

Multinational enterprise in historical perspective

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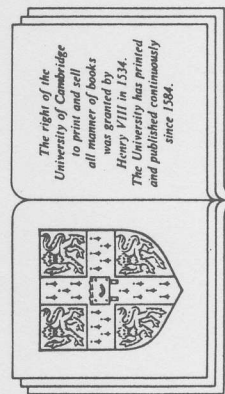
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10 Financial strategies and adaptation to foreign markets: the German electro-technical industry and its multinational activities: 1890s to 1939

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The problem

In 1913, according to one estimate, the German electro-technical industry's share of world production approximated to 35%, compared to the United States' 29% and to the 16% claimed by Great Britain.¹ Another estimate accords 31% to the German industry, 35% to the American and only 11% to the British.² It is agreed, however, that German industry, with its comparatively limited home market, dominated world exports of electro-technical material with a share of 46%, followed by the British and US industries with shares of 22 and 16% respectively.³ According to a contemporary observer German electro-technical industry exported 22% of its production; the corresponding values for its British competitors reached the level of 30% whereas the Americans remained at a level of about 7%.⁴

Since the crisis of 1901/2, which hit the German electro-technical producers especially hard,⁵ a virtual duopoly had been established on the German market with the Siemens concern (Siemens & Halske in the low-voltage sector, Siemens-Schuckert in the high-voltage business) on one side and the Allgemeine Elektrizitäts-Gesellschaft (AEG) on the other.⁶ In 1913 they were both larger than their principal competitors – the American firms of General Electric and Westinghouse on a world-wide scale. Whereas AEG achieved sales of about 453 million marks and the Siemens group even reached the figure of 472 million, General Electric claimed a corresponding figure of about 357 million marks and Westinghouse remained at a level of 160 million.⁷ In 1913 the Siemens group employed 82,900 people, of whom nearly 17,000 worked in the group's factories in Austria, Hungary, Russia, France, Britain, and Spain.⁸ During the previous year AEG's workforce had totalled 70,162, 6,551 of whom were employed abroad in its plants in Vienna, Milan, and Riga.⁹

If one considers these multiplant firms which control and manage 'production establishments...located in at least two countries', moreover, as companies that operate in an oligopolistically structured market, many 'conventional' arguments could be made to accept the two German groups as multinational enterprises (MNEs).¹⁰ If, however, one takes a closer look at their development over several decades, and sees that their expansion abroad followed certain 'stages in foreign involvement' by changes in the mode of transaction,¹¹ one readily comes to accept the validity of the internalisation paradigm,¹² possibly employed in an 'eclectic' approach.¹³ In the latter case the concept of 'comparative advantages', originating from theories of imperfect competition which developed in the beginning of theoretical discussions on the MNE, could be added;¹⁴ this point should help us to explain not only 'degrees of multinationality' but also 'discrete acts of foreign investment'.¹⁵ For these reasons this paper will, in the first instance, be dedicated to a - partial, and of necessity a rather provisional - reconstruction of the gradual process of multinationalisation in the German electro-technical industry up to the First World War. It will be followed by a brief explanation of the subsequent development during the inter-war period.

Multinationalisation from the beginnings until the crisis of 1901

By far the oldest German firm in this sector was Siemens & Halske, founded in 1847 in Berlin as a workshop for telegraph equipment by Werner Siemens, then a Prussian army officer, and by Johann Georg Halske, a gifted Berlin mechanic.¹⁶ For more than four decades Werner Siemens remained the driving force behind the entire enterprise, combining considerable organisational abilities with a highly inventive mind in the field of engineering and electro-technology. Soon other members of his family became involved. The existence of those family ties offered special incentives to internalisation and certainly contributed to the firm's successful engagement abroad at a very early stage.

Hence, from 1852 onwards, when the Russian government first placed substantial contracts for telegraph equipment and its maintenance, the firm responded by establishing a local office and a workshop where, from 1855, components manufactured in Berlin were assembled. The Russian transaction was supervised on the spot by Carl Siemens, the brother of Werner, who became a partner of the Berlin firm in 1855 while staying in Russia. In 1864 Carl persuaded his brother to invest in a copper mine at Kedabeg in Transcaucasia, the first, and for a long time the only, raw material venture of the Siemens & Halske firm.¹⁷ Another of Werner Siemens's brothers, Wilhelm, or William as he later called himself, represented the firm's interests in Britain and directed the British Siemens branch, founded in 1858, which

was engaged in laying sea cables - a potentially very profitable but highly risky business. By 1863 production of these cables and of other electro-technical material was started at Woolwich near London. In 1865 the London branch changed its name to 'Siemens Brothers', the former partners having left and Werner and William remaining sole owners of the firm.¹⁸ In order to settle disputes about responsibility and profit distribution which had come up between the brothers, in 1867 the whole firm was reorganised under the roof of a 'common business' (*Gesamtgeschäft*) with its head office in Berlin. The existence of two formally independent companies, Siemens & Halske in Berlin and Siemens Brothers in London, was acknowledged, while the Russian branch was given the status of an affiliate to the Berlin firm Siemens & Halske.¹⁹

At first sight this might appear to have been a multinational group with Berlin as its centre investing directly in Britain and Russia. However, closer scrutiny reveals that William Siemens operated quite independently despite the fact that, sea cables and telegraph equipment apart, all material originated from Germany since advantage was taken of the existing free-trade status of the United Kingdom. There was considerable dispute between the two firms because of Siemens Brothers' claim to control most overseas sales. Nor did the establishment of the British firm as a limited liability company in 1880 resolve this problem, and William's death in 1883 further aggravated it, since the manager who succeeded him refused to adopt any accommodating solution. The question was eventually resolved in 1888 when Werner Siemens replaced William's successor and re-established strict family control of the company.²⁰ Structurally this family enterprise was more akin to traditional models of international business such as the Huguenot, and later Jewish, bankers operating as family firms simultaneously in several European countries; it was certainly not co-incidental that Werner Siemens wrote to his brother Carl in 1887 that he had been enthusiastic from his early days about founding a 'world-wide business à la Fugger'.²¹

Apart from those in London and St Petersburg the foreign Siemens outposts grew rather slowly: a first subsidiary in Vienna, established in 1858, had to be closed down in 1864 and it was only in 1879 that a second (and finally successful) attempt was made in the Habsburg monarchy's capital.²² Until the 1890s the standard type of representation abroad was an agent who had to buy Siemens material on his own account. In Europe this system of subsidiary representatives was started in the 1870s and agents were appointed for Holland, Belgium, Italy, Switzerland, and Scandinavia;²³ at about the same time a corresponding initiative was taken for Latin America, followed by the establishments of agents in China in 1879.²⁴ In France, the existing legislation required that patents be worked within the country; this is why - well before the outburst of protectionism in the guise of new tariffs - a French Siemens subsidiary was founded in 1878. Siemens frères, which was

supposed to produce dynamos and arc lamps, failed to establish itself, probably because it depended on the London branch which neglected the high-voltage sector during the 1880s. In 1886 it was liquidated.²⁵ Another reason for this failure might have been increased anti-German feelings after 1871, which certainly did not favour sales and autonomous direct investment. Joint ventures proved to be a viable solution: accordingly in 1889 Siemens & Halske, Siemens Brothers (London), and the Société alsacienne de constructions mécaniques (Mulhouse) founded a common company to produce high-voltage material at Belfort, just inside the French border. The Mulhouse firm, which retained a 37.5% share, was to provide all the non-electrical mechanical equipment, while Siemens would furnish the electrical parts. In the long run, the Belfort company proved to be quite successful. However, Siemens was forced to abandon it in 1904, since the merger with Schuckert a year earlier had left Schuckert's French subsidiary – the *Compagnie générale d'électricité de Creil*, founded in 1897 – practically at Siemens's disposal. Consequently, Siemens-Schuckert rented the Creil works from the Schuckert holding E.A.G. vorm. Schuckert, which formally was still independent. A jointly owned cable factory at Belfort was nevertheless still managed with the *Société alsacienne*.²⁶ In Tsarist Russia Siemens started production of low- and high-voltage material on a larger scale as late as 1880–2. Up to that point its activities had been largely confined to repair and maintenance work.²⁷ The reason for this change of strategy was not so much increasing Tsarist tariffs as the growing pressure from a Russian administration insistent upon domestic production in exchange for the continuing placement of State orders.²⁸

Though Siemens grew gradually, at home and abroad, it was quite circumspect in its involvement in the rapidly expanding high-voltage sector during the late 1880s and early 1890s; however, its main competitor, AEG, followed a more dynamic policy during these years.²⁹ It had only started in 1883 as the German licence-holder of Edison. Moreover, it had, during the first decade of its existence, been technically dependent on Siemens and financially on Siemens, and on a number of banks, particularly the *Deutsche Bank*. In 1887 it became independent of the Edison companies and its technological dependence on Siemens was somewhat lessened. Only in 1894 did it become completely independent of its principal competitor. During the first years of its existence AEG concentrated primarily upon the electrification of Berlin. Soon it began to handle other projects in Germany, creating the first three local offices at Munich, Leipzig, and Breslau in 1885/6.³⁰

In contrast to Siemens, AEG abandoned the agent system comparatively early and established a network of 'bureaux' all over Germany and Europe. It adopted this policy essentially for two reasons: firstly the power station, lighting, and electrification of transport business dealt with a relatively large number of customers, whereas the early telegraph systems had the State as

exclusive partner; secondly, growing product sophistication demanded personnel with commensurate sales training and training in repair and maintenance, in other words, the traditional sales agent had to be displaced by a sales engineer employed by the producer.³¹

In 1900, AEG could muster no less than 42 'bureaux' in Germany, 37 in other European countries, and 38 overseas.³² Its activities were no longer confined to the finance and operation of electrical utilities and to the production of incandescent lamps, as it had been in the mid 1880s. Now it 'had expanded its manufacturing to include power equipment and had introduced a line of polyphase machinery', continuing, however, to finance and build power stations and electric tramway systems.³³ Yet, unlike Siemens, by 1900 AEG had virtually no production units abroad, even if one keeps in mind that it had participated with Siemens in founding the *Accumulateur-Fabrik-Actien-Gesellschaft* in 1890, which was to become a small MNE in its own right.³⁴ Equally, one should not forget that AEG was one of the founders of the *Neuhausen aluminium company* in Switzerland (1889) and that it took part in the creation of the *Edison General Electric Company* in 1890 – giving up its shares, however, two years later when the American group merged with its main rival, the *Thomson-Houston company*.³⁵

Incidentally, the general trend towards growing internalisation did not exclude the minor competitors of the two emerging giants. Despite its somewhat precarious financial structure which, two years later, was to become decisive in its loss of independence, the Nuremberg firm of Schuckert had by 1899/1900 almost rivalled the 'big two'. In terms of sales, 77 million marks, it slightly surpassed the corresponding Siemens figures (76.8), even if the latter figures exclude sales abroad. With 100.2 million marks AEG sales lay considerably but not spectacularly above these results.³⁶ Schuckert's sales organisation had also passed through a comparable evolution: founded in 1873, the firm had already established its first subsidiary abroad two years later in Vienna. By 1900 it possessed 36 agencies and technical bureaux in Germany, and it was represented in nine European and seven extra-European countries; it had no less than eight technical bureaux in Russia, and three in Spain.³⁷ Unlike AEG, Schuckert did own producing units abroad: in Austria in 1896/7 a Viennese factory was bought and transformed into the *Österreichische Schuckert-Werke AG* with the participation of the *Böhmische Unionbank*.³⁸ In France the *Compagnie générale d'électricité de Creil*, mentioned above, was founded jointly with a French construction firm in 1897. There appear to have been joint ventures with local firms in Stockholm and Oslo,³⁹ whereas the London and St Petersburg subsidiaries, both of them established in 1898/9, did not take up production but remained commercial outposts.⁴⁰

Other medium-sized firms besides Schuckert expanded abroad in the 1890s: this was certainly true of the *Union Elektrizitätsgesellschaft*, founded in 1892

by the engineering firm of Ludwig Loewe & Co. and by Thomson Houston.⁴¹ The Union owned two production units abroad, one in Austria, the other in Russia, which together accounted for approximately half of Siemens's total investment in these two countries and were about 40% higher in terms of value than those of the Schuckert plants in these same two countries.⁴²

Reasons for these different modes of international expansion can be found without too much difficulty. In most of these cases one would easily identify State intervention in the form of tariffs or non-tariff trade measures, especially where the State was an important customer, as in the case of Tsarist Russia, where even at local level a contractual stipulation was made by such city councils as St Petersburg's, which from 1898 required all electrical firms to ensure that two-thirds of technical staff and all electro-technical materials used were of indigenous origin.⁴³ These facts explain quite well why most of the investment in producing units made by electro-technical manufacturers during the 1880s and 1890s went to typical high-tariff countries like Russia, Austria-Hungary or – if one takes also into account the national patent legislation – France. It could also explain the long hesitation of AEG before investing in plants abroad: apparently it felt that its 'ownership advantages' secured by the quality and price of its products were so considerable in the second half of the 1890s that it could easily overcome the rising tariff walls.⁴⁴ As to Britain, foreign electro-technical investment there was at first certainly influenced by its unique position at the centre of world trade.⁴⁵ After the turn of the century the advantages of imperial preference, introduced by Canada in 1897 and, followed by South Africa and New Zealand in 1903 and by Australia in 1906, did provide a certain incentive to foreign investors.⁴⁶

Nevertheless, other factors must have been present and influential to account for the fact that in 1913, for instance, 87% of all electro-technical imports into Russia originated in Germany,⁴⁷ that in the same year the German share of Italian electro-technical imports reached 70%,⁴⁸ and that the Germans regularly succeeded, between 1903 and 1913, in providing about half of Argentina's imports in this field.⁴⁹ One of the principal causes of this development can be found in the nature of the so-called *Unternehmengeschäft*: this meant that the large German electro-technical producers created their own market by establishing local and regional power, tramway and lighting companies in those countries (e.g. Russia, Italy, Spain, Latin America) and for those customers (particularly local public authorities) which suffered from chronic lack of capital. Newly created companies were forced by statute to buy their electro-technical supplies from their big industrial founders.⁵⁰ Doubtless these operations were further steps in internalisation aimed at reducing the risks of selling in a foreign market. However, the electro-technical producers found themselves with the risks attendant upon accumulation of a growing volume of equity capital which they had to keep in their portfolios and which tended to reduce their liquidity quite dangerously. By creating

financial holdings together with the great banks the producers found a solution to this problem. The financial holding companies were supposed to take over the shares and bonds of the newly created public utility companies, to keep them in their portfolios during the period of construction and initial development, and to sell most of these holdings to the general public as soon as they had 'matured' and were able to yield a profit. For the financial holding companies it was normally sufficient to retain afterwards only a controlling minority share.⁵¹ Each of the German producers had such intermediate financial holdings at its disposal: AEG had among others the Bank für Elektrische Unternehmungen, which it had founded in 1895 at Zürich together with a group of mainly German and Swiss banks. Siemens could rely on the Basel-based Schweizerische Gesellschaft für Elektrische Industrie, formed in 1896, as well as on its Elektrische Licht- und Kraftanlagen, founded at Berlin in the same year. Schuckert and the larger of the minor electro-technical producers equally controlled their own *Finanzierungsgesellschaften*.⁵² Some of the most important of these financial holdings took their legal seat in Switzerland or Belgium – in the latter country, for instance, the well-known AEG-controlled SOFINA was based. This was due mainly to the liberal company law and stock exchange regulations of the two countries; in part it was probably also due to the participation of important Swiss and Belgian banks in these holdings.⁵³

The development from 1901/2 until the First World War

The decade that followed the crisis of 1901/2 was characterised by two fundamental developments:

- 1 There was an extraordinary process of concentration in this branch of German industry which led to the disappearance or subjugation of most of the medium-sized producers. The lesser firms in this group either went bankrupt (as did Kummer of Dresden) or were, at the point of failure, bought up by their larger rivals and simply shut down (as happened to Helios).⁵⁴ The two largest and technically certainly most advanced firms of this group were very rapidly taken over by AEG and Siemens: thus Schuckert merged with Siemens in 1903: their new common high-voltage division, the Siemens-Schuckertwerke, formally an independent unit, helped Siemens to overcome its relatively weaker position in that field.⁵⁵ AEG's take-over of the Union Elektrizitätsgesellschaft in two stages in 1902 and 1904 was more important for its consequences in the field of international contacts, the Union being closely connected with Thomson Houston from its beginnings and later on with General Electric.⁵⁶ The two remaining middle-sized companies which survived the immediate impact of the 1901/2 crisis succumbed at a later stage: although Lahmeyer had

in 1905 found a partner in the Felten & Guilleaume cable works, both of them lost their independence in 1910 and were – especially Lahmeyer – firmly integrated in the AEG group.⁵⁷ Siemens gained control of the Bergmann Elektrizitätswerke in 1912 when the Deutsche Bank, with whom both of them had worked so far, threatened to cut its credits to the Bergmann firm, which was not very soundly organised.⁵⁸

As a consequence of this whole process of concentration, the two remaining large producers reorganised, among other things, their international network of agencies, technical bureaux, and plants. Thus, by taking over the existing factories of the Union Elektrizitätsgesellschaft, AEG finally became a producer in Russia and Austria-Hungary.⁵⁹ Its technical bureaux abroad were increasingly transformed into legally independent foreign subsidiaries; in 1911/12, for instance, a South-American AEG company, responsible for business in Argentina, Brazil, and Chile, and a Mexican AEG company were founded.⁶⁰

After its merger with Schuckert, Siemens took over the plants possessed by the Nuremberg firm in Austria and Hungary and created the Österreichische Siemens-Schuckertwerke and likewise a Hungarian Siemens-Schuckert company, the latter with plants in Budapest and Bratislava.⁶¹ In France, the Schuckert factory at Creil was, as we have already seen, leased to Siemens-Schuckert which, not very successfully, tried to reorganise it during the years just before the outbreak of the First World War.⁶² In Russia, close collaboration between Russian Siemens and Schuckert subsidiaries was stipulated in 1904 for the high-voltage business, but only in 1913 was a common Russian Siemens-Schuckert company with considerable manufacturing capacities established.⁶³ Finally, the growing importance of exports to extra-European countries required better control and coordination, including the business of the British Siemens branch, over which Berlin had regained complete control after the turn of the century. In 1908, therefore, a common overseas department was created, since it was felt that the extra-European markets needed special care and monitoring.⁶⁴

2 The second factor was the rapid increase in 'coordination', on a national and an international level, not only between AEG and Siemens but also between, for instance, AEG and General Electric (in 1903). Since this was a branch with rather heterogeneous products (light bulbs were a notable exception and there were permanent attempts to cartelize this product), the creation of cartels remained rather the exception than the rule. A more tangible result was the creation of common companies, for instance between Siemens and AEG in Russia, because in this case – the production of cables – the internal Russian market was considered to be too small for two competitors.⁶⁵ In Italy, AEG and General Electric – represented by one of the European Thomson Houston companies – in 1904 founded a joint

producing firm, since they had decided to share this market in common when 'dividing up the world' the year before.⁶⁶ The Italian firm of AEG-Thomson Houston started production on a larger scale only in 1909, but it was clear right from the beginning that it should produce only material which could not be delivered 'under more favorable conditions by AEG of Berlin or Thomson Houston of Paris'.⁶⁷ The German consul in Rome indicated another reason for direct investment in the Italian electro-technical industry in his annual report for the year 1910: 'Important firms such as AEG or Brown Boveri have established subsidiaries not only in order to save tariff duties but also for calming the protectionist lobby by offering national products'.⁶⁸ Another country where production had to be started without much enthusiasm was Spain. There Siemens in 1910 took over an electro-technical plant from a local producer in the vicinity of Barcelona because of increasing Spanish tariffs and a new law for the protection of national industry.⁶⁹

In most of these cases of direct investment in producing units there were only two alternatives. As Felix Deutsch, successor of the two Rathenaus at the head of AEG, once put it, they were 'either to renounce such business completely or to start part of the production in the foreign country itself'.⁷⁰ In the absence of such state-enforced multinationalisation the large producers preferred, however, to profit from increasing economies of scale in the big factories of their countries of origin. The growth of internalisation thus found its limits in certain technical constraints as long as typical location-specific factors – the protectionist policies mentioned above – did not prevail.

The interwar period

The loss of the war by Germany and the loss of most of their direct investments abroad confronted the German electro-technical producers with a radically changed situation. The old strategy, i.e. providing the product and at the same time its financing via the network of the international financial holdings, was no longer feasible after the Swiss and the Belgian holding companies slipped away from producers' control during the post-war inflation period. At that time neither AEG, Siemens nor the German banks were able to provide the necessary foreign exchange needed for maintaining the financial liquidity of these holdings.⁷¹ Thus the high-voltage sector especially, with its long-term capital requirements, was hit particularly hard.⁷² On the other hand, the telephone equipment and the wireless communications sector, in which a firm like Siemens traditionally had a strong position, could increase its share in German exports quite considerably during the 1920s.⁷³

In any case, the dominant position held by the German electro-technical industry on the world market until 1914 could not be re-established. Its share

of world exports – 46% before the war, as we have seen – fluctuated around 25–8% during the second half of the 1920s. Only in 1931, at the height of the crisis, did it reach the exceptional percentage of 32.7.⁷⁴ In 1927 the total volume of US production amounted to 7 billion marks against 2.7 billion marks for the German output of electro-technical material, which means that American production had grown almost five fold since 1912 whereas in the German case it had only somewhat more than doubled.⁷⁵ In 1929 Siemens's sales volume amounted to 850 million marks and AEG had a corresponding figure of 580 million. They were largely left behind by General Electric and Western Electric with 1,744 and 1,722 million respectively, whereas the second American producer of high-voltage material, Westinghouse, was not so far removed from the two German companies with its sales volume of 909 million marks.⁷⁶

Under these conditions of reduced strength only certain strategies could guarantee a limited degree of success. A few of them will be mentioned here:

- 1 Despite serious financial constraints the German electro-technical producers could, in certain cases, try again to resort to limited direct investment. This was done, for instance, by Siemens in Italy and in Czechoslovakia in the communications sector, where the State as a customer for wireless and telephone equipment bought exclusively from 'national' producers.⁷⁷ Also in France a telephone producing firm was bought up by Siemens in order to get access to this specific market.⁷⁸ The situation was, of course, much more favourable for both Siemens and AEG in Austria and Hungary, where the previously established subsidiaries were not lost after the war and guaranteed therefore a strong position in these markets.⁷⁹ When, during the 1930s, the protectionist pressure grew in all these countries, an increasing scale of products could then be manufactured in these foreign producing units.⁸⁰
- 2 Cartelisation proved to be only a rather limited possibility given the special character, already mentioned, of electro-technical goods. Nevertheless there were, beside the cartel of light bulb producers, founded in 1924, some efforts in the telephone sector in which Siemens participated against the powerful ITT.⁸¹ Besides this, in the high-voltage business the big American, German, and British producers succeeded in signing the International Notification and Compensation Agreement in 1931 which covered the world outside Europe and which lasted until the outbreak of the Second World War.⁸²
- 3 Technical co-operation, i.e. the exchange of patents and other types of know-how, with the large US companies was another chance for the German producers who wanted to get rid of the isolation caused by the First World War and its immediate aftermath. Thus in 1923 AEG renewed its traditional ties with General Electric, and Siemens chose in 1924 the

other important American producer, Westinghouse, as a partner for a ten-year technical agreement, renewed in 1934.⁸³

- 4 The most promising solution seemed to be the search for new financial resources which in practical terms meant loans or equity capital from US investors. Siemens used this possibility quite extensively between 1925 and 1930,⁸⁴ and it is well known that in 1929 General Electric took a 25% share in AEG.⁸⁵ Where the German electro-technical producers lacked this financial support, competition with American industry became increasingly difficult, especially in the capital-intensive high-voltage sector. Argentina in 1926/7 illustrates this perfectly: Siemens and AEG tried to acquire control there of a considerable number of small power plants owned by the national Herlitzka group. The Brussels-based SOFINA, before the war controlled by AEG, hesitated to give the necessary financial support to this operation. It was therefore hardly surprising that the Electric Bond and Share Company, a financial holding of General Electric, succeeded in buying up the Herlitzka companies.⁸⁶

As indicated in this brief analysis of the multinational activities of the German electro-technical industry, the processes of internalisation do not, historically speaking, have to be one-way developments by any means. The German case illustrates particularly well how the rapid growth of the electro-technical sector until the First World War and how the ensuing dramatic change in political and economic conditions affected the international strategies of the leading firms of this comparatively new industry.

NOTES

Abbreviations used: *ETZ* = *Elektrotechnische Zeitschrift* Siemens Archives = Siemens-Museum, München: Firmenarchiv

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- 2 G. Jacob-Wendler, *Deutsche Elektroindustrie in Lateinamerika: Siemens und AEG (1890–1914)* (Stuttgart, 1982), p. 11; 'Die Elektrizität auf dem Weltmarkt', *ETZ* (1913), 1016.
- 3 Czada, pp. 137ff; Jacob-Wendler, p. 11; see also the statistical tables in Siemens Archives, SAA 11/Lb 581 (Liedtke).
- 4 'Die Elektrizität auf dem Weltmarkt'.
- 5 J. Loewe, 'Die elektrotechnische Industrie', *Die Störungen im deutschen Wirtschaftsleben während der Jahre 1900ff.*, III, *Schriften des Vereins für Socialpolitik*, CVII (Leipzig, 1903).
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- 7 I. C. R. Byatt, *The British electrical industry 1875–1914* (Oxford, 1979), p. 166.
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- 14 S. H. Hymer, *The international operations of national firms: a study of direct foreign investment* (Cambridge, Mass., 1976); C. P. Kindleberger, *American business abroad: six lectures on direct investment* (London, 1969).
- 15 J. H. Dunning, 'Explaining the international direct investment position of countries: towards a dynamic or developmental approach', *Weltwirtschaftliches Archiv* (1981), 30–64; quotation from p. 33.
- 16 See for the whole first phase of development Siemens, *Geschichte*, vol. I, and S. v. Weiher and H. Goetzler, *Weg und Wirken der Siemens-Werke im Fortschritt der Elektrotechnik 1847–1972* (München, 1972), pp. 8ff.
- 17 S. v. Weiher, 'Carl von Siemens, 1829–1906: Ein deutscher Unternehmer in Russland und England', *Tradition* (1956), 13–25.
- 18 S. v. Weiher, *Die Entwicklung der englischen Siemens-Werke und des Siemens-Überseegeschäfts in der zweiten Hälfte des 19. Jahrhunderts* (doctoral thesis, University of Freiburg im Breisgau, 1959), pp. 33ff.
- 19 Siemens, *Geschichte*, vol. I, p. 87.
- 20 v. Weiher, *Die Entwicklung der englischen Siemens-Werke*, pp. 115ff., 143f., 154ff., 180ff.; Scott, pp. 61ff.
- 21 Quoted in v. Weiher and Goetzler, p. 9, n. 2.
- 22 v. Weiher, *Die Entwicklung der englischen Siemens-Werke*, p. 143, n. 4.
- 23 Waller, III, p. 130.
- 24 v. Weiher, *Die Entwicklung der englischen Siemens-Werke*, pp. 149ff.
- 25 Siemens archives, SAA 68/Li 177: 'Das Schicksal von Siemens frères, Paris...'
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