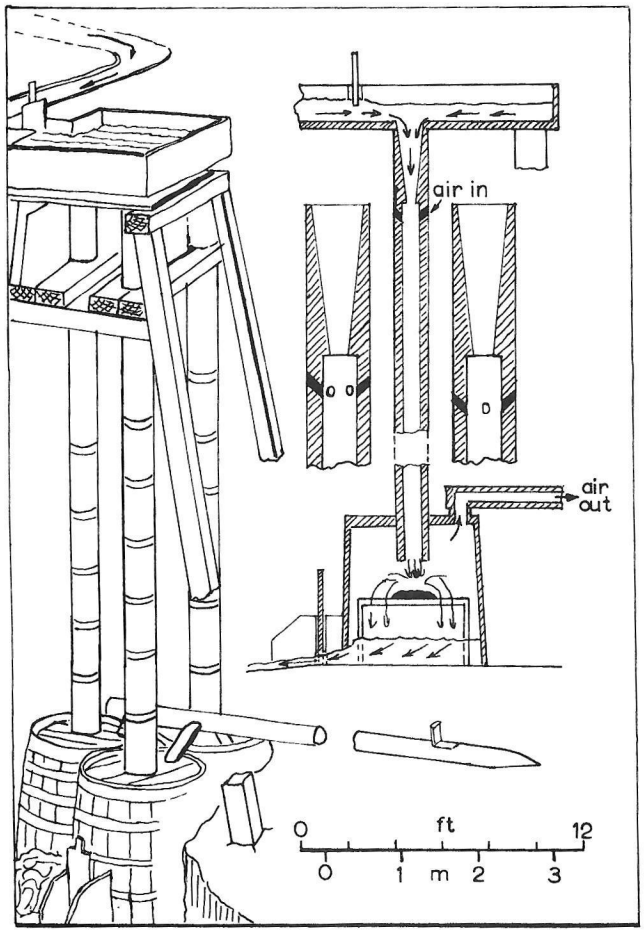


Fig. 4 Details of trompe supplying air to a blast furnace (after Swedenborg, De Ferro, Leipzig, 1734)

Fig. 5 Cast iron cross from the first smelt at Ipanema, Nov 1st, 1818

No mention is made of the high humidity of the air so provided. Clearly the absence of moving parts and the continuity of the blast was the main reason for such apparatus.

Varnhagen's plant at Ipanema

Varnhagen's history was quite different. At the same time as he was preparing plans for a blast furnace plant in the Serra de Aracoiaba, the Brazilian Consul in Sweden, Mr Baier, engaged a group of Swedes to run an iron making plant at Ipanema, 100km to the west of Sao Paulo (Figure 1). A certain Mr Hedberg, mining accountant, owed a large amount of money to the Brazilian Consul Baier, a Swede: so Mr Baier was largely interested in providing a favourable contract to Hedberg as a means of getting his money back, regardless of his technical capacity. The contract of Hedberg and his team is still extant and quite an interesting example of early know-how and service contracts.

The Swedes arrived in Ipanema early in 1811. Hedberg became the director general and works manager of the future plant; and Varnhagen, who was not at all pleased by this development, became chairman of the board of the company. Though Varnhagen favoured blast furnaces, Hedberg built bloomeries of the Swedish type.

The technically and financially disastrous management of Hedberg ended in 1814 when he was definitely fired, and the management of the company, the majority owned by the government and the rest by private shareholders was entrusted to Varnhagen. Immediately Varnhagen started to develop his plans to build two blast furnaces, his old favourite idea. He worked hard and finally on the 1st of November of 1818, the first pig iron was produced out of one of the twin furnaces. Current literature quite frequently mentions that it was the very first in Brazil, which is not correct because a few years earlier a blast furnace was tapped at Minas Geraes which had been built by the Brazilian Camera (also ex-students of Freiberg, Saxony). But shortly after, this was closed when the whole enterprise collapsed technically and financially. So the 1st of November, All Saints Day, of 1818 continues to be **the** day of pig iron making in Brazil. Two large crosses were cast in open moulds (Figure 5), both of them still existing.

In 1820 the French scholar and traveller, Auguste de Saint Hilaire (amongst many other famous European travellers) visited Ipanema. He wrote: "only who knows the intrigues which dominate the country, the ignorance of the workers and their indolence may give a clue to the nearly insuperable obstacles which Varnhagen had to overcome, and one must admire the speed by which

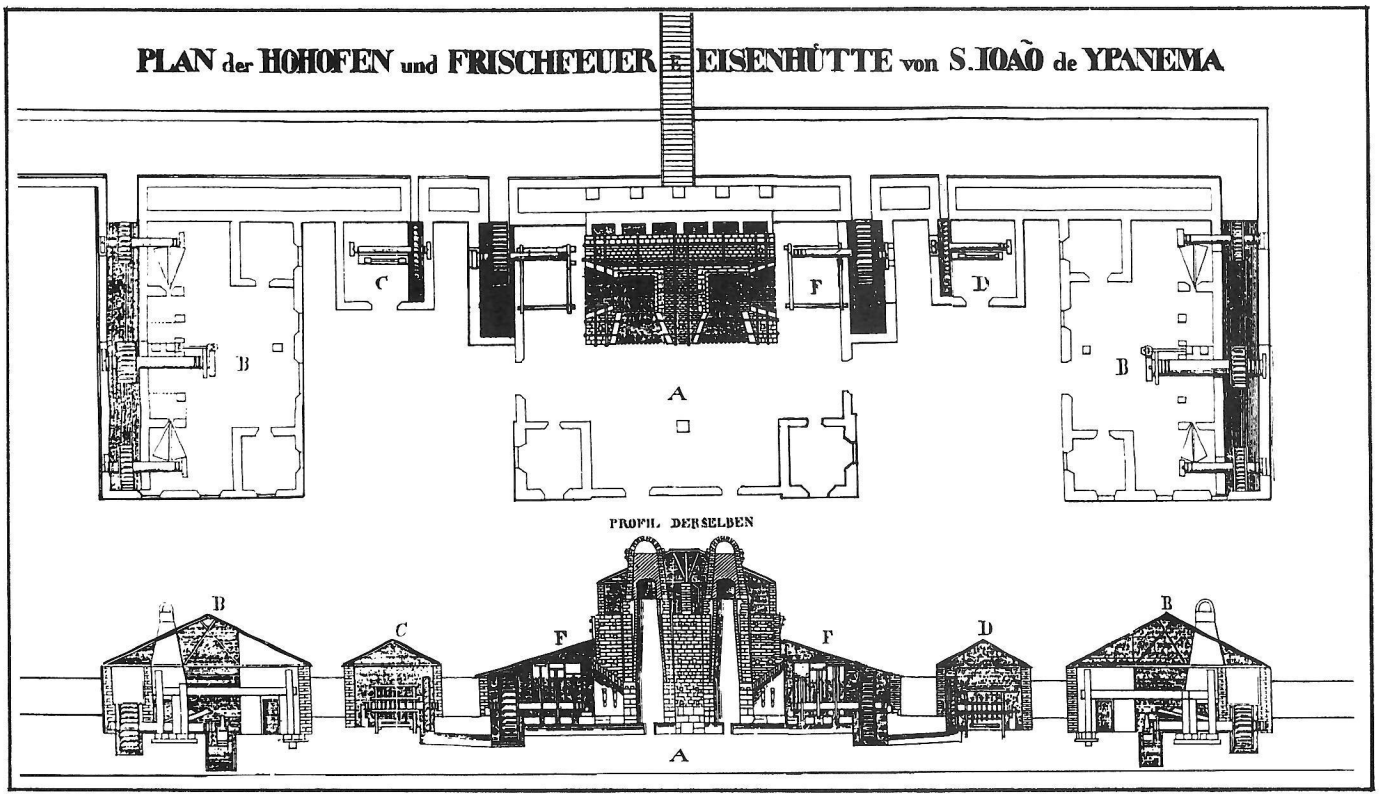


Fig. 6 Plan of twin furnaces and bloomeries at Ipanema, built by Varnhagen and drawn by Eschwege

he finished such important work." Elsewhere Saint Hilaire says: "In all the iron works of Ipanema there consist two blast furnaces, each of them with its wooden blower, eight refineries, equally with their blowers, two mills with their stamps, two hammers, four Catalan forges, one tube-boring machine etc. etc., there exist in all seventeen water wheels." Plan, Figure 6). In those times Ipanema was really a huge industrial enterprise, considered by the government, since 1822 the independent empire, as the main producer of arms, such as guns, cannon balls, sabres etc. The plan shows from left to right two water-driven bloomery or chafery hearths with a belly helve (B), a water-driven stamp mill for ore (C) and a pair of blast furnaces (A). These were blown by the Swedish type of 3-cylinder blowers (Bagge's) (F). The furnaces were charged via the bridge (E). Afurther set of stamps for slag (D) and finery hearths (B) with helve hammer completed the plant up to about 1885. (Figure 7, shows the profiles and plans of two of the furnaces in area A). These show the sort of modifications one would expect in Europe. In 1818 we have a simple tuyere, while by 1865 we have two tuyeres. In 1885 a further furnace (Mursa's) was added to the right hand side of the plant. The drawing shown in Fig. 8 gives the detail of this plant with its hydraulic hoist and bridge.

Similarly to the "Fabrica Patriotica' of Eschwege in Minas Gerais, part of this plant has been preserved to the present day due to the fact that no other industrial activities have taken place in this area, a fact which very rarely happened in our densely populated Europe.

The further history of Ipanema was very varying. In the 1830s there was another German director, Major Boehm. From his time date the marvellous gates — a beautiful example of many artistic castings (high phosphorus content) produced by the plant. There were many "ups" and "downs" until the last "up". In 1865 Colonel Joaquim de Mursa took over the management of the plant. Mursa was a student of the Freiberg Academy in Saxony. Mursa was, after Varnhagen and Boehm, the most active director of the company.

Products of Ipanema were exhibited at the World Fair in Philadelphia in 1876. Ipanema played an important role in the construction of the "Estrada de Ferro Sorocabana" (railway of Sorocabana) in 1878. Certainly the war against Paraguay which started in 1864 had been an important incentive for the government to promote the plant. Varnhagen, after his return to Europe in the early twenties, left one of his sons in Brazil, Adolpho Francisco de Varnhagen, born in 1816 in the iron-master's residence at Ipanema, who became the most famous historian of Brazil of the 19th century. He was named in 1872, Viscount of Porto Seguro (the landing place of Cabral, the discoverer of Brazil) and died in 1873 as Ambassador of Brazil in Vienna. Just the year before, the Viscount of Porto Seguro visited for the last time his birthplace and the area of his father's activities. Colonel Mursa promised to erect a monument in honour of his father, a monument which stands till today, high above the plain of Ipanema.

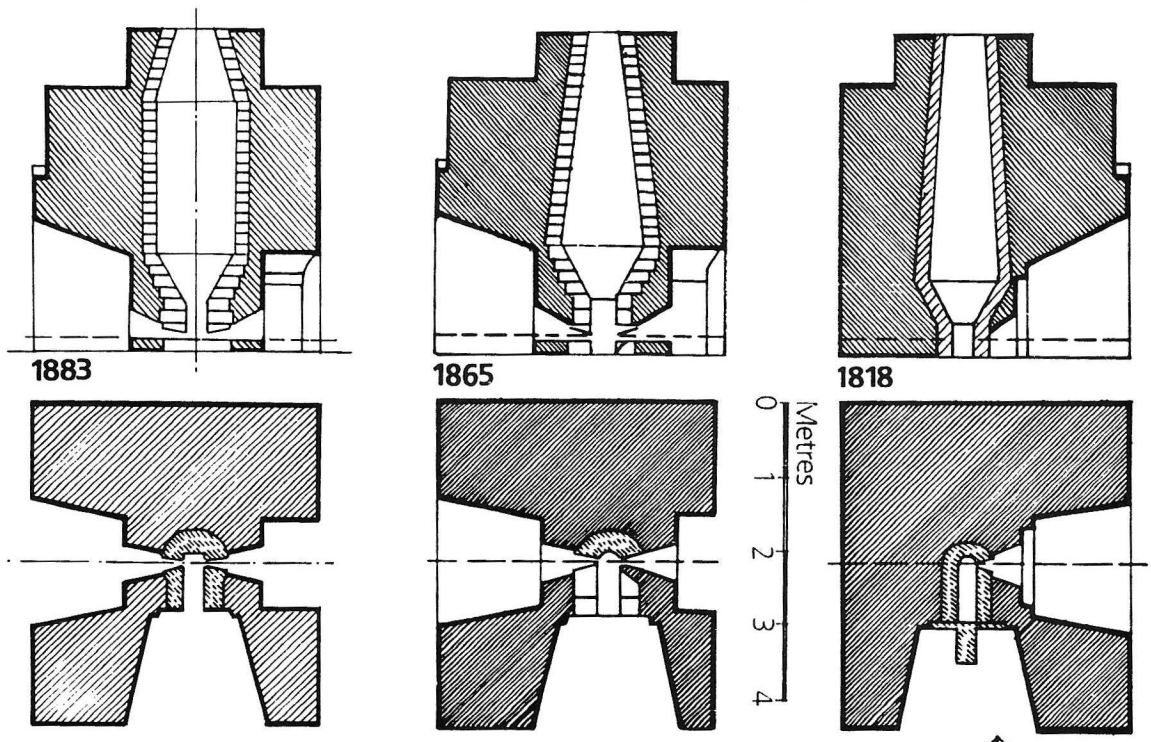
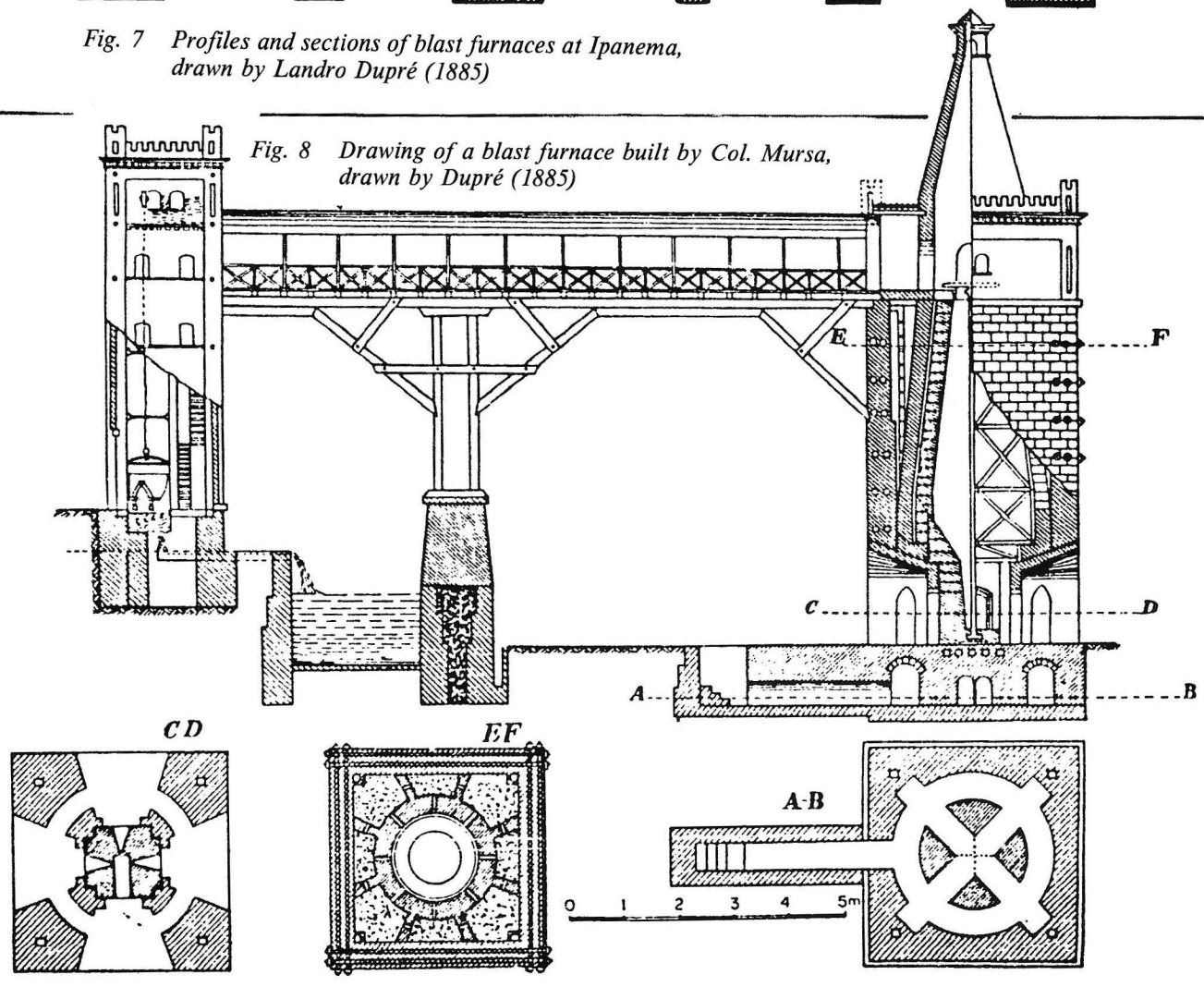


Fig. 7 Profiles and sections of blast furnaces at Ipanema, drawn by Landro Dupré (1885)

Fig. 8 Drawing of a blast furnace built by Col. Mursa, drawn by Dupré (1885)



In 1878 Colonel Mursa started the construction of a new blast furnace finished in 1885. Unfortunately this furnace was never blown in. But Mursa introduced many modern techniques like puddling, rolling etc., and many of his buildings still exist.

According to a report of a German traveller in 1883 there were plans to build an open hearth furnace and a crucible steel plant, plans which could not be completed due to the lack of financial interest by the new republican government.

Fig. 9 Bee-hive charcoal making ovens installed in 1913 but never lit

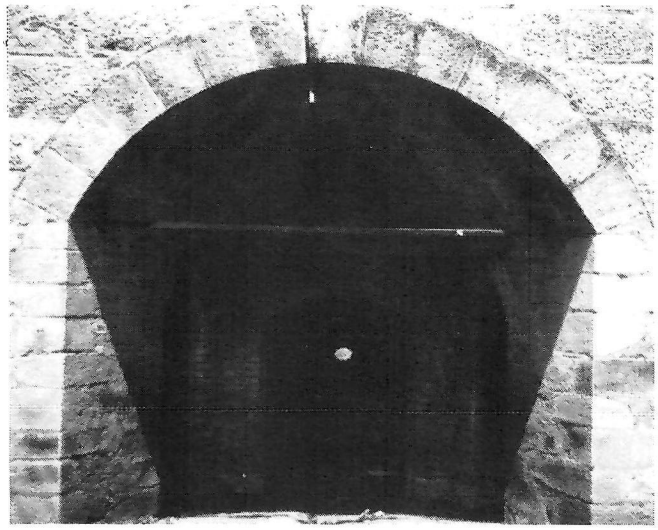


Fig. 10 Tapping arch of Col. Mursa's furnace

The very last investment in Ipanema was finished in 1913, a battery of bee-hive charcoal ovens (Figure 9). They have never been lit, and the plant was at its end. An important chapter of Brazilian iron making ended, but a new one started. The first metal-clad furnace went into operation about the same time in Mines Geraes at Esperanca (1910). Iron making remained at a low level in Brazil until the first integrated plant at Volta Redonda was built at the end of the Second World War. Since then iron making in Brazil has grown continuously, until today it has surpassed "old" iron making countries like Britain and France, ranking the seventh place in world production.

The major iron ore deposits of the world are in Brazil, just 18 billion tons of rich ore (more than 60% Fe) at Carajas, with another 12 billion tons near Corumba in Mato Grasso.

The story has not yet ended.

Fig. 11 Shafts of the two furnaces shown in the top centre of Fig. 6

Fig. 12 Some of the buildings as seen today. Sabre-making shop on right

Acknowledgements

The author is very much indebted to many friends from Brazil, Britiain and Germany. He specially wants to mention José Manhino Salazar from Impanema. Dr Werner Toenges from Fuhico in Belo Horizonte and many former colleagues at Thyssen Fundiçoes S/A. I am grateful to R F Tylecote and Charles Blick for

transposing the text into readable English, for their intriguing questions and many technical contributions.

With the kind help of Dr Werner Toenges of Belo Horizonte I have received samples of iron and slag from the Eschwege furnaces which are now under examination. These most interesting results will be published very soon.

Bibliography

1. José Manhino Salazar O Esconderijo do Sol. Sorocaiba, 1982
2. Nicolau Pereira de Campos Vergueiro. Historia da Fabrica de Ipanema, Brasilia, 1978
3. Gabriel Soares de Sousa. Tratado Descritivo do Brasil em 1587. Sao Paulo, 1971
4. Gilberto Freyre. Cas Grande e Senzala. Rio de Janeiro, 1980
5. Auguste de Saint-Hilaire. Viagem a Provincia de Sao Paulo, Sao Paulo, 1976
6. W L v Eschwege. Pluto Brasiliensis, Berlin, 1833 and Sao Paulo 1979
7. Jeninino Felicissimo Jr. Historiada Sidurgia de Sao Paulo, Sao Paulo, 1969

Biography

Our member, Friedrich Toussaint, is managing director of the Bergische Stahl-Industrie Edelstahlwerk Lindenberg, in Remscheid, West Germany. After training in Aachen and Berlin he became assistant metallurgist in the Phoenix-Rohrort plant at Duisberg in 1959, and in 1979 became President of Thyssen Fundicoes SA in Brazil until 1983.

Cover illustration

Bartolomeo Colleoni, was born in 1400 and became a soldier fighting in the wars between Milan and Venice, serving on whichever side best suited his purpose. In 1455 he was appointed generalissimo of the Venetian forces amassing a huge fortune and becoming an extremely powerful man. On his deathbed in 1475 he bequeathed all of this to the State on condition that a monument be erected to his memory in front of San Marco.

The Venetian State had not before authorised a public memorial but not wishing to lose the money, commissioned a suitable statue. It was not to be a likeness of Colleoni but was to be an evocation of all a 'condottieri' should look like: proud and supremely aware of his great power.

When complete it was erected in front of the Scuola Grande di San Marco which was the headquarters of the confraternity of goldsmiths and silk merchants, not, as Colleoni had intended, before the Church of San Marco. Unfortunately he had omitted to specify exactly which building.

Incidentally Bartolomeo Colleoni is credited with being the first person to fit guns with trunnions. George Parker took the picture.