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VISITS AND EXCURSIONS AT THE VIENNA MEETING.

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Iron and Steel Institute.

REPORT ON THE VISITS AND EXCURSIONS AT THE VIENNA MEETING.

EDITED BY

BENNETT H. BROUGH,
Secretary.

His Imperial and Royal Highness
THE ARCHDUKE FRIEDRICH OF AUSTRIA
Hon. Member of the Iron and Steel Institute

Frontispiece

VISITS AND EXCURSIONS AT THE VIENNA MEETING.

ARMS OF THE CITY
OF VIENNA

IN connection with the Meeting of the Iron and Steel Institute in Vienna, an influential General Reception Committee was formed in order to make the necessary arrangements. The constitution of this committee was as follows:—

Patron.

His Imperial and Royal Highness the ARCHDUKE FRIEDRICH.

General Reception Committee.

His Excellency Leopold Graf Auersperg, k. k. Geheimer Rat, the Minister of Agriculture.
Henrik Bäckström, Technical Director of the Oesterr. Alpine-Montangesellschaft. Member of the Iron and Steel Institute.
His Excellency Max Vladimir Baron von Beck, k. k. Geheimer Rat, the Prime Minister.
Adalbert Bergmann, General Director of the "Felten und Guilleaume, Fabrik elektrischer Kabel, Stahl- und Kupferwerke-Aktiengesellschaft." Member of the Iron and Steel Institute.
Bernhard Bettelheim, Director of the Albert Hahn Tube Rolling Mills.
Friedrich Böhler, Ironmaster and Colliery Owner.
Dr. Hugo Böhm, k. k. Hofrat, General Director of the Buschtěhrader Railway.
Maximilian Bondy, Verwaltungsrat der Kupferwerke Oesterreich.
Johann Brik, k. k. Hofrat, Professor of the Technical High School of Vienna.
Josef von Ehrenwerth, Professor at the Mining High School of Leoben. Hon. Member of the Iron and Steel Institute.
Dr. Alexander von Eger, k. k. Hofrat, General Manager of the Southern Railway.
His Excellency Dr. Josef Foŕt, k. k. Geheimer Rat, the Minister of Commerce.
Eugen Friedländer, Managing Director of Böhler Brothers.
Rt. Hon. Sir William Edward Goschen, G.C.V.O., K.C.M.G., British Ambassador at Vienna.
Rudolf Grimus Ritter von Grimburg, k. k. Hofrat, Director of the Austrian-Hungarian State Railway Company.
Georg Günther, General Director of the Skodawerke.
Otto Günther, k. k. Oberbaurat, Vice-President of the Verein der Montan-, Eisen- und Maschinen-Industriellen Oesterreichs.
David Ritter von Gutmann, Ironmaster and Colliery Owner.
Max Ritter von Gutmann, Ironmaster, k. k. Bergrat. Member of the Iron and Steel Institute.

Johann Ritter von Habrda, Head of the Department of Police, Vienna.
Karl Hochenegg, Oberbaurat, Rector and Professor at the Technical High School of Vienna.
Zdenko Hořovsky, Technical Director of the Prager Eisen-Industriegesellschaft. Member of the Iron and Steel Institute.
Alphonse Edler von Huze, Manager of the Ternitzer Stahl- und Eisenwerke.
Hans Baron Jüptner von Jonstorff, Professor at the Technical High School in Vienna. Member of the Iron and Steel Institute.
Anton Ritter von Kerpely, General Director of the Oesterr. Alpine-Montangesellschaft. Member of the Iron and Steel Institute.
Wilhelm Kestranek, Central Director of the Prager Eisen-Industriegesellschaft and of the Böhmischen Montangesellschaft. Member of the Iron and Steel Institute.
His Excellency Erich Graf Kielmansegg, k. k. Geheimer Rat und Kämmerer, the Governor of Lower Austria.
Julius Ritter von Kink, President of the Chamber of Commerce and Industry of Lower Austria.
Josef Klaudy, Professor at the Technological Museum; President of the Oesterr. Ingenieur- und Architektenverein.
Wilhelm Köhler, k. k. Bergrat, Central Director of the Oesterr. Berg- und Hüttenwerks-gesellschaft. Member of the Iron and Steel Institute.
Rudolf Krassl, Partner in the firm of C. Z. Petzold & Co.
Arthur Krupp, Member of the Upper House.
Heinrich Ritter von Kuh, k. k. Baurat.
Paul Kupelwieser, Member of the Iron and Steel Institute.
His Excellency Heinrich Graf Larisch-Mönnich, k. k. Geheimer Rat und Kämmerer, Lord-Lieutenant of Silesia, President of the Verein der Montan-, Eisen- und Maschinen-Industriellen Oesterreichs.
Dr. Karl Lueger, the Lord Mayor of Vienna.
His Excellency Max Graf Montecuccoli-Laderchi, k. k. Geheimer Rat, President of the Oesterr. Alpine-Montangesellschaft.
Karl Neufeldt, Consul-General for Norway.
Friedrich von Neuman, Ironmaster.
Hugo von Noot, President of the Krainische Industriegesellschaft. Member of the Iron and Steel Institute.
His Excellency Erwein Graf Nostitz-Rieneck, k. k. Geheimer Rat und Kämmerer, Member of the Upper House, Ironmaster.
Albert Baron von Rothschild.
Paul Ritter von Schoeller, C.M.G., British Consul-General; Member of the Upper House.
Richard Ritter von Schoeller, Ironmaster.
Friedrich Schuster, General Director of the Witkowitzer Bergbau- und Eisenhütten-Gewerkschaft. Member of the Iron and Steel Institute.
Alphons Senitza, Director of the Zöptauer- und Stefanauer Gewerkschaft.
Edgar von Spiegl, President of the Concordia Society of Journalists and Authors.
Theodor Ritter von Taussig, Vice-Governor of the k. k. a. p. Oesterr. Bodenkreditanstalt, President of the State Railway Company, and of the Oesterr. Berg- und Hüttenwerks-gesellschaft.
Emil Tietze, k. k. Hofrat, Director of the Geological Survey of Austria.
Rudolf Vambera, Rector and Professor of the Přibram Mining High School.
Friedrich Wannieck, President of the Prager Eisen-Industriegesellschaft.
Viktor Waltl, Rector and Professor of the Leoben Mining High School.
Isidor Weinberger, President of the Böhmische Montangesellschaft.
Karl von Webern, Head of Department in the Ministry of Agriculture.
His Excellency Hans Graf Wilczek, k. k. Geheimer Rat, Member of the Upper House.

The Executive Committee consisted of the following gentlemen :—

Chairman.—WILHELM KESTRANEK.
Vice-Chairman.—MAX RITTER VON GUTMANN.
Treasurer.—RICHARD RITTER VON SCHOELLER.

Members of Committee.

HANS BARON JÜPTNER VON JONSTORFF. | HUGO VON NOOT.
ANTON RITTER VON KERPELY. | FRIEDRICH SCHUSTER.

Hon. Secretaries.

Dr. EUGEN HERZ. | HUGO VON NOOT, Junior.

In addition to the foregoing an influential Ladies' Reception Committee was also formed, consisting of the following ladies :—

Baronin Amélie Ferstel.
Frau Emilie von Gutmann.
Baronin Jüptner von Jonstorff.
Frau Bertha von Kerpely.
Frau Marie Kestranek.
Frau Irene von Noot.
Frau Helene Rothballer.
Frau Josephine Schuster.
Frau Emmy von Schoeller.
Fräulein Lily Ehrenfeld.
Fräulein Rosa Frieb.
Baronesse Jüptner von Jonstorff.
Fräulein Ida Kestranek.

Owing to the illness of Baron von Jüptner, the Baroness and her daughter were unfortunately debarred from taking part in the meeting.

It would be impossible to praise too highly the members of the Austrian Reception Committee for the excellence of the arrangements made for the comfort and entertainment of the visitors, or for the generous scale upon which hospitality was dispensed.

The attendance of members was unusually large for a foreign meeting, some 450 members and ladies having registered their names. The Honorary Secretaries' office was situated in the House of the Society of Austrian Engineers and Architects, in which the meeting was held by the kind permission of the Council of the Society; and it was here that the members assembled on the mornings of September 23 and 24 to attend the business meetings of the Institute and to receive tickets and information respecting the longer excursions to Bohemia, Styria, and Moravia and Silesia, as well as for the Court Reception held on the evening of Tuesday, September 24, and the excursion on September 24 to the Hoch Schneeberg. The main party of members who, to the number of 250, travelled by the tour organised by the Great Northern Railway Company, arrived at Vienna on the evening of Saturday, September 21, and proceeded to the hotels allotted to them by the Reception Committee. These were the Hotel Erzherzog Carl, at which most of the members of Council attending the meeting stayed; the Hotel Bristol; the Hotel Metropole; and the Hotel Continental, at which the largest number were accommodated. Smaller parties were allocated to the Hotel Sacher, Hotel Kaiserin Elisabeth, the Matschakerhof, the Meissl und Schadn Hotel, the Oesterreichischer Hof, the Hotel de France, the Hotel König von Ungarn, and the Hotel Dungl respectively. On arrival at their various destinations the visitors found awaiting them, in their rooms, a handsome box, specially prepared for the occasion, containing an album of 146 views of Vienna, presented by the Reception Committee; several illustrated guides to places of interest in Austria; an envelope containing tickets for the gala performance at the opera on the opening night of the meeting; an invitation to the Court Reception at the Imperial Palace; and a box containing the badge, which was to serve as a passport to the other functions, and, in particular, to the Banquet. This badge was beautifully executed in bronze from a design by Dr. Eugen Herz, and represented, in relief, a smith working at his anvil, and surrounded by the implements of his craft. It was encircled by a band bearing the inscription, "Iron and Steel Institute, Vienna, 1907."

The Austrian Society of Engineers and Architects.

The House of the Society of Austrian Engineers and Architects, which, as on the occasion of the meeting of the Iron and Steel Institute in Vienna twenty-five years previously, was the official place of meeting, is a handsome three-storied building of grey stone situated in the Eschenbachgasse, in close proximity to the Opern Ring, one of the most beautiful thorough-

fares of the city. The ground-floor is let out in offices; the first floor is occupied by the Scientific Club, and the upper storey is devoted to the administrative work of the Society. The lecture-theatre, in which during the winter months the members foregather weekly for the discussion of technical and scientific subjects, has seating accommodation for four hundred persons, while about a hundred more can be accommodated in the gallery. The room itself is entirely panelled and roofed with dark oak, the brown tones of which harmonise excellently with the dull gold in which some of the decorative lines are traced. Behind the presidential chair hangs a large oil painting of the Emperor of Austria. Adjoining the theatre are two or three committee rooms, and above it is the Society's library, containing about 10,000 volumes, and a council room, with an interesting collection of addresses presented to the Society on the occasion of its jubilee in 1899,* and other objects of architectural and engineering interest. The President of the Society is Joseph Klaudy, Professor at the Museum of Industrial Technology at Vienna; and Baron Constantin von Popp is the secretary. He is also editor of the Society's admirable weekly journal.

Baron Rothschild's Gardens.

The mornings of Monday and Tuesday, September 23 and 24, were devoted to the official reception of the Institute and to the reading and discussion of papers. The ladies of the party assembled at the Karlsplatz on the morning of the 23rd, where they were met by the Austrian Ladies' Reception Committee and Mr. Hugo von Noot, junior, by whom they were conducted in carriages to visit the gardens and greenhouses belonging to Baron Alphonse Rothschild, at his estate on the Hohe Warte. At the conclusion of the visit the ladies were entertained at luncheon, and subsequently drove back to the Karlsplatz.

Drive through Vienna.

On Monday afternoon practically the whole of the visitors assembled in the open space to the north of the Votive Church, which was built, from designs by Ferstel, to commemorate the Emperor's escape from attempted assassination in 1853, and entered the conveyances which had been provided to drive them through the chief thoroughfares of the city, and to visit the Historical Museum and the Town Hall. The party, which was driven in eighty conveyances, was taken through the Ring streets which surround the inner city, and over the Danube Canal to the broad thoroughfare which leads from the Aspern Bridge to the Prater, and thence by a different route to the Town Hall, a beautiful building in the Gothic style, not far removed from the Maximilian Platz, from which the start had been made.

The Town Hall.

The Town Hall contains the Historical Museum of the city; and the magnificent collections of arms and armour attracted much interest. They are housed in the galleries of the second floor, and embrace weapons and trophies from all parts of the world, one of the chief curiosities being the Ahlspiesse, or fifteenth-century pikes shown. After a brief survey of the art treasures of the museum the visitors were taken to the Council Chamber, where they were received by the Deputy Mayor, Dr. Neumayer, who

* *Journal of the Iron and Steel Institute*, 1899, No. I. p. 253.

acted on behalf of the Lord Mayor, Dr. Karl Lueger, whose health incapacitated him from attendance. Dr. Neumayer welcomed the members in a few well-chosen sentences, and pointed out that while Vienna was justly proud of its historical past, it was to the future, and its accompanying industrial and commercial development, that her citizens looked with the deepest interest. Sir Hugh Bell replied in German on behalf of the Institute, and thanked the Deputy Mayor for his kind welcome, after which a procession was formed to the Festsaal, where the visitors partook of a splendid collation, served at separate tables, which, in honour of the occasion, had been rendered gay with flowers. On entering the banqueting hall the visitors were made the recipients of fresh evidences of the genial hospitality of their hosts, in the shape of handsome boxes of sweetmeats, bearing the inscription, "Iron and Steel Institute, Wien," and well-filled cigar-cases in crimson leather, crossed by a broad white band (red and white being the colours of the city), which bore, in its centre, the arms of Vienna. At the conclusion of the repast the Deputy Mayor proposed the toast of the Emperor, and again welcomed the visitors to Vienna. On leaving the Town Hall the members of the party found awaiting them conveyances, in which they were driven to their respective hotels.

Performance at the Opera.

The evening was devoted to a visit to the Imperial Opera House, where a special performance of Karl Goldmarck's "Queen of Sheba" was given. The Reception Committee had secured for their guests the whole of the best parts of the house, and the attendance fell little short of 450 persons. The opera, which was followed with the greatest interest by those present, was superbly staged and mounted, and produced a deep impression on the visitors, while the music and acting worthily sustained the high traditions of the Opera House of Vienna.

Luncheon at the Archduke's Palace.

On September 24 the President and Council and a few representative foreign members of the Institute were invited by the Archduke Friedrich to luncheon at his palace in Vienna. The company included Sir Hugh Bell, Bart., President, Mr. E. P. Martin, Past-President, Mr. W. H. Bleckly, Hon. Treasurer, Mr. G. Ainsworth, Mr. J. M. Gledhill, Mr. A. Greiner, Mr. J. E. Stead, F.R.S., Mr. Illtyd Williams, Members of Council, Mr. Bennett H. Brough, Secretary, Mr. A. Dreux (France), Mr. C. Fera (Italy), Mr. J. Goujon (Russia), Dr. G. Hahn (Germany), Mr. J. E. Ljungberg (Sweden), Mr. G. McMurtry (United States), and Mr. H. Post van der Burg (Holland). The Reception Committee was represented by Mr. W. Kestranek, Chairman, the Ritter Max von Gutmann, Vice-Chairman, the Ritter Anton von Kerpely, Mr. Hugo von Noot, Mr. F. Schuster, and Dr. E. Herz, Hon. Secretary. There were also present the Right Hon. Sir W. E. Goschen, G.C.V.O., K.C.M.G., British Ambassador, and the Archduke's equerry, General Count Bigot de St. Quentin. Before the luncheon the President handed to His Imperial and Royal Highness the diploma of honorary membership, sealed with the Common Seal of the Institute, and, speaking in German, said :—

"On behalf of the Council and Members of the Iron and Steel Institute, I beg to be allowed to present the diploma of honorary membership which your Imperial Highness has honoured us by deigning to accept.

"It is a source of quite peculiar pleasure that we are permitted to add the name of your Imperial Highness to the list of our members, for there is thus afforded to us the opportunity of giving expression to the gratitude

we feel for the distinguished honour which has been done us by the government of His Imperial Majesty during the visit of the Institute to Vienna.

"But there is another reason of a more direct and personal kind why we desire to enroll your Imperial Highness on our list of members. Your Imperial Highness is qualified as an ironmaster, and is regarded as the head of the iron trade of this country.

"By consenting to become an honorary member, your Imperial Highness gives us the satisfaction of numbering amongst us a prince who holds so distinguished a position, and we tender to your Imperial Highness our sincere thanks for the honour which has thus been conferred upon the Institute."

In reply, the Archduke expressed his gratification at his election, and assured the President that he had always taken and would always take the greatest interest in the proceedings of the Institute.

Schönbrunn.

On the afternoon of Tuesday, September 24, the visitors again assembled at the Karlsplatz, whence they proceeded under the guidance of Mr. Z. Hořovsky, aided by several other members of the Reception Committees, including the Honorary Secretaries, Dr. Eugen Herz and Mr. Hugo von Noot, junior, to visit the park, gardens, and palm-houses of the Imperial Palace of Schönbrunn. Special tram-cars were provided to take the party to the park gates, a distance of about two and a half miles from Vienna. As the Emperor was in residence at the time of the visit, the members were unable to view the Imperial apartments, and the visit was therefore confined to the gardens. Here the visitors were shown the parterre, with its magnificent flower-beds and lofty hedges, laid out in the French style of the eighteenth century, and ornamented with thirty-two marble statues, the work of Beyer and other celebrated sculptors; the palm-house, the main avenue, to the left of which stands a beautiful arch built up of Roman remains, the Obelisk, Der Schöne Brunnen, which shows the beautiful reclining statue, by Beyer, of the Nymph Egeria, and the celebrated Neptune fountain. The visitors then climbed the hill, nearly 800 feet in height, upon which stands the Gloriette, built by Von Hohenberg. The atmosphere was clear, and from the Belvedere a splendid view of Vienna and of the surrounding country was obtained.

The palace of Schönbrunn stands on the site of a hunting lodge built in 1570 by the Emperor Maximilian II., and dates back to the year 1619. In the reign of Maria Theresa it was almost entirely rebuilt (1744–1750). It contains 1441 apartments, and is of special interest as having been, in 1805 and 1806, the headquarters of Napoleon, whose son, the Duke of Reichstadt, died, in 1832, at the age of twenty-one, in the room once occupied by his father.

After visiting the grounds, the visitors proceeded to the Tivoli Restaurant, which stands in an extensive garden adjoining the east side of the Imperial Park. Here they were entertained with light refreshments, after which they were driven in carriages back to their hotels.

Reception at Court.

In the evening the members of the Institute had the honour of being received by His Imperial and Royal Highness the Archduke Friedrich, who held a levee at the Hofburg on behalf of His Imperial and Royal Apostolic Majesty the Emperor of Austria. The ceremony was fixed for 8 P.M., and

was attended by about 250 members of the Institute. It took place in the Neuer Saal, a handsome reception room adjoining the Emperor's apartments. The Archduke was attended by his equerry, General Count Bigot de St. Quentin; and the British Ambassador, Sir W. E. Goschen, was also present. Mr. Kestranek acted as introducer, and presented the members of Council of the Iron and Steel Institute to His Highness, as well as the members of the Austrian Executive Committee, and one member of the Iron and Steel Institute from each of the foreign countries represented at the meeting. His Imperial and Royal Highness conversed at some length in German and French with a number of these gentlemen, and evinced a deep interest in the Institute and its objects.

The Archduke Friedrich Maria Albrecht Wilhelm Karl, who has accepted Honorary Membership of the Iron and Steel Institute, was born in 1856, and is a cousin of the Emperor. He is a Field-Marshal of the Austrian Army, and Commander-in-Chief of the Landwehr. He was married in 1878 to Isabella Hedwig Franziska Natalie, daughter of the Duke of Croy-Dülmen. He owns considerable estates, and is closely connected with the Austrian iron industry, the works at Teschen being situated on his property.

Visit to the Hoch Schneeberg.

On the morning of Wednesday, September 25, about 400 members and ladies assembled at the Aspang Railway Station, whence they proceeded, by a special train leaving at 8.20 A.M., to Puchberg, nearly sixty miles from Vienna. Here they alighted, after a journey of two and a half hours, and entered the carriages of the Abt cogwheel railway, by which the ascent of the Hoch Schneeberg, at whose foot Puchberg stands, was to be made.

The Hoch Schneeberg is 6810 feet above sea level, and the ascent, by the rack and pinion railway, occupies a little over an hour. Magnificent views are obtainable on the way up, and the prospect, for the whole distance, is charming. The sun shone brightly, and some of the party began to question the wisdom of the advice given them to bring overcoats and wraps, as the day was one of the finest and hottest of the whole week. Later on a piercing wind blowing across the plateau upon which the hotel stands bore testimony to the soundness of the advice which most of the party had fortunately followed. An excellent luncheon was provided at the Hoch Schneeberg Hotel, and at the conclusion of the repast some of the members scaled the summit of the mountain, which is reached by well-marked paths, but the bulk of the party contented themselves with the magnificent view to be obtained from the hotel. On a fine clear day the Alps are visible as far as Dachstein, together with the Vienna Basin and the Hungarian Plain, but there was a slight haze which prevented the far distance from being clearly defined. The highest summits of the Schneeberg are the Klosterwappen (6810 feet) and the Kaiserstein (6750 feet). Shortly after two o'clock the downward journey was commenced, and the party ultimately arrived in Vienna before 6 P.M., and drove to their respective hotels.

Banquet at the Hall of the Musical Society.

The proceedings in Vienna concluded with a banquet, on September 25, offered to the members of the Institute and the ladies accompanying them, by the Austrian Iron Trade, in the Hall of the Musical Society (Gesellschaft der Musikfreunde).

The guests arrived at 7.45 P.M., and were received by the Chairman of the Reception Committee and Mrs. Kestranek, by Dr. E. Herz, Hon. Secretary, and by the members of the Executive and of the Ladies' Committees. Among the Austrian guests invited to meet the members of the Institute were the Minister of the Interior, the head of the police (the Ritter von Habrda), the Ritter M. von Rössler, Mr. F. Schonka, and Mr. J. Tucek, heads of government departments, the deputy mayors of Vienna (Dr. J. Neumeyer and Dr. J. Porzer), Mr. J. Blum, director of the Creditanstalt, Mr. E. Palmer, director of the Länderbank, Mr. K. Morawitz, president of the Anglobank, Mr. K. Stögermayer, director of the Bankverein, Mr. J. Herz, director of the Bodenkreditanstalt, Mr. W. Kux and Mr. Krassny, directors of the Escompte Company, Mr. E. von Spiegl (president of the Concordia Society of Journalists), Count St. Julien-Wallsee, the Ritter A. von Fries, Dr. S. Brosche, Mr. E. Homan, Dr. Gatnar, Dr. Zampach, Mr. O. Günther, Mr. G. Günther, Mr. A. Bergmann, Mr. E. Friedländer, Mr. W. Köhler, Mr. K. Neufeldt, Professor J. Klaudy, Professor R. Vambera, Professor F. Berwerth, Professor J. von Ehrenwerth, Professor K. Hochenegg, the Ritter von Kuh, and many others.

At the request of his hosts, the PRESIDENT occupied the chair and proposed the first toast, the health of the Emperor, the health of King Edward, and the healths of the rulers of the other nations represented amongst the 586 ladies and gentlemen present.

Mr. W. KESTRANEK then proposed the toast of the Iron and Steel Institute in the following words:—"If I am to propose a toast to the Iron and Steel Institute, there is no need to work myself up into enthusiasm by talking; on the contrary, I must restrain myself not to lift my glass at once as would be the most pleasant, no doubt, to my hearers on account of my imperfect English.

"I wish, however, to contemplate for the short period of your indulgence the Iron and Steel Institute. What is the Iron and Steel Institute? It is an unrivalled international association. Representatives of substantial interests from all countries meet together, not to forward these interests alone, but to promote technical progress by mutual stimulation. Rivals of all nationalities meet together to render their achievements profitable to one another instead of concealing them narrow-mindedly. In such behaviour there lies a liberal—I might say an ideal—feature inherent in every able technical man. The priests of technical arts are naturally men of liberty and progress, and the high-priests of our profession are not less so than poets and artists. The poet and the artist must be filled with a great idea and a mighty feeling, and, with the power of inspiration, he must be able to embody it in a perfect manner. Likewise the engineer. Should he succeed in realising his creative thoughts, then he, too, is a poet, an artist in our own domains.

"In the last few years we Austrian ironmasters have appeared not so much as creative poets, but rather as reproductive artists. We were not so much the givers as the takers. The nature of the Austrians is remarkably pliable, accommodating, and receptive. For that reason, in the unfettered field of engineering, progress has, in our country, always found ready admittance and fostering care.

"Austria can boast of the first German technical high school, founded in 1806; in Austria appeared, as early as 1837, the first locomotive, and Austria was the first country on the continent which introduced, in 1863, the grand invention of Henry Bessemer, and later on hastened to adopt Thomas and Gilchrist's ingenious improvement. As just one hundred years are coming to a close since the first successful steamer triumphed over the waters, I may be allowed to recall that it was an Austrian, Josef Ressel, who invented,

in 1829, the most important improvement of the steamship—the screw. He, too, experienced how the goddess of fame often presents the palm not to the pioneer, wandering through untrodden paths, but to that happier one who succeeds in removing the last obstructive boulder.

"If we Austrians have to thank the masters in our profession represented in the Iron and Steel Institute for powerful impulses and rich instruction which we eagerly imbibed, we, too, can, in all modesty, claim to have responded with many a valuable suggestion. We all, united in the Iron and Steel Institute, furnish smaller and larger stones to erect the towering edifice of technical perfection, and each one has his part in the building-up of our theoretical and empiric knowledge. In mutual stimulation one thanks the other for success and profit. We are united by the enthusiasm with which we devote ourselves to work and progress, without which nothing grand can be created, neither works of art nor technics. Great Britain called our community into existence nearly forty years ago, and still to-day it remains under Britain's leadership, that Britain—it should never be forgotten—which was the great master of all modern engineering, and has given us Henry Bessemer, whose prolific brain revolutionised the whole iron industry. What Great Britain has done for mankind impressed me most forcibly in connection with two localities: Darlington, where the sight of Stephenson's first primitive locomotive filled me with admiration and reverence, and Westminster Abbey, where one enters with awe the Poet's Corner, or steps, deeply impressed, over the tombs of Watt, of Newton, and of Darwin.

"Britain, that land, as democratic as aristocratic, has left her mark on the constitution of our association; a community of democrats placing at its head aristocrats of intellect. As such we see before us our honoured President, Sir Hugh Bell, springing from an ancient race of technical nobility, who has shown us again, in his last brilliant address, that we are right to be proud of our eloquent and inspiring leader.

"Now I see that, on my mentioning the name of Sir Hugh Bell, your self-restraint has come to an end, and therefore I raise my glass—asking you to do the same—to the prosperity of the Iron and Steel Institute and to the health of its President."

Sir HUGH BELL, in replying to the toast, expressed the deepest obligation of the members for the unbounded courtesy and hospitality they had received.

Mr. A. GREINER (Member of Council), speaking in French, proposed the toast of the State and Civic authorities. He said there was probably no other country where the useful was more closely blended with the pleasant, the practical with that which is in good taste, than in Austria. Just as the previous day they had passed at once from the industrial districts of Vienna to the eighteenth-century serenity of Schönbrunn, so in the Austrian character of the most serious laboriousness was linked with an intense joy of living. Vienna was a city which had shown the value of the municipalisation of the gas, electrical, and tramway undertakings, as these brought in a net profit of £400,000 a year after providing interest on the capital outlay and sinking fund. In the past twenty-five years the population had increased from 750,000 to 2,000,000, and the rate of mortality had fallen from twenty-five to sixteen per 1000, thanks largely to the energetic rule of Dr. Lueger, whose reputation as a civic administrator had spread far beyond the boundaries of his own country. He asked those present to drink the health of the administrators.

His Excellency Baron von BIENERTH, Minister of the Interior, responding to Mr. Greiner's toast in English and German, expressed his gratification at being present as representative of the Austrian Government, and at

learning that the Institute had met for a second time in Vienna. He referred to the value of the work of the Institute, and ventured to claim for Austrian brains and Austrian hands a not inconsiderable share in the progress of the development of the iron and steel industries. The recognition given to such work by the Institute would be a source of gratification to the Austrian industry, and he assured his hearers that the Institute's visit to Vienna would always remain in pleasant memory.

Dr. NEUMEYER, the Deputy Mayor, also responded in German. The city of Vienna was, he said, delighted to welcome the Institute. The offering of hospitality to other nations was, he considered, one of the duties of a metropolis of civilisation. The Viennese were proud of their city, a city with a history of two thousand years. They loved it as a man loved a wife to whom he owed everything, and they did all they could to keep her young in her old age. When the Viennese went abroad they often wished to take their city with them to show the world what a fine city they had. He concluded his speech by proposing the health of the ladies who had honoured the city by their presence. The Deputy Mayor's speech was interpreted to the members by Mr. Bennett H. Brough, the secretary, who added that nothing had been said in the speech about the Austrian ladies. He therefore proposed the health of the Ladies' Committee, which was drunk with enthusiasm.

The hall in which the banquet was held was beautifully decorated for the occasion, the tasteful floral arrangements exciting special admiration. Innumerable electric lights, in blue, red, and yellow bulbs, outlined the arches, and twined round the pillars of the hall, while at one end an ornamental fountain, gaily festooned with clusters of electric bulbs, played throughout the banquet, rendering the air in the hall remarkably cool and sweet. Surmounting the fountain was an illuminated device with the initials of the Iron and Steel Institute. The menu was artistically printed on thick hand-made paper in brown ink, and bore, as a medallion, on its first page, a reproduction of the badge, struck in brown and white.

During the banquet a military orchestra played Viennese airs, those of Strauss predominating, and the visitors had a unique opportunity of listening in exceptional circumstances to a skilful rendering of Joh. Strauss' classic waltz, "An den schönen blauen Donau," which has become almost as familiar to British ears as the stately National Anthem of Austria.

The dinner itself was a triumph of culinary art, and the guests were much pleased to make the acquaintance of several characteristic Viennese dishes —such as the *Fogas* (a Danubian fish) *au gratin*, *selle de veau à la viennoise*, *ragout d'écrevisses en terrine*, and *Faschingskrapfen*, or carnival pancakes. The wines were of the choicest, and the service was so admirable as to reflect great credit on the organising skill of the caterer, Eduard Sacher, in the serving of a banquet in a concert-hall where the requisite kitchens had to be specially built for the occasion.

PRIVATE HOSPITALITY.

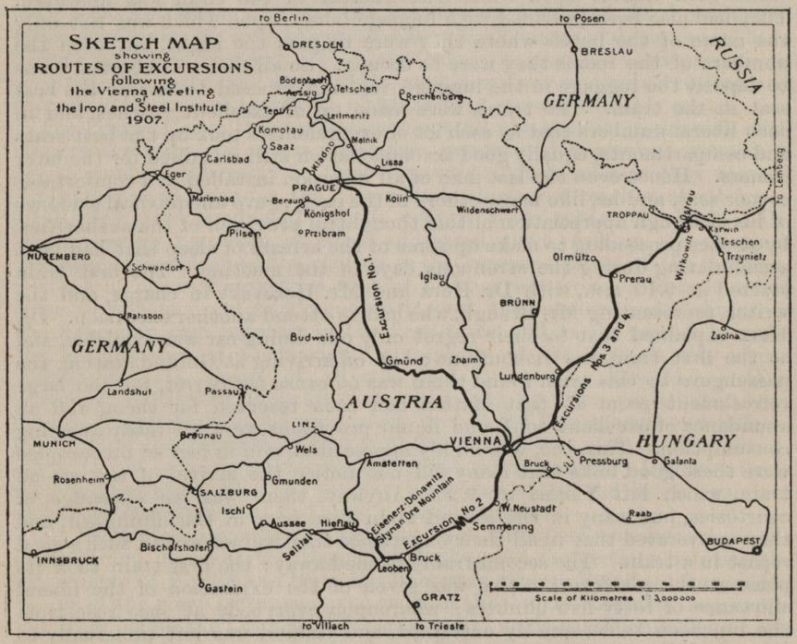
During the meeting much hospitality was dispensed to the members, and there were numerous entertainments not included in the official programme. For example, for the week before the meeting the Ritter Max von Gutmann organised a chamois hunt, in honour of the Institute, on his estate in Styria. The party who enjoyed this exceptional privilege comprised Mr. W. H. Bleckly, Hon. Treasurer, Mr. D. Selby Bigge (Newcastle-on-Tyne), and Messrs. T. K. and W. P. Rylands (Warrington). On September 22 the Council and the Executive Reception Committee were entertained at

luncheon by Mr. Kestranek at his house, and after luncheon the visitors were entertained by the acting of two French plays, written by Lady Bell, by Mr. Kestranek's children. Subsequently the visitors were taken for motor drives in the Wiener Wald. On September 23 the Council was entertained at luncheon by the Ritter Max von Gutmann at the Hotel Sacher.

On the Sunday preceding the commencement of the meeting some of the members took advantage of the opportunity most obligingly afforded by the head of the mineralogical department of the Imperial Natural History Museum, Dr. Berwerth, of making a somewhat thorough examination of the meteoric iron collection, where the more important and interesting examples, and those of the systematic collection, were explained in the fullest detail by Dr. Berwerth in a demonstration extending over the whole period that the museum was open to the public, and for some time after its close. On Saturday, September 28, Dr. Berwerth kindly gave a further demonstration.

EXCURSIONS AFTER THE MEETING.

On the conclusion of the meeting in Vienna, Thursday and Friday, September 26 and 27, were devoted to excursions to the chief centres of the Austrian and Bohemian iron industries. The arrangements had been



carefully thought out by the Reception Committee, and extensive preparations made for the comfort and convenience of the members of the Iron and Steel Institute taking part in them. Three main excursions had been

organised: (1) to Bohemia, which included a visit to the city of Prague, or alternatively to the works of the Böhmische Montangesellschaft, at Koenigshof, followed by a visit to the Kladno works; (2) to Styria, to visit the works of the Alpine-Montangesellschaft, and the Erzberg iron-ore mines; and (3) to Moravia, to visit the Witkowitz works, and thence to Trzynietz, in Silesia, to inspect the new electric rolling-mill installed at the works there. The accompanying map shows the routes taken on each of these excursions.

(1) EXCURSION TO BOHEMIA.*

One hundred and fifty-two excursionists, of whom sixty-four were ladies, assembled at the terminus of the Franz Josef Railway on the morning of September 26, bent on worshipping at the shrines of Bohemian art and industry. Director Kestranek, Dr. Eugen Herz (the local secretary), Mr. Zdenko Horovsky (technical manager of the Prague ironworks), and Mr. A. F. Ridley (manager of the Koenigshof ironworks) met the party at the station. The excursionists came, some with one bundle, some with several pieces of luggage of various dimensions and shapes, and all with more or less bewilderment and excitement; but so excellent were the arrangements that they soon found themselves perfectly at their ease and comfortably settled in the two special trains that awaited them. They had been provided with tickets upon which the number of the train was indicated. They had also been provided with luggage-labels, upon which was not only the name of the hotels where they were to pass the night, but even the numbers of the rooms they were to occupy. So all that was necessary was to deposit the luggage in the luggage van and proceed to occupy the best seat in the train. The trains were made up of excellent coaches, and in such liberal numbers that as each lot of excursionists took up the best seats and compartments, equally good accommodation still remained for the later comers. Hence even the last man of all was soon installed in a comfortable corner seat, and he, like many others of the party, gave unequivocal evidence of his thorough appreciation of this thoughtful provision of the authorities, by at once proceeding to make up some of the arrears of sleep that had been accumulating during the strenuous days of the meeting. The first train started at 9.10 A.M., with Dr. Herz and Mr. Horovsky in charge, and the writer, representing Mr. Brough, who had to attend another excursion. Dr. Herz explained that to their regret only one dining-car was available, and so the first train was without one; but on arriving at Gmünd station, the passengers by this train found there was no cause for regret, for the large refreshment room at that station had been reserved for them, and an abundance of excellent solid and liquid provisions were all ready awaiting consumption. This, too, was highly appreciated, and in fact so preoccupied were these good folks that many did not notice the arrival of the second train, which left Vienna at 9.20. Anyway, there was an exchange of courtesies, but many in the second train were busy in the dining-car, and they asseverated that in all their experience they had never had such a good repast in a train. The second train steamed away; the first train took its place at the platform; notice was given of the expiration of the liberal allowance of forty-five minutes; whereupon everybody at once rose from the luncheon table, quietly entrained, and Gmünd was left punctually to time, and Prague was reached in proper time also. Here there was a division of the party, one portion, 132 out of the 152, remaining to see

* The report on the excursion to Bohemia has been written by Mr. D. A. Louis, F.I.C.

Prague, and the rest, under the leadership of Mr. Ridley, going to see the Koenigshof works, which entailed another fifty minutes in the train.

The Koenigshof Party.

The railway journey proved very pretty, as the line follows the valley of the Beraun River; hence, although the works are only about twenty miles south-west from Prague, the distance by rail is greater. At the works the party was joined by Mr. Richard Schimek, who shared with Mr. Ridley the duties of exponent and guide. The party visited the gas blowing-engines, the blast-furnaces, the ore and coke depôts, the electric power-stations, the steelworks, the gas-producers, and the sheet mill, and had subsequently to rejoin the train and return to Prague, which they reached in time to refresh themselves and go to the performance of "The Bartered Bride" at the Czechish opera. The participants in this excursion were: Messrs. W. F. Cheesewright, A. R. Davis, A. Dreux, J. Duffield, J. Goujon, R. F. Hall, B. W. Head, J. Hunter, D. Lewis, W. R. Lewis, D. A. Louis, K. W. Lundeberg, J. Raine, A. F. Ridley, S. S. Somers, W. Somers, J. Summers, Z. T. K. Woo, and L. Yngström. A general view of the Koenigshof works is shown in Plate I.

Visit to Prague.

A hearty welcome to the visitors was tendered by both the Bohemian and German sections of the population. Dr. Gros, Dr. Maly, and Dr. Sum were amongst those who did the honours on behalf of the Bohemians; these gentlemen are well known to many Englishmen, and, moreover, have visited and know England. They particularly emphasised their pleasure in receiving the party, and showing the members some of the interesting and attractive features of their city, of which they are so justifiably proud.

The Prague Committee had thought out all the details of the visit with the greatest care, and at Prague station several of its members were waiting to conduct the party to their respective hotels, whence they started again almost at once for the Town Hall, which was reached about 5 P.M. Here they were conducted to the council room, where the Mayor, Dr. Gros, wearing his chain of office, addressed them first in the Czechish language, and welcomed the visitors as the representatives of the most important of primary industries, that of making and working iron, who had come to Bohemia and to Prague, to inspect the modern undertakings of the Bohemian iron industry in the first place, and, in the second, to make the acquaintance of the ancient monuments of the historic city whose beauty was the theme of all who had visited it. The Mayor then proceeded in English to recall that within the past few years it had been his proud privilege to welcome many prominent Englishmen and delegations of British Societies in that hall, and that it was a pleasure to him so often to see representatives of the great island nation. Incidentally it may be mentioned that the present party contained the largest number of British travellers that had ever visited Bohemia.

Sir Hugh Bell responded in English. The historical associations of the city afforded him a fertile theme. Recalling the associations between the movements of Wycliff and Huss, the Bohemian Church Reformer, he pointed to one of the great pictures on the walls of the Council Chamber, representing Huss before the Council of Constance, and made passing allusion to one of the old links between England and Bohemia, the common striving for freedom of conscience. He told the Mayor that, although those on whose behalf he spoke were primarily devoted to industrial pursuits, and not pilgrims to the shrines of history, yet only a man of restricted mind could

fail to be impressed with the great and romantic associations of Prague and Bohemia.

Dr. Maly, one of the Magistrates, then briefly explained in English the meaning of the two historic pictures on the walls of the room, and gave a sketch of the history of the Town Hall itself, after which the members made the round of the building, the President signing his name in the distinguished visitors' book.

The oldest part of the Town Hall dates from the first half of the fourteenth century. The hall has, however, been gradually enlarged and altered, the most recent changes dating from the eighteenth century. An interesting feature of the building is a Horologium or astronomical clock constructed in 1490, which indicates, besides the hours, the time of the rising and setting of the sun and the moon. The Council Chamber in which the reception took place is a modern room.

Upon leaving the Town Hall the party again entered their carriages and were driven through the curious winding streets of the old town across the famous Old Bridge, adorned with many statues, among them St. John Nepomuk, the tutelary patron of the city, who is said to have been thrown in the river here because he refused to reveal to the King what the Queen had told him in the confessional. The saint's body, it is said, floated about the spot for several days, giving forth flames at night; and in commemoration of the miracle the statue on the parapet is adorned with five metal lanterns in the shape of stars, whilst his shrine, in the Cathedral, is remarkable for a profusion of massive silver ornaments. From the bridge the procession of carriages mounted the hill commanding the city on which stands the famous royal castle of the Hradchany or Hradschin, with the St. Vitus Cathedral, now in course of restoration—a fine Gothic building, but almost entirely modern.

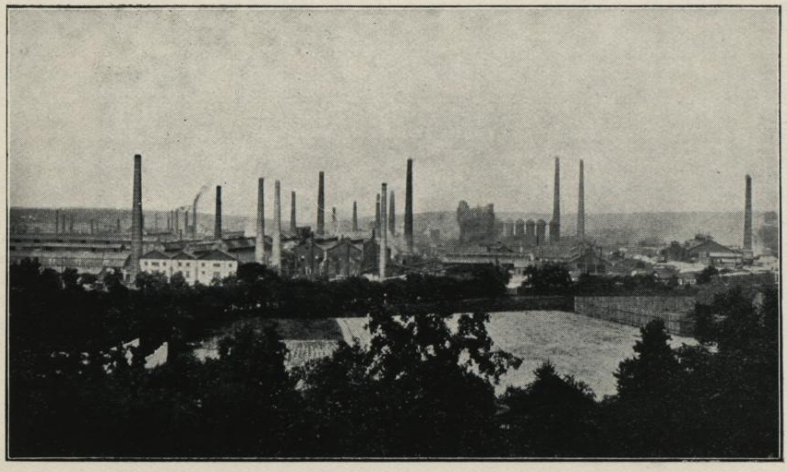
On returning to the hotels there was just time to dress for the performance at the Czechish opera, to which all the guests had been bidden, the boxes and orchestra stalls being entirely reserved for them. The play was a musical comedy by Smetana, the founder of Bohemian opera. The title of the play was "The Bartered Bride" (*Prodaná nevyésta*).

The performance itself was thoroughly enjoyed by all the visitors. The Reception Committee had kindly provided a summary of the plot in English. The acting was most expressive, and the performance was rendered still more pleasurable by the excellent light music.

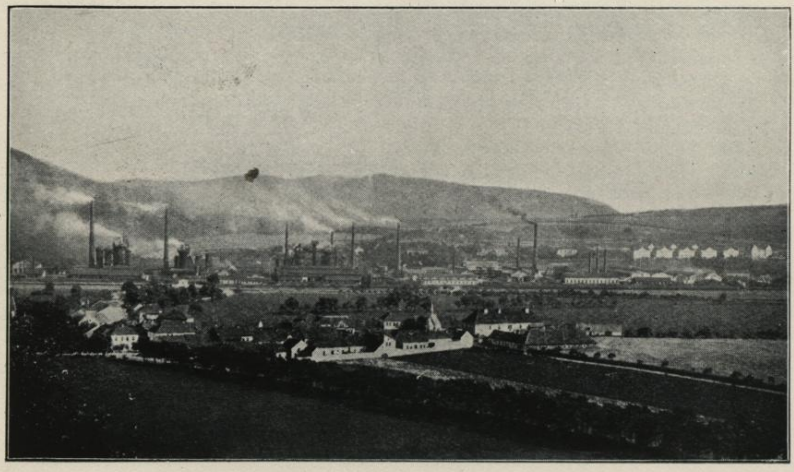
From the theatre the party drove to the German Club, where a smoking concert (*Bierabend*) had been arranged. The German Casino, a palatial and evidently prosperous institution, was richly decorated with flowers and draperies, and at one end of the large mirror-hall an enormous buffet groaned under the profusion of cold viands. The entertainment closed somewhat after 1 A.M.

The Kladno Excursion.

Betimes on the morning of Friday, September 27, the members were astir at their various hotels, in spite of the lateness that many allowed the hour to reach before they withdrew from the seductive *Bierabend* at the German Casino. Inquiries at the different hotels elicited the fact that the only difference in the accommodation was that each hotel seemed to have provided better rooms than the other, and as for the size of some of the rooms, it would seem, from what the occupants said, that many of them would be large enough for an armour-plate mill. But a strange feature about these nice rooms was that, when payment was offered for them, it was found that no charge was made for them. In fact, the hospitable hosts had arranged



View of Kladno Iron Works.



View of the Iron Works in Koenigshof.

to pay all bills—to save time, they prettily put it; it certainly did save time, but the generousness of this considerate mark of attention was by no means lost on the greater number of the visitors. The carriages were also free. So everybody was in a very good temper on arrival at the station to join the special train which was to take them to the Kladno Ironworks. A count showed that there were eighty-five smiling faces in the train, which, too, was the total number present; the line traversed was that of the Buschtehrad Railway, about which two things were remarked: the smoothness of the permanent way, and the remarkable curves it made. But before the excursionists had time to compare it with their local lines, or to complete their remarks on the pretty villages, "The Bartered Bride," the geology of the district, the *Bierabend* and Huss, the train had drawn up at Kladno station, where various officials appeared. The train then continued its way to the works, and all got out near the offices, round about which the ground had been spread with a covering of buff-coloured sand, consisting of crushed granulated slag; a notable feature, too, was that slag-bricks were conspicuously evident in the buildings around. A few words of welcome by the manager of the works, and a brief acknowledgment by Sir Hugh Bell, occupied but a few minutes, when the visitors were broken into small groups, and, under the amiable and efficient guidance of various officials, were taken through the works. The arrangements were so well devised that—anyway so far as the group of which the writer formed one was concerned—there was no opportunity given for that element of confusion which so often arises on such occasions as these, namely, the mingling of the groups. The course followed through the works was—the roll park, the roll-turning shop, the electric power-station, the blast engine-house, the blast-furnaces, the ore tanks and roasting kilns, the fitting shop, the foundry, the Bessemer steel works, the mill, the loading yard, the new open-hearth works in course of construction, and the works casino. There a bevy of men awaited to give numbers in exchange for coats and umbrellas. In an adjoining room, upon extemporised tables, were rows of basins, which were filled, emptied, and re-filled with lightning speed, and in a moment the whole party, radiant and well groomed, was trooping into the large hall of the casino, which was tastefully decorated, and a prominent feature, which, however, was no detraction, was the group of well-laid tables. A delicious and sumptuous luncheon was served, with French and German wines, to the accompaniment of an agreeable selection of music, very creditably performed by the works band. Towards the finish the President, Sir Hugh Bell, rose and said, that although there had been a sort of understanding that there should be no speeches, yet he felt sure that none of the visitors would like to leave that interesting and hospitable place without an expression of high appreciation. He said that the reception they had met with everywhere in Austria had been beyond anything they could have anticipated, and the Prager Eisen-Industriegesellschaft had evidently determined not to be outdone by any other of the entertainers, and had undoubtedly succeeded, for not only had they unreservedly thrown open their most interesting and instructive works for inspection, but they had provided this enjoyable luncheon in such agreeable surroundings. He could not help particularly emphasising the part played by Mr. Kestranek in all these successful functions, for he was also associated with the Koenigshof works, which had been a source of admiration to those who had had the privilege of visiting them on the previous day. Shaking hands with Mr. Kestranek, he gave the toast of success to the company, and particularly to his friend. This was received with musical honours. Mr. Kestranek said the train was going, and as they must be doing the same, he would simply say how gratified he was that all were satisfied, and able

to see that if England had led the way in many things, that Austria had made good use of the lessons taught. The special train took the party back to Prague, where ample time was given for making small purchases, for having a final peep at some favourite object in the vicinity of the hotels, and for having a final chat with one or other of the charming entertainers. Unlimited carriages were in waiting to take the luggage and the owners to the station, and soon this very agreeable excursion came to an end, by the dispersal of the participants, some by the special trains back to Vienna, some in other directions. A general view of the Kladno works is shown in Plate I.

(2) EXCURSION TO STYRIA.

The party that took advantage of the invitation of the Oesterreichische Alpine-Montangesellschaft to visit Styria numbered about seventy, under the leadership of Mr. E. P. Martin, Past-President, Mr. Illtyd Williams, Member of Council, and Professor H. Bauerman, Hon. Member. They left Vienna by special train at 2.20 P.M. on September 26, being met at the station by the Ritter Anton von Kerpely, general manager of the company, with Mr. H. Bäckström, technical director, and Mr. Oscar Rothballer, the business manager. The Semmering was crossed in the afternoon, and at nightfall Leoben was reached. Here accommodation had generously been provided for the party in the different hotels.

In the evening the party was entertained at a banquet in the Hotel Gärner. The Ritter von Kerpely presided, and welcomed the visitors in a speech in English. Mr. E. P. Martin, in reply, expressed the thanks of the members for the hospitable reception, and his pleasure at seeing on the walls a portrait of Sir Lowthian Bell, taken during the previous visit twenty-five years ago when he had been made an honorary freeman of Leoben. This portrait had been brought for the occasion by Professor J. von Ehrenwerth, hon. member. Mr. Bennett H. Brough having given, for the information of the Austrian visitors present, a synopsis, in German, of Mr. Martin's speech, Count Rudolph Schönfeld, Bezirkshauptmann of Leoben, as representative of the government, proposed the toast of the Iron and Steel Institute, which was responded to by Mr. Brough, who incidentally referred to the legend of the origin of the Erzberg mines as related in Rudolf Baumbach's poem, "Eisen auf immerdar," and told how that the hordes of Germans, who at the end of the fifth century destroyed the Roman dominion of the Alpine lands, were startled after a victory on the Erzbach by the appearance of the Spirit of the Mountain, who asked them whether they would prefer gold for a hundred years or iron for eternity. They chose the latter.

> "Sprecht, wollt ihr Gold auf hundert Jahr
> Oder Eisen auf immerdar?
> Da klirrten zusammen die Schwerter gut,
> Rot beronnen von Feindesblut
> Und brausend rief die ganze Schar:
> Eisen, Eisen auf immerdar."

Toasts were also proposed by Mr. Max Meier (Luxemburg), a former student of the Leoben School, by the Mayor of Leoben, and by the Mayor of Donawitz.

During the banquet a well-chosen selection of music was ably rendered by the concert quartette of the Vienna Orchestra of C. W. Drescher. The outside of the hotel was specially illuminated with electric lights, and the

The Peter von Tunner Memorial at Leoben.

flags of Austria and Great Britain hung side by side. The festivities were kept up to a late hour, notwithstanding which a small number of members were enabled to pay an early visit to Professor von Ehrenwerth's metallurgical collections at the Mining Academy and to the handsome memorial to the late Peter von Tunner, hon. member of the Iron and Steel Institute, which has been erected by his scholars and friends in all parts of the world, the Council of the Iron and Steel Institute being included in the list. (See Plate II.)

At 8 A.M. the special train started for Donawitz, which was reached in a few minutes, and a complete inspection of the works followed, under the guidance of Ritter von Kerpely and the heads of the different departments. From Donawitz the train worked its way up the valley, passing Trofaiach and Vordernberg, with their small and picturesque blast-furnaces now entirely extinguished, to the Prebichel summit, where the main line was left. The party proceeded by the mineral line to the Wismuth terrace of the Erzberg, whence the descent was made by the zig-zag path of the Kaisersberg, which had been newly swept, garnished, and supplied with fresh gravel, passing the various levels in the workings to the Barbara chapel in the wood below, where luncheon was provided in a shaded open-air restaurant of an exceedingly attractive character.

A chapel to St. Barbara, the patron saint of miners, has existed at this point, 956 metres above sea level, for centuries. The present chapel was built in 1703 to replace the earlier wooden one. It is built of stone, and closed on three sides with artistic wrought-iron screens. The altar bears the statue of St. Barbara, with a votive tablet above it with the words :—

"Heilige Barbara, erhöre des Bergvolkes Bitte:
Sei ihm Beschützerin bei seiner Arbeit voll von Gefahren."

(Saint Barbara, hear the miners' prayer:
Guard them in their dangerous work.)

The front of the altar bears the text :—

"Wie gross und herrlich sind deine Werke
Du hast Alles weislich gemacht,
Die Erde is voll von deinen Gütern."
(Psalm civ. 24.)

And over the portal, on a heart-shaped tablet, there is written :—

"Allmächtiger Gütiger
Erfülle unsere Bitte
Ergiesse deinen Segen
Ueber unseren Erzberg."

(Almighty and Merciful One,
Fulfil our prayer:
Pour thy blessing
On our Ore Mountain.)

After the luncheon a start was made for an outlook point whence the blasting could be seen. This was arranged by the director of the mines, Mr. A. Zahlbruckner, upon a somewhat larger scale than usual. Sixteen hundred and two boreholes, of a total length of 6050 feet, were loaded with 3208 lbs. of dynamite, the amount blown down being estimated at 58,200 tons. On an average, 1 lb. of dynamite breaks down about 40,000 lbs. of rock. After the end of the blasting the party continued

the descent to the electric railway below the Liedermann adit, whence a train conveyed them to the Eisenerz blast-furnace.

At the blast-furnace yard the special train was again met, and the party returned to Vienna *viâ* Hieflau, taking with them the remembrance of an extremely pleasant and successful excursion. A small number, however, remained behind, where they were hospitably entertained by the company, and had the opportunity of exploring some of the mountain scenery of the neighbourhood, under the guidance of Mr. Zahlbruckner, the general manager of the mining department.

(3) EXCURSION TO MORAVIA AND SILESIA.*

Visit to Witkowitz.

On the morning of Thursday, September 26, eighty members and a few ladies drove to the Nordbanhof, Vienna, in order to take the special train which was to convey them to Witkowitz. Vienna was left at 8.10 A.M., and an excellent luncheon was served on the train during the journey. The train arrived at Witkowitz at 12.50 P.M., where the members were met at the station by Mr. Friedrich Schuster, the general-director of the Witkowitz works, and by a number of the officials of the company. Mr. Schuster welcomed the members of the Iron and Steel Institute to Witkowitz in a few well-chosen sentences, to which Mr. J. E. Stead and Mr. Greiner, the only two members of the Council who were present, responded. The members were then divided into four groups, which were conducted round the works by Messrs. Wittmann, Wojtechovsky, J. Hofman, and O. Christen respectively.

The first department visited was the hammer shop, where they witnessed the forging of wheel blanks for rail wagons, proceeding thence to the open-hearth furnace plant, the pressed steel shops, the steel foundry, and the machine shops. They then visited the armour-plate and gun annealing departments, after which tea and light refreshments were served prior to the resumption of the tour of inspection. After tea the party was conducted to the rolling-mills, the armour-plate mill and the engine-house, and on the conclusion of the tour of inspection they were driven from the works to their respective destinations. A number of the members were accommodated in the works hotel, which is maintained by the company, while arrangements for others had been made in the gymnasium, which had temporarily been converted into an hotel. As even these hospitable arrangements proved inadequate to accommodate so large a party, the remainder slept in the *wagons-lits* which had been kindly provided on the train.

At eight in the evening a magnificent banquet was given under the presidency of Mr. Schuster. The handsome hall of the works hotel had been tastefully decorated for the occasion, the platform being a mass of foliage, behind which the Witkowitz works band performed an admirable programme of music. To each of the company there was presented on this occasion a set of twenty beautifully printed postcards, tastefully arranged as an album, giving views of the town and of the works. On the conclusion of the repast Mr. Schuster made a short speech in English. He welcomed the members and ladies accompanying them to Witkowitz, and claimed that, while Great Britain must be regarded as the pioneer in the manufacture of iron and steel, the works which the members had just visited would serve to show them that Austria had not been slow to follow the lead, and that at Witkowitz they were proud of their works. He proposed the toast of

* The report on the excursion to Moravia and Silesia has been written by Mr. L. P. Sidney.

the visitors. Mr. Stead responded, and expressed, on behalf of the members present, their extreme gratification at the splendid hospitality which had been shown them and the interest that had been felt during the inspection of the great works, to the prosperity of which Mr. Schuster had, during his long term of management, contributed so much. Mr. A. Greiner then proposed the toast of the Austrian ladies present, which he coupled with the name of Frau Schuster. The toast having been enthusiastically honoured, the company slowly and reluctantly dispersed on being warned that an early start would be necessary on the following morning, when arrangements had been made to proceed from Witkowitz to Trzynietz.

The members taking part in this excursion had been provided, before leaving Vienna, with a handsome badge in oxidised silver, bearing the device of the hammer and gad, crossed with a pair of pincers, and mounted on a rosette of green plush with streamers of green silk; while, in addition to a tastefully printed booklet descriptive of the works, and a coloured plan showing its development from its foundation to the present time, they were presented, on the train, with a large and handsome album containing twenty photographic views of the various departments.

Visit to Trzynietz.

The special train from Witkowitz to Trzynietz left Witkowitz at 7.50 A.M. on the morning of September 27, and reached its destination at 10 A.M. Bergrat Köhler, the general-director of the Trzynietz works, Geheimrat Rathenau and Kommerzienrat F. Deutsch, both of whom represented the Allgemeine Elektricitäts Gesellschaft, were in attendance at the station to meet the party to whom Mr. Köhler addressed a warm welcome to Trzynietz. Mr. Stead having replied on behalf of the members of the Iron and Steel Institute, the party was at once driven to the works in carriages. The road lay through a prettily wooded country, and much interest was manifested by the townspeople and the villagers in the visit of so large a number of strangers. The entrance to the works was adorned with bunting in honour of the occasion.

On their arrival the visitors were taken through the coke-oven installation to the blast-furnace plant, which consists of three blast-furnaces, only two of which were in blast at the time of the visit. The party was then conducted to the blast-furnace blowing-engine plant by the director and Mr. Selby Bigge, who, throughout the visit, acted as a guide and interpreter to the party.

After visiting the steelworks and the new electric rolling-mill, which was the chief attraction of the excursion, the visitors proceeded to the works hotel, where they were entertained at luncheon in the great hall. Mr. Hugo von Noot presided, and made a speech of welcome in reply to a vote of thanks proposed in felicitous terms by Mr. Stead. Mr. Stead expressed his regret that as a chemist and metallurgist he was not able adequately to do justice to the wonderful display of electrical engineering which had been shown the members during the morning. Mr. D. Selby-Bigge then made an eloquent speech, dealing with the technical lessons to be derived from the visit, and explaining the methods which had been adopted at Trzynietz to overcome the engineering difficulties which presented themselves in the application of electricity to rolling-mills. A capital programme of music was rendered during the luncheon by the works orchestra, and the proceedings terminated with much enthusiasm, the hosts accompanying their visitors back to the station, where the special train started shortly after 3 P.M. for the return journey to Vienna.

TRAVELLING ARRANGEMENTS.*

The arrangements for the conveyance of the main body of members travelling to and from Vienna had been placed in the hands of the Great Northern Railway Tourist Agency, and the wisdom of this arrangement was abundantly manifested throughout the whole of the journey, during which nothing was neglected by Mr. G. K. Turnham (who organised the tour) to ensure the comfort and convenience of the members. Mr. Turnham was accompanied by his chief assistant, Mr. J. Middleton, and by Mr. Simon Vernon-Harcourt, both of whom did all in their power to ensure the success of the expedition. The party, which numbered 250 members and ladies, assembled at the Holborn Viaduct Station on the morning of Tuesday, September 17, where a special staff of officials had been provided by the South Eastern & Chatham Railway Company to assist in registering the heavy baggage through to Vienna, while Mr. E. H. Hiley, chief passenger agent of the Great Northern Railway, was also present to see the party safely off. Distinctive labels had been provided, printed in black and yellow, the Austrian National colours, and little doubt can be entertained that, with the courteous co-operation of the continental railway authorities, and, in particular, of the Austrian State railways, these symbols secured for the travellers special consideration, for the customs authorities throughout reduced their examination of the luggage to the merest formality.

The black and yellow pocket-book containing the tickets for the journey, together with the book of hotel vouchers for use *en route*, also contained a convenient itinerary of the route traversed, drawn up by Mr. Turnham.

The special train steamed out of the terminus punctually at the time arranged, 10.57 A.M., and an equally punctual start was made from Dover, Calais being reached at 2.20 P.M., after an excellent crossing. Arrangements were made to allow of a halt of nearly one hour for luncheon, which was served at the buffet under conditions of greater comfort than usually attend the private traveller, and the special train provided by the Nord Railway Company left Calais shortly after 3 P.M. Throughout the whole journey the members had the advantage of having with them Mr. L. Sigmund, the London representative of the Austrian State railways, who contributed greatly to the success of the tour by the arrangements he had made for their entertainment, on the outward journey, at Innsbruck, and on the homeward voyage, at Salzburg.

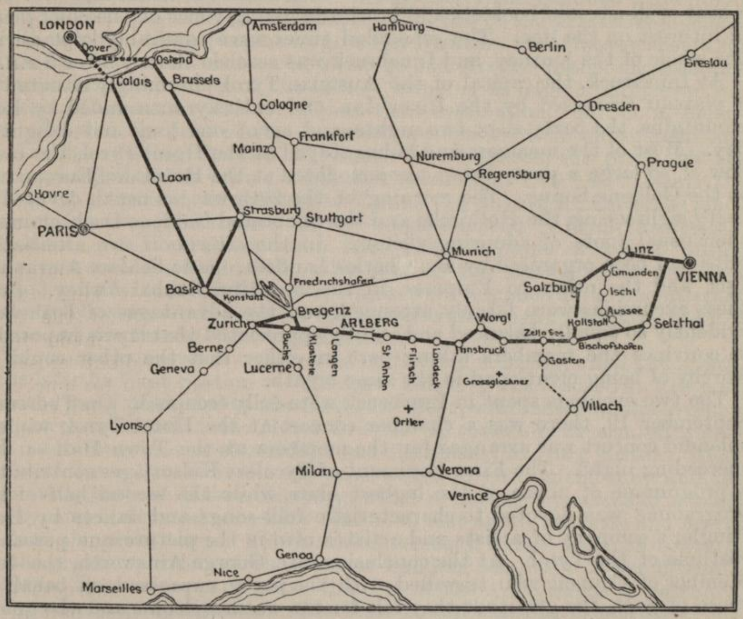
The route lay through Laon, Basle, Zürich, Buchs, Innsbruck, and Salzburg, and is shown in the accompanying map. The first halt after leaving Calais was at Laon. Here an excellent dinner was served at the station buffet at about 6.30 P.M., the journey being resumed at 7.40. Basle was reached at 4.40 A.M. on the morning of Wednesday, September 18, and the members filed down the long platforms for a hurried visit to the handsome new buffet, where they secured coffee before regaining their carriages. Zürich was reached at about 7 A.M., when the members repaired to their various hotels to remove the traces of the long night journey, and to breakfast preparatory to exploring the town. As an instance of the thoroughness of the arrangements made, it may be mentioned that, in order to secure free access to the bedrooms of the various hotels for the travellers at so early an hour, Mr. Turnham had thoughtfully booked the rooms for the previous night.

The hotels selected were the Grand Hotel National (opposite the station),

* The report on the travelling arrangements has been written by Mr. L. P. Sidney.

the Bellevue au Lac, and the Hotel Grand Dolder. The bulk of the members spent the morning in viewing the town, where amongst other buildings of much interest should be mentioned the church in which Calvin preached. The afternoon was spent in excursions to the Dolder, to the Uetliberg, and in trips on the lake, the glorious weather which was enjoyed on this occasion, and, indeed, throughout the whole period covered by the visit to the Continent, contributing greatly to the enjoyment of the members.

On the following morning (September 19) the party left Zürich by special train at 8.14 A.M. The country traversed was exceedingly beautiful, and before long all the members and the ladies had assembled in the corridors of the carriages to view the scenery, which became more and more entrancing the nearer it approached the Austrian frontier. Buchs, the



frontier station, was reached at 10.32 A.M. Here the party was met by Captain Maximilian Stockinger, of the Austrian railway service at Innsbruck. This gentleman accompanied the party to Linz, and the courtesy and attention with which he placed his services at the disposition of the members, and the information he afforded as to the various localities of interest *en route*, conduced in no small measure to the pleasure experienced on this occasion. At Linz several officials of the Austrian State railways joined the train and travelled with it to Vienna. Luncheon was served at the buffet at Buchs, the station where, it was understood, the formal and usually somewhat stringent customs examination would be held. This time, however, the customs officials appeared conspicuous by their absence, and no formality whatever was gone through. Indeed, the treatment which the members of the Iron and Steel Institute, travelling together on this occasion, met with from the railway authorities throughout the whole period

of their sojourn on Austrian soil was typical of the warm and hearty kindness of the welcome which awaited them at the hands of the Reception Committee on their arrival at the capital.

After luncheon the members stormed (and carried) the two special trains in which the remainder of the journey to Vienna was to be made. These were composed of the best and most luxurious carriages which the Austrian railway companies had been able to secure, including a number of specially comfortable carriages of the International Sleeping Car Company, whose courteous attendants rendered every assistance in their power.

The departure from Buchs was made by the first train at 12.30 P.M., the second being timed to follow ten minutes later throughout. A printed itinerary of the route traversed, showing the times at which the trains were scheduled for the various stations, prepared by the Austrian State railways specially for the occasion, was distributed on the train, together with a host of illustrated booklets and brochures giving views of the chief places of interest on the line. The scheduled times were admirably kept during the whole of the journey, and Innsbruck was reached shortly after 5 P.M.

At Innsbruck, the capital of the Austrian Tyrol, charmingly situated on a plateau traversed by the River Inn, and entirely surrounded by lofty mountains, the party slept two nights, and spent one long and delightful day. Most of the members and ladies stayed at the Hotel Tyrol, the overflow of so large a party being accommodated at the Hotel de l'Europe and at the Goldene Sonne. The morning of the 20th was, as usual, devoted to hasty sightseeing, the Hofkirche and the celebrated Goldene Dachl claiming their usual quota of admiring visitors. In the afternoon two alternative trips had been organised by Mr. Charles Landsee, one to Schloss Amras and Igls, and the other to Fulpmes, in the beautiful Stubai Valley. Both these excursions were largely attended, and the advantages of both were evidently so equally balanced and so fully appreciated that it was impossible to convince the members taking part in either that the other could be worthy of being mentioned in the same breath.

The two evenings spent in Innsbruck were fully occupied. On Thursday, September 19, there was a chamber concert at the Hotel Tyrol, while a splendid concert was arranged for the members at the Town Hall on the succeeding night. The First Regiment of Tyrolese Kaiserjäger contributed a programme of music of the highest class, while the second half of the programme was devoted to characteristic folk-songs and dances by Herr Ringler's company of artists and artistes clad in the picturesque peasant's costume of the Tyrol. At the conclusion, Mr. George Ainsworth, the only Member of Council who travelled with the party, expressed, on behalf of those present, the gratitude they felt for the warm welcome and the genial kindness which had been extended to them during their stay in Innsbruck. He thanked the civic authorities for the share they had taken in rendering the visit such an enjoyable one, and proposed a vote of thanks to them, coupled with the names of Mr. Charles Landsee and Captain Stockinger. At the conclusion of his speech three hearty cheers were given for the gentlemen concerned, and Mr. Landsee, in a few well-chosen expressions, referred to the gratification of the citizens of Innsbruck at having been able to welcome the party to their town, and hoped that many of the members might again find themselves in the Tyrolean capital on some future occasion. The proceedings terminated shortly after, as an early start had to be made on the following morning.

On Saturday, the 21st, the members bade farewell to Innsbruck, and started, at 7.20, for the last stage of what had proved a thoroughly enjoyable journey, to Vienna. The special trains arrived at Salzburg at 12.48 after passing through scenery that was even grander than the section

traversed on the journey from Buchs to Innsbruck. During part of the journey the famous Stubai Glacier could be plainly discerned in the distance, while the views to be obtained as the trains passed through Worgl, St. Johann im Tyrol, Zell-am-See, and Bischofshofen, were greatly admired.

On arrival at Salzburg the visitors alighted and proceeded on foot to the Hotel de l'Europe, which is charmingly situated in a garden in close proximity to the station. Here a first-class luncheon was served, at the conclusion of which Mr. Geo. H. Smith acted as spokesman of the party, and after reminding the members that the outward journey was now fast drawing to a close, expressed himself as voicing the general feeling of indebtedness of all present to Mr. Turnham for the care, forethought, and untiring attention which he had manifested throughout. The lavish scale upon which he had attended to the needs of the party had beguiled what might otherwise have proved a tedious journey into one of the utmost enjoyment, and he called on those present to give Mr. Turnham three hearty cheers for the kind and courteous manner in which he and Mr. Middleton, his assistant, had acquitted themselves of the task of bringing so large a party over and delivering them safely and soundly at their destination. Mr. O. A. Malmberg seconded the vote of thanks, which was passed with enthusiasm, and Mr. Turnham having thanked Mr. Smith for his speech, the party left the hotel and regained the trains, which left Salzburg at 2.25 P.M. During the concluding portion of the journey to Vienna the train again traversed much charming scenery, particularly in the neighbourhood of Wels, Amstetten, and Melk. At Linz there was a halt while a couple of special dining carriages were attached, which, after leaving the station, were promptly invaded for tea and refreshments, which were supplied on a liberal scale. Evening fell soon after, and at a few minutes past eight the party reached Vienna and dispersed to its various hotels.

The return journey was commenced on Sunday morning, when two special trains left the West Station at 7.10 A.M. Salzburg was reached at 1.15 P.M., when the party proceeded to the Hotel de l'Europe for luncheon, the overflow being accommodated at the Hotel Bristol. A tastefully illustrated guide-book containing a series of etchings was distributed to every visitor. After luncheon the remainder of the day was devoted to visiting the town and the celebrated Castle of Hohen-Salzburg, which is reached by means of a cable railway, and is situated on a lofty bluff 1780 feet above sea level and nearly 500 feet above the town. The castle dates back to the eleventh century, but the greater portion of the present building was built in the fifteenth century. It was for many years the seat of the Archbishops of Salzburg, and was deemed impregnable. The View Tower, which is 82 feet high, commands a magnificent view of the surrounding country, extending from the Gaisberg to the Sonntagshorn. Other buildings of interest in the city are the Church of St. Peter, with its ancient burying-ground, in a corner of the approach to which is the Stiftskeller, a quaint hostelry where a special wine known as St. Peter's wine can be obtained. The day being Sunday, the cellar was crowded with peasants and others from the adjoining districts, who, in their Tyrolean costumes, presented a typical display and lent an air of extreme picturesqueness to the old-world surroundings. The beautiful cathedral was also visited, as well as the Schloss Mirabell, built in 1606 by Archbishop Wolf Dietrich, and rebuilt in 1818.

In the evening an interesting entertainment was provided in the dining-hall of the Hotel de l'Europe, a number of dancers, male and female, in the costume of the district, giving a display of the Almtanz, a national dance involving a number of curious and complicated figures. The proceedings were characterised by the utmost jollity, and towards the close assumed the

character of an informal ball. During a temporary lull in the festivities Mr. Ainsworth seized the opportunity to express the pleasure of the members at the surprise that had awaited them, and moved a hearty vote of thanks to Mr. Turnham for all the trouble he had taken in making the whole journey to and from Vienna so thorough a success, to Mr. L. Sigmund for his share of the festivities provided at Innsbruck and again at Salzburg, and to Messrs. Middleton and Harcourt, who had borne so large a part in carrying out the arrangements so admirably planned by Mr. Turnham. The vote of thanks was enthusiastically passed, and the company thereafter slowly dispersed.

The special trains left Salzburg at 6.50 A.M. the following morning (Monday, September 30), and arrived at Innsbruck at 12.20 P.M., when a halt was made for lunch, which was served at the Hotel Tyrol. The journey was resumed at 1.40 P.M., and Buchs was reached at 6.14 P.M. Here the two special trains which had brought the party through Austrian territory were finally abandoned, the remainder of the journey being made in a commodious special train provided by the Swiss railways. Dinner was served at Buchs, and the departure made at 7.30 P.M. ; the next stage of the homeward journey, Basle, being reached at 11.5 P.M. Here the party was distributed, for the night, at various hotels (the Euler, Continental, Trois Rois, Victoria, and Schweitzerhof).

At 9 A.M. on October 1 the party left Basle and commenced what was to prove the most tedious and least satisfactory portion of the journey. It had been originally intended to halt at Metz for luncheon, but at somewhat short notice it was found impracticable to do this, and Mr. Turnham was driven to the expedient of improvising a luncheon in the train. This he did on a generous scale, and the experiment succeeded admirably, the novelty of the meal compensating somewhat for the tedium of the journey which, owing to the slow speed of the train and the frequent lengthy stoppages just outside stations, was beginning to tell on the travellers. The luncheon in question deserves more than a passing mention, as it shows the ability which was displayed throughout by those in charge of the party in dealing with unforeseen difficulties. Each member of the party was provided with a large brown paper bag which on investigation proved to contain a whole chicken, a large ham and beef sandwich, two rolls, a supply of fruit (grapes, pears, and nuts), the necessary salt, two paper napkins, a papier-mâché plate, a knife and fork, specially purchased, as no other means of obtaining a supply had presented itself, and a half bottle of excellent Macon. A number of glasses and corkscrews, indispensable in the circumstances, had also been provided, and thus armed it was possible satisfactorily to surmount a difficulty which might otherwise have proved a serious hardship.

After passing the Belgian frontier the running improved noticeably, and every attempt was made to recover the time lost on the German section, which was due, it transpired, to an accident on the line not far from Namur. The train was, however, over two and a half hours late on reaching Brussels. Notwithstanding the delay thus occasioned, members who were desirous of completing the remainder of the journey that night were sent on, by special train, to Ostend, where they caught the night boat and ultimately arrived in London little the worse for their adventures. The bulk of the party had, however, elected to remain in Brussels, where they repaired to the Grand Hotel for dinner. This function might be described as the end of the tour, for thereafter the members dispersed various ways, many of them proceeding to London *viâ* Ostend and Calais the following morning, and the rest either remaining a few days longer in the Belgian capital, or journeying, on their own accounts, to Paris and elsewhere.

NOTES ON WORKS VISITED.

Prague Iron Industry Company.*

In the year 1852 Messrs. Klein, Lanna, and Novotny, gentlemen in a large way of business, and founders of the Kladno Ironworks and Kladno Coal Company, started an ironworks in Kladno, which was named the Adalbert Works. The chief factors which were the cause of this new establishment were the rich coal-fields in the neighbourhood, and the occurrence of ore in Nučitz. The first blast-furnace of the Adalbert Works, blown in on May 4, 1854, and the second furnace which shortly after followed, were only built for the production of foundry pig. The necessary coke for running these furnaces was made from coke which was won in the western part of the Kladno coal-seam. In 1857 the works railway was built for the purpose of carrying the iron ore from Nučitz to Kladno.

In July of 1857 the Kladno Ironworks Company and the Kladno Coal Company amalgamated with the wholesale firm of Rohert & Company of Vienna, owners of the Rappitz Collieries, and with H. D. Lindheim, owner of several collieries and works in the district around Pilsen and Eger, under the title of the Prague Iron Industry Company. During 1856 to 1860 the erection of four more blast-furnaces was undertaken, including ore-roasting kilns, tanks for leaching the ore, and coke-ovens.

In 1863 the Prague Iron Industry Company, which up to that time had been a syndicate, was turned into a limited liability company. The new company, which held its inaugurational general meeting on September 14, 1863, had, soon after its formation, to contend with manifold difficulties, and got into a precarious position owing to the revolution in the manufacture of iron, caused by the introduction of the Bessemer process, which the whole iron industry had to undergo, because the company's ore being high in phosphorus, was unsuitable for the Bessemer process, so that the undertaking was badly handicapped as regards its competitive powers, and could not, therefore, from 1873 to 1881, pay any dividend to the shareholders. It was only when the basic Bessemer process, the rights of which were purchased in the business year 1878–1879, was introduced, by means of which the ore from Nučitz could be utilised, that the undertaking acquired a foundation for a profitable development, which was especially inaugurated through the amalgamation, in 1886, of the Prague Iron Industry Company with the Teplitz Rolling-Mills and Bessemer Works Company.

Later on, in 1904, the Prague Iron Industry Company acquired the shares of the Bohemian Mining Company and took over that company as well. The desire for concentrating the works as far as possible led to the abandonment of the Hermannshütte (1903) and the stopping of the ironworks at Teplitz (1907). By purchasing, in 1905, the Johann and Schoeller pits in Libuschin, which up till then had been in possession of the Libuschin Coal Company, the Prague Iron Industry Company has rounded up its coal-mining property, and now runs four pits.

The Kladno Collieries.—In the four collieries which the Prague Iron Industry Company own in the neighbourhood, bituminous coal is raised from the chief seam of the Rakonitz-Schlan-Kladno Valley.

* This description is reprinted from an illustrated account of the works published by the conjoint companies and distributed to the members who took part in the excursion.

The strata enclosing the seam belong to the earliest stage of the Carboniferous system, and lay directly on the Silurian slate, covered by chalk. The seam has a thickness of 5 to 12 metres, and is divided, by shale, into banks. The caloric value of the coal amounts to from 5000 to 6000 heat units, pure sorts of coal evaporating 9 kilos of water per kilo. In spite of its coking properties the coal is not used for coke-making, owing to the quality obtained being unable to fulfil the requirements of modern blast-furnaces. The great thickness of the seam, as well as the difficulty in obtaining gobstuff, permit of no other method of working than that of pillars and short stalls. In the workings, only naked lights are used, there

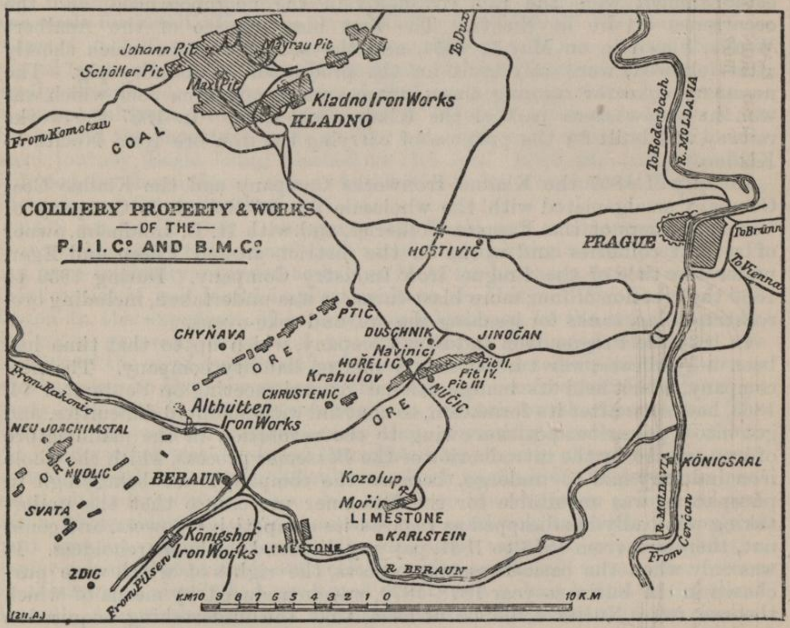


FIG. 1.

being no fire-damp. Further particulars with regard to the pits, which are named Max, Mayrau, Schoeller, and Johann, are given in Table XIV.

The Kladno Ironworks.—These works have at the present time four blast-furnaces with two double hoists. For roasting the ore forty-seven kilns are available which are charged by means of an overhead gantry. The ore and limestone are carried to the works over the Kladno-Nučitz Railway, having a length of 57·9 kilometres. The roasted ore is transported by means of a wire tramway to ten leaching tanks, which are in front of the kilns, and after about from seven to ten days' soaking is transferred by a Brown hoisting-crane to the bogies. All the materials, therefore, not only the ore and coke, but also the limestone, are carried from the bunkers right up to the blast-furnace hoists by means of chain haulage. The pig-iron production of the furnaces appears in Table I. The greater part of the blast-furnace slag is granulated, and worked up for slag-bricks in the neighbouring plant

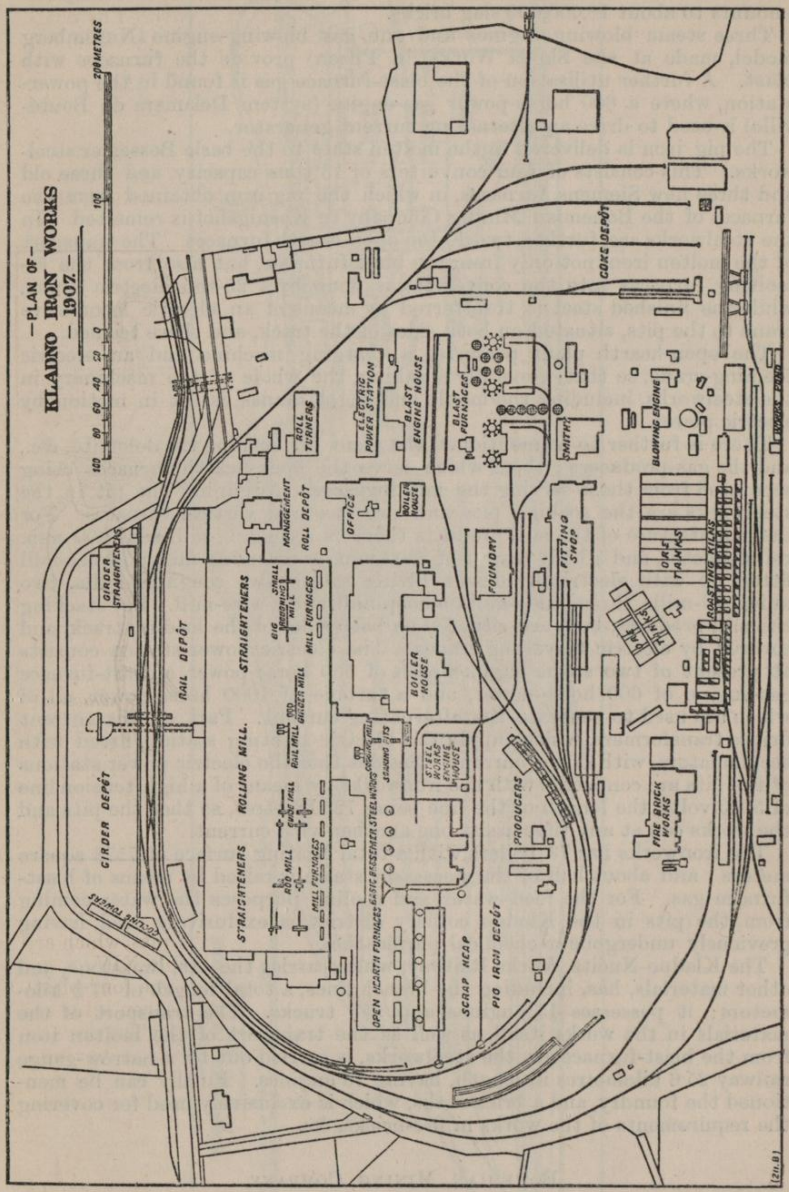

—PLAN OF—
KLADNO IRON WORKS
— 1907. —
200 METRES
GIRDER DEPÓT
RAIL DEPÓT
STRAIGHTENERS
ROLLING MILL.
STRAIGHTENERS
GIRDER STRAIGHTENERS
ROLL TURNERS
ELECTRIC POWER STATION
BLAST ENGINE HOUSE
BLAST FURNACES
COKE DEPÓT
BLOWING ENGINE
SMITHY
OFFICE
MANAGEMENT
ROLL DEPÓT
BOILER HOUSE
FOUNDRY
FITTING SHOP
ORE TRAMWAY
COKE STOVE KILNS
BOILER HOUSE
STEEL MELTING HOUSE
PRODUCERS
FIRE BRICK WORKS
SCRAP HEAP
PIG IRON DEPÓT
OPEN HEARTH FURNACES
MILL FURNACES

FIG. 2.

of the Koenigshof Cement Works. The annual production of this plant amounts to about 18,000,000 slag bricks.

Three steam blowing-engines and one gas blowing-engine (Nuremberg model, made at the Skoda Works, in Pilsen) provide the furnaces with blast. A further utilisation of the blast-furnace gas is found in the power-station, where a 600 horse-power gas-engine (system Delamara de Boutteville) is used to drive an alternating current generator.

The pig iron is delivered in the molten state to the basic Bessemer steel-works. This consists of four converters of 13 tons capacity, and three old and three new Siemens furnaces, in which the pig iron obtained from the furnaces of the Bohemian Mining Company in Koenigshof is remelted. In the steelworks are, further, two 20-ton open-hearth furnaces. The transport of the molten iron, not only from the blast-furnaces, but also from the re-melting furnaces into the converters, is done by a 25-ton electric crane, while the finished steel is transferred by means of an electric locomotive crane to the pits, situated on both sides of the track, and there teemed.

The open-hearth plant possesses a charging machine and an electric teeming-crane, so that, generally speaking, the whole of the machinery in the steelworks, including the mould and ingot cranes, is set in motion by electric power.

There is further to be mentioned the plant for burning the dolomite, &c., and the gas-producers ; those which serve the open-hearth furnaces being separated from those serving the mill furnaces. Adjoining the pit in the steelworks are the soaking pits and two gas-fired vertical furnaces. For the manufacture of the mill products there is a cogging-mill with 900 mm. roll diameter, and a body length of 2800 mm., a reversing-mill, a girder-mill fitted up with electrically driven lifting tables, two roughing-mills, two universal-mills, three guide-mills, a hoop-mill, and a wire-mill. For stacking the mill products, beds are situated on both sides of the loading track, and covered by electric travelling cranes. The electric power-station consists at present of two steam-engines each of 550 horse-power, a blast-furnace gas-engine of 600 horse-power, and a turbine of 1000 horse-power, all of which are used to generate the alternating current. Part of this current drives transformers, which supply the electric lighting station, fitted with accumulators, with direct current. Besides this, the electric power stations of the pits are connected with the ironworks by means of a high tension line of 5000 volts, the length of the line being 7250 metres, so that the pits and the works can at any time assist one another with current.

The ironworks has 73 boilers with a total heating surface of 7578 square meters ; and about half of the necessary steam is raised by means of blast-furnace gas. For the feed water and cooling purposes the water coming from the pits in the Kladno colliery district is exclusively used, having previously undergone a chemical purification.

The Kladno-Nučitz Works Railway, which carries the ore, limestone, and other materials, has, including the branch lines, a total length of 57·9 kilometers; it possesses 15 engines and 257 trucks. The transport of the materials in the works itself, as well as the transport of the molten iron from the blast-furnaces to the steelworks, is carried out by a narrow-gauge railway 25·6 kilometres in length, having 16 engines. Finally can be mentioned the foundry, and a brickworks, which is exclusively used for covering the requirements of the works in fire-bricks, &c.

Bohemian Mining Company.

The iron industry of the above company has to thank the numerous ore-fields in the neighbourhood of Prague and Pilsen for its origin. The work-

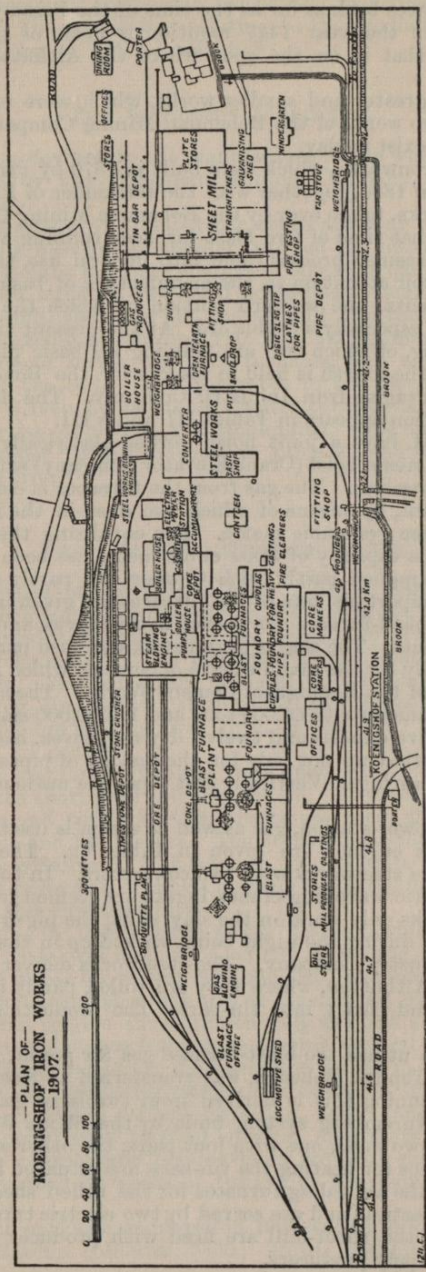

PLAN OF
KOENIGSHOF IRON WORKS
1907.
KOENIGSHOF STATION
SHEET MILL
PLATE STORES
PIPE DEPOT
STEEL WORKS
FITTING SHOP
BLAST FURNACE
BOILER HOUSE
OFFICES
SMITHY
ROAD
BROOK

FIG. 3.

ing of these fields dates back as far as the time of the Przemysls. Even in an old document of the year 1417 mention is made of the working of iron near Hiskov—that is, on the spot where the Althütten works now stand.

Of the numerous greater and smaller works, which were erected in this district, only the two works of the Bohemian Mining Company in Koenigshof and Althütten exist to-day.

The Koenigshof ironworks, which were built in 1870 by Prince Max Egon Fürstenberg, were in 1886, together with the remainder of Prince Fürstenberg's mines and works, taken over by the Bohemian Mining Company. The works consisted at that time of two blast-furnaces running on foundry pig. When the Basic Bessemer process came into general use, the Koenigshof ironworks turned their attention to the manufacture of basic iron, because the ore-field of Nučitz, the western portion of which the company had obtained, yielded an especially suitable ore. At the present time four blast-furnaces are standing, of which two are running on basic pig iron, one on foundry iron, while the fourth is held in reserve for the Bohemian Mining Company and the Prague Iron Industry Company. The development in the pig-iron production appears in Tables III. and VIII.

Furnaces I. and II. have a joint hoist worked electrically; furnace III. and IV. have each a steam hoist (Crane Elevator Company) which are worked by the chargers themselves. The gas from the furnaces is cleaned by three Shiele centrifugal fans, by means of which the dust in the gas is reduced to only 0·008 gramme per cubic metre. For equalising the gas pressure a gasometer having a capacity of 3000 cubic metre has been put up. The blast-furnaces are supplied partly with Cowper and partly with Whitwell stoves. The more important data of the furnaces are given in Table III.

The whole of the blast-furnace gas is used in the stoves, under the boilers, and for the gas-engines. The slag is granulated, and used partly for making slag-bricks, and partly for the manufacture of cement, which is made in the neighbouring plant of the Koenigshof Cement Works. The annual production of slag cement amounts to 65,000 tons and 14,000,000 slag-bricks. The foundry, which has five cupolas and twelve drying stoves, has several electric cranes, and is fitted up not only for the casting of pipes and columns, but also for general castings. Vertically cast pipes are made up to 1200 mm. diameter.

For the electric power-station, gas as well as steam is used. The dimensions of the various engines are given in Table V*a*. The molten basic pig iron is blown in a steelworks with two converters. In the pit, which is covered by two electric travelling cranes, ingots are teemed from 70 to 1000 kilos. The steelworks only work on the day shift, the pig-iron production of the blast-furnaces during the night being worked up in the steelworks of the Prague Iron Industry Company. The steelworks deliver the ingots to a great extent to Althütten, where they are rolled partly into merchant sections, wire, &c., and partly into tin-bars. The production of ingots is given in Table IX.

In order better to utilise the blast-furnace gas for power, the sheet-mill "Rudolfshütte" in Teplitz, Bohemia, was transferred to Koenigshof. The motive power for running this is derived from two large gas-engines each 1200 horse-power (Nuremberg system built by the Skoda Works, Pilsen). Each engine drives two mills, one with four pairs, the other with five pairs, of rolls. The furnaces for heating the tin-bars are situated in front of the mills, behind which the annealing furnaces for the rolled sheets are placed. These furnaces are vertical, and are served by two electric travelling cranes. All the furnaces of the sheet-mill are fired with producer gas, which is drawn from four Kerpely producers.

Finally, the sheet-mill contains a mechanical galvaniser for making galvanised sheets. The particulars relating to the production of sheets are given in Table X. under "Mill Products."

The Althütten Ironworks.

These works are devoted to the manufacture of the whole of the puddled iron worked up by the Bohemian Mining Company and Prague Iron Industry Company.

For the manufacture of puddled bar there are four puddling furnaces, each fitted with a mechanical puddler, worked by electricity. A furnace turns out twenty-eight to thirty charges of 500 kilos daily.

In the mill are situated two 1000 horse-power engines, one of which drives the guide-mill, the other the tin-bar mill. In the latter tin-bars are rolled to the following dimensions, 180, 240, 300 millimetres. An electric ingot-charging crane serves the mill furnaces, and also transports the heated ingots to the rolls. The generator in the electric power-station, which is usually driven by means of a water-turbine, can, when there is a scarcity of water, be coupled to a steam-engine. The output of Althütten is given partly under "Mill Products" in Table X., and partly in Table XI. under "Puddled Iron."

The Ironstone Mines of Nučitz.

The blast-furnaces of the Prague Iron Industry Company, as well as those of the Bohemian Mining Company, are at present supplied with iron ore from the mines at Nučitz. The bed consists of blue-black oolitic ore, which is named chamoisite. The thickness of the stratum varies between 2 and 22 metres. The bed, which is found in the Silurian formation, is, generally speaking, almost vertical up to 60°, and shows many faults. The composition of the ore is as follows: Iron, 42 per cent.; silica, 17 per cent., and phosphorus, 2·1 per cent.

The ore, which was formerly raised from open casts, is at present worked throughout on the short stall and tier system. To open up the bed, partly sloping galleries and partly vertical shafts are used, the depth of which varies between 64 and 149 metres. The ironstone of the Prague Iron Industry Company is delivered to Kladno in the raw state and there roasted, while that of the Bohemian Mining Company is roasted in the kilns situated near the Vinice and Krahulov Pits.

Works Hospital.—In 1896 a large works hospital, which at present possesses over 110 beds, was built in Kladno. Adjoining the main building are a number of wards for women and children, and infectious cases. The works hospital in Koenigshof has also at its disposal over sixty-five beds. In order to be able to give the workmen help as quick as possible at other points, situated at a distance from these centres, medical stations have been fitted up at Libuschin and at the ironstone mines in Nučitz, in such a manner that severely injured workmen can be taken in and nursed. The medical service is under a head physician, works and district doctors. Besides these permanent medical officers, specialists for the eye and dentistry act as consultants. Moreover, a requisite number of workmen are thoroughly trained by weeks of tuition in life-saving and first aid for colliery accidents.

The number of workmen employed in 1907 was as follows: Kladno Ironworks, 3984; Kladno collieries, 5450; brown coal-pits in Teplitz, 200;

ironstone mine in Nučitz, 713; limestone quarry, Mořin-Kozolup, 250; basic slag-mill in Bubenč, 104; Carl-Emils works, Koenigshof, 1367; steel-works, Koenigshof, 175; sheet-mill, Koenigshof, 583; Althütten works, 480; limestone quarry in Tetin, 141; and the ironstone mine in Nučitz, 764—making a total of 14,211. At the Teplitz Ironworks there are 931 men employed, and at the basic slag-mill in Teplitz 35. These works will, however, be closed in the end of 1907.

TABLE I.—*Blast-furnaces in Kladno.*

Number of furnace.	Tons per 24 hours.	Number of tuyeres.	Diameter of tuyeres.		Productive content.	Number of hot-blast stoves.	Dimensions of stack.	Remarks.
			Max.	Min.				
I. . . .	115	10	85	45	302 m.³	3 Whitwell	80 m. high. 2·4 m. diam.	Basic pig
II. . . .	120	8	100	50	376 m.³	3 Whitwell		Basic pig
III. . . .	125	8	100	50	450 m.³	3 Cowper	75 m. high. 2·4 m. diam.	Basic pig
IV. . . .	180	10	110	50	778 m.³	3 Cowper		Basic pig

TABLE II.—*Blast-engines in Kladno.*

Engine.	Stroke in mm.	Diam. of high pressure resp. gas cylind.	Low pressure cylind.	Diam. of wind cylind.	Number of revolutions per minute.	Max. wind pressure.	Amount of wind drawn in per revol. in cub. met.	Max. Ind. H.P.	Suction and pressure arrangement.	Remarks.
Steam .	2133	900	1260	2033	16–20	35	27·48	500	Pyramid valves	Built 1860 in England reconstr. 1888 Daněk
Steam .	2133	900	1260	1700	26–30	50	19·00	850		Built 1890 by Daněk reconstr. 1905
Steam .	1500	1073	1500	2200	38–42	50	22·61	1200	Stumpf-Riedler	Built 1894 by Daněk
Gas . .	1200	950	...	1580	55–80	70	9·40	930	Hoerbiger	Built 1906 by Skoda

TABLE III.—*Blast-furnaces in Koenigshof.*

Number of furnace.	Tons per 24 hours.	Number of tuyeres.	Diameter of tuyeres.		Productive content.	Number of hot-blast stoves.	Dimensions of stack.	Remarks.
			Max.	Min.				
I. . . .	160	8	100	50	515 m.³	4 Whitwell	60 m. high 1·7 m. diam.	Basic pig
II. . . .	140	12	80	60	440 m.³	4 Whitwell	58 m. high 1·5 m. diam.	Relining
III. . . .	135	8	100	50	464 m.³	4 Whitwell	72 m. high 1·8 m. diam.	Foundry pig
IV. . . .	180	12	100	50	535 m.³	4 Cowper	76·4 m. high 2·4 m. diam.	Basic pig

TABLE IIIA.—*Blowing-engines in Koenigshof.*

Engine.	Stroke in mm.	Diam. of high pressure resp. gas cylind.	Low pressure cylind.	Diam. of wind cylind.	Number of revolutions per minute.	Max. wind pressure.	Amount of wind drawn in per revol. in cub. met.	Max. Ind. H.P.	Suction and pressure arrangement.	Remarks.
Steam III.	1857	1110	1520	2850	15	34	26·31	450	Automatic valves	Built 1882 Bolzano in Schlan
Steam IV.	2133	814	1140	2033	30	60	27·48	850		Built 1891
Steam V.	1500	1070	1500	2200	50	70	22·62	1500	Riedler valve gear	Built 1898
Gas I. . .	1400	1300	...	1500	65	70	4·81	600	Corliss slide valve	Built 1901
Gas II. .	1400	1300	...	1500	75	70	4·81	680	Pyramid valves	Built 1904
Gas III. .	1200	950	...	1650	75	70	5·05	700		Built 1904

from Breitfeld, Daněk & Co.

TABLE IV.—*Particulars of the*

		Steam-engines.		Housing in pairs.	Roughing-mill.	
		Max. Ind. H.P.	System.		Roll diam. in mm.	Body of roll in mm.
Cogging-mill, two-high		6500	Reversing triple compound	1	1100	2800
Girder mill, two-high		7500	do.	4	...	...
Rail-mill, two-high		4000	Reversing twin	3	...	...
Roughing-mill I., three-high	Universal mill	1500	Flywheel tandem	1	...	...
	Mill for shapes			3	...	...
Roughing-mill II., three-high	Universal mill, two-high	1000	do.	1	...	...
	Mill for shapes			3	...	...
Guide-mill, three-high		800	do.	5	550	1600
Guide-mill I., three-high		1000	do.	5	450	1350
Guide-mill II., three-high				8	...	...
Guide-mill III., three-high		400	do.	5	545	1410
Wire-mill, three-high		1200	Compound with flywheel	12	410	1020

Mills in Kladno Ironworks

Finishing-mill.		Number of mill furnaces.		Programme of rolling.
Roll diam. in mm.	Body of roll in mm.			
...	...	1 non-fired, 2 fired	Vertical furnag.	Billets for own mills and for sale
900	2000	...		⌶ from No. 200–500 [from No. 200–300 ⊤ from 35–44 kg. per metre
700	1750	...		⌶ from No. 200–260 [from No. 200–300 ⊤ up to 35 kg. per metre Short billets, squares and rounds
730 500	2265	3		Flats from 200–800 mm. width
600	1500			⌶ from No. 90–180 | Z from No. 100–180 [from No. 90–180 | ■ from No. 90–120 ∿ from No. 160–260 | ● from No. 55–180
535	1640			Flats from 120–500 mm. width
545	1460			⌞ from No. 90–130 ⊥ from No. 65/110–115/150 Sole plates, &c., for railways
400	1100	2	together two furnaces in reserve	Flats 30–120 mm. | Angles 50/50–85/85 Squares 31–85 mm. | ⊥ 30/70–65/95 Rounds 35–83 mm. ϕ | [60–80 Mine rails from 4–12 kg. | ⊤ 60–80
350	1000	1		Flats 40–70 mm. Hoops 50–100 mm. Rounds 25–42 mm. ϕ Squares 22–42 mm. □
275	700 400	1		Flats 10–60 mm. Hoops 10–60 mm. Sharp-edged ⊥ 16–40/30
275	700	1		Flats 15–70 mm. | ⊥ 16/16–30/60 Rounds 10–40 mm. ϕ | Z 15–25 Squares 10–45 mm. □ | [35–40 ⌞ 35–45 |
275	400 600	1		Round wire 5–10 mm. ϕ Square wire 5–10 mm. □

TABLE IVA.—*Particulars of the Mill in Althütten Ironworks.*

	Steam-engine.		Number of housings in pairs.	Roughing rolls.		Finishing rolls.		Number of furnaces.	Programme of rolling.
	Max. Ind. H.P.	System.		Diam. in mm.	Length of body in mm.	Diam. in mm.	Length of body in mm.		
Guide and wire mill, three-high	800	Tandem engine flywheel	10	500	1200	300 360	1000 800 620	2	Flats . . . . . 10–60 mm. Hoops . . . . . 30–55 ,, Rounds . . . . . 5–39 ,, Squares . . . . . 5–35 ,, Isosceles L . . . . . 20–50 ,, Cash L . . . . . 15–52 ,, Divers shapes
Roughing and tin-bar mill, three-high	1000	do.	7	650	1800	650 600 460	1700 1500 620	2	Flats . . . . . 60–130 mm. Hoops . . . . . 60–130 ,, Rounds . . . . . 40–130 ,, Squares . . . . . 35–130 ,, Isosceles L . . . . . 50–130 ,, Cash L . . . . . 60– 70 ,, Mine rails . . . . . 5– 12 kg. Tin-bars . . . . . 183–240 mm.
Mill-bars mill, three-high	200	Flywheel engine	2	...	...	550	1750	6 double puddling-furnaces	Mill-bars . . . . . 60–125 mm. Billets . . . . . 45–110 ,,

TABLE IVB.—*Particulars of the Sheet Mill in Koenigshof.*

	Gas-engine.		Number of housings in pairs.	Roughing mills.		Finishing rolls.		No. of mill furnaces.	No. of mill furnaces for tin-bars; system, Siemens.	Programme of rolling.
	Max. Ind. H.P.	System.		Diam. in mm.	Length of body in mm.	Diam. in mm.	Length of body in mm.			
Mill I.	1200	Four cycle "Nuremberger model"	5	2 Housings 600	1000	550	1 Hous. 1100 2 Hous. 1000	6	1	Sheets from 650 to 800 mm. wide, up to 2500 mm. long, 0·35 to 4 mm. thick
Mill II.			4	1 Housing 650	1350	630	3 Hous. 1350	6		Sheets from 800 to 1100 mm. wide, up to 3500 mm. long, 0·40 to 4 mm. thick
Mill III.	1200		4	1 Housing 680	1800	650 630	1 Hous. 1800 2 Hous. 1350	6	1	Sheets from 800 to 1600 mm. wide, up to 4000 mm. long, 0·40 to 5 mm. thick
Mill IV.			5	2 Housings 550, 520	2 Hous. 1000 1 Hous. 800	520 500	2 Hous. 1000 1 Hous. 800	6		Sheets from 300 to 750 mm. wide, to 2000 mm. long, 0·25 to 3 mm. thick

TABLE V.—*Electric Power-station in Kladno.*

Driving-engines.	H.P. of each.	Total H.P.	Remarks.
2 vertical steam-engines	500	1000	...
1 gas-engine	500	500	System, Delamare Debouttéville
1 steam-turbine . . .	1000	1000	System, Parsons
	Total . .	2500	

For power purposes, alternating current with 550 volts pressure and 25 periods is at disposal.
Continuous current with 2 × 110 volts pressure 15 used for lighting by means of the three-line system.

TABLE Va.—*Electric Power-station in Koenigshof.*

Driving-engines.	H.P. of each.	Total H.P.
3 vertical steam-engines	50	150
1 horizontal tandem steam-engine .	200	200
2 gas-engines	250	500
1 gas-engine	500	500
1 gas-engine	1000	1000
	Total	2350

For lighting and power purposes the continuous current with 110 volts is used.

TABLE VI.—*Bituminous Coal Output (in metric tons).*

Working year.	1885–6.	1890–1.	1894–5.	1899–0.	1900–1.	1901–2.	1902–3.	1903–4.	1904–5.	1905–6.	1906–7.
Pit: Mayrau.	...	...	...	...	...	300,028	295 399	379,168	479,796	493,834	510,308
Pit: Max	...	...	...	...	...	327,034	325,378	408,786	496,763	508,257	578,383
Pit: Johann.	...	..	...	...	...	...	...	...	...	263,061	243,156
Pit: Schoeller	...	...	...	...	...	...	...	...	...	255,505	251,787
Total . .	503,820	599 294	720,673	673,582	935,281	627,062	620,777	787,954	976,559	1,520,657	1,583,634

TABLE VIa.—*Brown Coal Output (in metric tons).*

Working year	1890–1.	1895–6.	1900–1.	1901–2.	1902–3.	1903–4.	1904–5.	1905–6.	1906–7.
Zuckmantel, near Teplitz	50,239	42,967	97,742	93,368	79,885	59,531	56,611	53,436	68,676

TABLE VII.—*Output of Ironstone in Nučitz (in metric tons).*

	1880.	1885.	1890.	1895.	1900.	1902.	1904.	1906.
P.I.I.Co.	28,687	94,314	191,452	248,714	348,990	249,035	331,398	368,797
B.M.Co.	11,269	72,409	190,371	238,522	397,659	351,470	418,591	370,795
Total	39,956	166,723	381,823	487,236	746,649	600,505	749,989	739,592

TABLE VIII.—*Pig Iron Production (in metric tons).*

	1880.	1885.	1890.	1895.	1900.	1902.	1904.	1906.
Kladno Basic	27,483	42,387	73,423	80,178	120,506	98,800	115,839	152,518
Koenigshof { Basic . .	...	32,279	69,200	106,270	145,300	128,770	137,460	98,930
Koenigshof { Foundry .	14,193	...	...	...	...	23,450	36,940	41,010
Total	41,676	74,666	142,623	186,448	265,806	251,020	290,239	292,458

TABLE IX.—*Production of Steel (in metric tons).*

	1890.	1893.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Basic Bessemer { Kladno . .	...	...	...	...	...	...	...	...	...
Basic Bessemer { Teplitz . .	...	...	...	...	...	...	...	...	...
Basic Bessemer { Total . .	...	...	...	...	...	...	...	...	...
Basic Bessemer { Kladno . .	55,955	80,500	78,275	72,418	80,672	84,362	92,203	110,685	131,388
Basic Bessemer { Teplitz . .	47,640	65,495	59,703	53,612	56,881	59,159	58,081	66,345	71,533
Basic Bessemer { Koenigshof	...	12,228	45,378	48,701	51,767	48,997	57,617	58,399	52,864
Basic Bessemer { Total . .	103,595	158,223	183,356	174,731	189,320	192,518	207,901	235,429	255,785
Open-hearth { Kladno	4,627	15,722	18,503	16,381	19,220	21,799	20,692	16,896	20,429
Total . . .	108,222	173,945	201,859	191,111	208,540	214,317	228,593	252,325	276,214

TABLE X.—*Output of Mill Products (in metric tons).*

	1872.	1880.	1890.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Kladno	...	...	...	81,777	80,539	91,474	89,577	106,462	110,090	133,399
Teplitz	...	9,300	31,777	49,953	48,791	47,302	41,987	45,604	50,885	57,628
Althütten	6,336	5,865	6,393	16,010	15,309	13,928	18,149	21,539	19,209	19,842
Hermannshütte . . .	9,708	14,453	14,179	14,365	15,008	16,171	7,848	...	...	...
Maria-Anna-Hütte . .	...	2,897	4,618	7,635	7,301	7,879	966	...	...	...
Total	...	...	...	169,740	166,948	176,754	158,527	173,605	180,184	210,869
Sheet mill { Blackplates . .	...	...	4,395	16,291	16,863	17,260	16,299	21,476	18,312	21,660
Sheet mill { Galvanised sheets	...	...	1,330	4,411	4,578	4,498	3,637	3,495	4,075	4,271
Sheet mill { Total . . .	...	...	5,725	20,702	21,441	21,758	19,936	24,971	22,387	25,931
Total output . .	...	...	...	190,442	188,389	198,512	178,463	198,576	202,571	236,800

TABLE XI.—*Puddled Iron Production (in metric tons).*

	1872.	1880.	1890.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Kladno	...	...	...	9,605	10,232	10,644	9,528	10,511	10,047	...
Hermannshütte .	...	...	20,040	18,021	19,337	19,180	10,180	...	...	...
Althütten . . .	7,053	3,966	9,730	18,569	13,610	11,309	9,439	14,800	8,335	12,667
Maria-Anna-Hütte	...	2,772	3,642	1,519	...	...	...	...	...	...
Total	...	...	...	47,714	43,179	41,133	29,147	25,311	18,382	12,667

TABLE XII.—*Production of Basic Slag (in metric tons).*

Year . . .	1890.	1900.	1901.	1902.	1903.	1904.	1905.	1906.
Teplitz . .	21,470	17,950	16,940	18,240	18,980	17,470	21,990	25,810
Bubenč . .	9,740	32,238	32,743	36,075	43,826	44,875	48,461	48,673
Total . .	31,210	50,188	49,683	54,315	62,806	62,345	70,451	74,483

TABLE XIII.—*Total Power of the Steam- and Gas-engines, Motors, and Dynamos.*

	Indicated power of			
	Steam-engines.	Gas-engines.	Dynamos.	Motors.
PRAG IRON IND. CO.				
Kladno ironworks	37,111	1,430	2,600	5,190
Collieries in Kladno	5,927	...	1,770	2,185
Ironstone mines, Nučitz . . .	495	...	316	227
Basic slag mill, Bubenč . . .	513	...	71	71
BOH. MINING CO.				
Koenigshof ironworks—				
Blast-furnaces	4,197	3,980	1,748	1,302
Sheet-mill	...	2,400	...	710
Steelworks	1,758	...	...	160
Ironstone mine	1,167	...	1,150	317
Althütten ironworks	2,490	...	510	756
Total	53,658	7,810	8,165	10,922

TABLE XIV.—*Collieries in Kladno.*

Mine.	Annual output in	No. of men.	No. of shafts.	Depth.	Diameter.	Timbering and walling.	Winding engines.	Weight raised per cage.	Ventilation.	Total effect of fans.	Pumping engines.	Effect of pumping engines.	System of dressing and amount.	Power station.	No. of boilers.	Total heating surface.	Special mechanical arrangements.
	mt.			m.	m.			mt.		m^3 per min.						$m.^2$	
Max.	580,000	1700	1	480	4·9	Walling and Iron.	2 double cylinder engines of 400 H.P. and 200 H.P.	3,6	2 centrifugal fans, syst. Pelzer motor 70 H.P.	2400	3 steam differential plunger pumps, Riedler valve motion 350 H.P.	3 $m.^3$ per minute to a height of 480 m.	Washer syst. Baum, 2400 q. in 24 hours	1 Alternating-current generator, 1 Parsons steam turbine 1000 H.P. 550 volts and 25 periods per second	20	2000	3100 m. elec. driven cable and 1400 m. elec. driven chain haulage, 4 pneum. coal cutt. machines "Eisenbeiss," 1 elec. chain coal cutting machine "Jeffrey," 3 elec. boring machines "Jeffrey."
Mayrau.	510,000	1600	2	520	3·9 3·0	do.	2 double cylinder engines of 700 H.P. and 260 H.P.	3,0	3 centrifugal fans, syst. Pelzer and Rateau motor 100 H.P.	3000	3 steam plunger pumps, Riedler valve motion 500 H.P.	2·5 $m.^3$ water per minute to a height of 520 m.	Washer combined with screening plant. system Schüchtermann, 2400 q. in 24 hours.	1 Alternating-current generator, 100 H.P., 1500 volts and 50 periods per second	19	1400	580 m. cable and 2470 m. chain haulage
Schoeller.	250,000	930	1	518	5·0	do.	1 double cylinder and 1 compound engine each 320 H.P.	3,0	1 centrifugal fans, syst. Geisler, motor 60 H.P.	2400	High pressure centrifugal pump. syst. Sulzer, driven electrically, motor 400 H.P.	2 $m.^3$ water per minute to a height of 520 m.	Washer direct loading 1000 q. in 24 hours	2 Alternating-current generators each 180 H.P. 225 volts 50 periods per second	10	1300	5 Brandt's hydraulic boring machines 50 atm. pressure
Johann.	240,000	1000	2	496	4·3	do.	2 double cylinder engines of 300 H.P.	8,0	2 fans, sys. Guibal, driven by two 30 H.P. steam engines.	2400	2 beam steam engines, syst. Regnier, each 300 H.P.	5 $m.^3$ water per minute to a height of 500 m.	Washer direct loading 1200 q. in 24 hours	6 direct-current dynamos for 130 H.P. 400 V.	13	1200	900 m. cable haulage, 4 Brandt's hydraulic boring machines 50 atm. pressure

TABLE XV.—*Ironstone Mines in the Nučitz District.*

Mine.	Depth in meters.	Winding engines.	Power station	No. of boilers.	Total heating surface.	Boring machines.	Pumping engines.	Effect of pumping engines.	Ventilation.	Ore-dressing plant.
	m.				m.²					
Jinočan .	149	1 horizontal double cylinder engine 34 H.P.	1 double steam engine 30 H.P. 1 single cylinder steam engine 15 H.P.	3	122	6 System Thomson-Houston	1 differential steam pump with condensation 5 H.P.	360 litres per minute	Electrically driven fan for 100 m.³ air per minute	...
III. .	70	1 horizontal double cylinder engine 38 H.P. Speed 3 m. a second	Current conducted from mines "IV." and "Vinice"	3	122	14 System Siemens-Schuckert	1 differential steam pump with condensation 1 electrically driven duplex pump	500 litres per minute 600 litres per minute	2 electrically driven fans each for 40 m.³ air per minute	...
IV. .	167	1 horizontal double cylinder engine 90 H.P. Speed 3 m. a second	2 horizontal compound steam engines with condensation 135 H.P.	3	510	10 6 System Thomson-Houston 4 Siemens-Schuckert	2 horizontal electric duplex pumps 2 horizontal electric duplex pumps	400 litres to a height of 102 m. 400 litres to a height of 66 m.	2 electrically driven fans one for 40 m.³, the other for 72 m.³ air per minute	...
Vinice .	64·5	1 horizontal double cylinder engine 35 H.P. Speed 1·5 m. a second	2 tandem compound steam engines with condensation 286 H.P.	3	580	13 System Siemens-Schuckert	2 horizontal electrically driven duplex pumps	Each 300 litres per minute to a height of 70 m.	1 mine fan for 80 m.³ air per minute	Stone crusher plant, 6 crusher, system Sivers 24 roasting kilns
Krahulov	94	Electrically driven windlass Speed 3 m. a second	1 compound-steam engine with condensation 150 H.P. 1 horizontal compound steam engine with condensation 150 H.P.	3	580	14 System Thomson-Houston	1 centrifugal pump 1 electrically driven triplex pump	60 litres per minute 150 litres per minute	1 mine fan for 80 m.³ air per minute	Stone crusher plant, 3 crusher, system Sivers 30 roasting kilns

Electrical Rolling-mill Transporters at Kladno.

A number of special electrically driven transporting devices have recently been installed at these works. The following description has been reprinted from an illustrated article which has appeared in the *Engineer*, October 18, 1907 :—

It has long been recognised that one of the most important features in the working of smelting works and rolling-mills is the facility of transport within and between the various departments. Modern applications of electricity have shown it to be specially suitable for this class of work, effecting a great saving of labour, and also, owing to the speed of operation, considerably increasing the output.

For driving the electrical transporting devices which have recently been constructed for the Eisen-Industriegesellschaft, Kladno, three-phase current at 500 volts pressure and 50 cycles is used throughout, except for the lifting magnets, for which purpose continuous current at 240 volts is employed.

The live roller table is used for carrying the work backwards and forwards to the main rolls. For the travelling motion of the table there is a totally enclosed motor of 60 horse-power, the travelling speed being 346 feet per minute. Brake motors are also used, which automatically come into action when the current is cut off, and so prevent over-running. The live rollers themselves are driven by means of a totally enclosed motor of 40 horse-power through worm gearing, which is found to work more satisfactorily than the usual method of driving through bevel gearing. There is also an arrangement for tilting the smaller sizes and sections, this being driven by a 10 horse-power motor. The various movements are controlled from the raised platform on which the driver stands. The total weight of the table is 61 tons.

An electrically driven crane is provided in the rail-finishing shop for the purpose of lifting the rails from the live rollers, turning them through a right angle into the direction to which they are to be conveyed, and depositing them in the store. The rails are lifted from underneath by means of four large hooks which are capable of taking eight rails at once. The latter are deposited either by lowering the carrier and letting them rest on the storing rack, or by tipping the hooks to an angle of 45°, so that the rails slide off; this latter operation is effected from the driver's cabin by means of a motor actuating an eccentric shaft attached to the rail carrier. After dropping the rails, this motor is automatically reversed by means of a switch operated by the eccentric shaft itself, and the carrier hooks are thus put into the normal position again. For the turning movement, the crab is provided with a turntable driven through bevel gearing. The lifting gear consists of two drums, from each of which a steel rope passes round a separate pulley fixed to the carrier, and then back to its own drum. The driver's cabin is fixed on the revolving part of the crab, so that the driver turns with the rails, which enables him to control the operation without difficulty. The crane is designed to deal with rails up to 50 feet in length, and to have a normal lifting capacity of four tons. The total span is 63 feet, and the various speeds are as follows: Travelling speed of crane, 395 feet per minute; travelling speed of crab, 200 feet per minute; lifting speed, 46 feet per minute; turning speed at the end of a rail 50 feet long, 362 feet per minute. The five motors for travelling, traversing, lifting, and tilting have outputs of 26, 7, 26, 4, and 1½ horse-power respectively. The total weight of the crane is 23 tons. Three brake motors are in use which automatically come into action immediately the current is cut off. This, it is claimed, allows of great speed of operation.

An electrically worked crane for storing rolls and girders constitutes another important portion of the equipment. This is a semi-bridge crane, designed to handle flat iron up to 2 feet 8 inches in width, round iron bars or ingots up to 9 inches in diameter, square iron rails, girders, angle iron, U and T-iron, varying in length from 3 feet 3 inches to 56 feet, and to pick these up by means of electro-magnets. The material from the rolling-mill is transported by the crane to the store, and lifted sufficiently to clear the stored material. The carrier gear of this crane is also mounted on a turntable, so that the load can be turned, and deposited in any desired direction. The crane is 142 feet long over all, the distance between the supports being 119 feet, and the projection outside 23 feet. The running rails for the crab are 20 feet above the floor. The material is picked up by means of a carrier provided with four lifting magnets designed for a normal load of 1 ton and a maximum possible load of 6 tons, thus allowing a large margin of safety. For extra security four hooks are provided on the carrier, which come under the material after it has been lifted by the magnets, and are operated from the driver's cabin by means of an eccentric shaft and toothed segments driven by a motor. In consequence of the great travelling and revolving speeds, the carrier is provided with a special guiding arrangement to prevent any swinging of the load. The driver's cabin is fixed to the crab, so that the driver moves along with the load and is therefore able to guide it. The opening between the main supports at the end is wide enough to allow rails 50 feet long to pass through, so that they can be picked up straight from the store and loaded on to a truck outside the supports without being turned. If longer than this they have to be slightly turned and passed through diagonally. The travelling speed of this crane is 278 feet per minute, the traversing speed of crab 495 feet per minute, the lifting speed 46 feet per minute, and the turning speed, at the end of a rail 50 feet long, 362 feet per minute. The travelling and lifting motors each have a capacity of 25 horse-power, the travelling motor 16 horse-power, and the motors for the turning arrangement, and for actuating the safety hooks, 3 and 1½ horse-power respectively. All movements are controlled by automatic brake motors. The lifting motors, being exposed to the weather, are totally enclosed and water-tight. The current for exciting the magnets is switched on and off in steps by means of resistances, each magnet taking 700 watts.

A magnetic crane capable of lifting girders up to 4 tons is used for dealing with U iron from 6 inches to 12 inches, and T iron from 6 inches to 22 inches, in lengths varying from 13 feet to 60 feet. The large girders are magnetically lifted off the rollers separately, while as many as four of the smaller sections are lifted at once. The crane conveys these girders either to the store, to the weighbridge, or to the trucks. The carrier is provided with six lifting magnets with safety hooks, each magnet being designed for a normal load of 15 cwt., but capable of taking 4½ tons, thus allowing a factor of 6. The total weight of the crane is 15½ tons, and the span 33 feet. The lifting speed is 100 feet per minute, and the traversing speed of crab 224 feet per minute. To prevent the load swinging when in motion, it is hoisted as high as possible against springs mounted underneath the driver's cabin, and a suitable guide is provided for lowering the material. The two motors for the hoisting drums each have a capacity of 27 horse-power, the traversing motor 10 horse-power, and the motor for actuating the hooks 1½ horse-power. All movements are automatically braked by means of special motors.

The crane used for the purpose of changing the rolls and roller frames has a normal carrying capacity of 25 tons and a span of 49 feet. It is similar to an ordinary travelling crane, except that the crab runs within the crane

girders, these being constructed in the form of a bridge. The total weight of this crane is 44 tons, and the travelling speed 148 feet per minute, the traversing speed of the crab is 100 feet per minute, and the lifting speed 10 feet per minute. The travelling and lifting motors each have a capacity of 20 horse-power, and the traversing motor 11 horse-power. A crane is also employed for storing rolls, and also conveys the rolls from the store either to the rolling-mill or to the roll-turning shop. The crane is built on the cantilever principle, the normal load being 25 tons. The total length is 104 feet, the centre span being 46 feet, and each of the two projections 29 feet. The crane framework weighs 30 tons, and the crab with hoisting gear 12 tons, so that the crane when loaded has a total weight of 67 tons. Each of the four supports of the crane rests on a truck running on two cast-steel wheels; the wheels of two of these trucks are connected by means of gearing and shafting to a motor placed in the centre of the main span, by means of which the travelling movement is effected. The driver's cabin is fixed to the crab, and thus moves with the load. The crane is so constructed that the load can pass between the supports to the ends of the projections. The travelling speed of the crane is 100 feet per minute, the traversing speed of the crab 66 feet per minute, and the lifting speed 8 feet per minute. The three motors for travelling, traversing, and lifting have a capacity of 20, 5½, and 26 horse-power respectively. All movements are controlled by brake motors.

For the purpose of hauling the slag trucks separately from the blast-furnaces and forming them into a train, to be taken away by the works locomotive, an electrically driven capstan has been installed. The capstan is designed for a hauling capacity of 1¼ ton at 100 feet per minute. The motor and gearing are contained in a well with cemented walls, built on a cast-iron frame, this being made water-tight. The power is transmitted to the capstan through worm gearing, and the motor is started and stopped by means of a foot lever, which actuates a switch, this being automatically pulled out by a spring as soon as the foot is taken off the lever. The total weight of the capstan is 2½ tons.

In conclusion, it may be mentioned that all the cranes described have been subjected to very severe tests, and have often had to work under difficult conditions. The main idea in the construction was that all parts, both electrical and mechanical, should be amply dimensioned, so that permanent working without serious breakdown could be guaranteed; at the same time, especially in the cranes with very large spans, the weight was reduced to a minimum by making use of the latest experience and improvements in bridge design, thus avoiding any unnecessary dead weight.

The Styrian Erzberg.*

The Erzberg is situated in the centre of Northern Styria. Surrounded by a circle of higher peaks, it forms an isolated cone, of which the reddish-brown slopes form a striking contrast to the dark-green woods covering the adjacent heights. Hundreds of years ago the Erzberg was the centre of an active industry, and it is now the centre of even greater activity. In those days small smelting houses and hammer works were spread along the narrow valleys extending from the mountain; at the present time the mine furnishes daily thousands of tons of ore.

The Styrian Erzberg is celebrated not only for the extent of the deposit,

* This description is reprinted from an illustrated monograph specially prepared in English and German by the Oesterreichische Alpine-Montangesellschaft for the information of members taking part in the excursion to Styria.

but also on account of the exceptional richness of the ores and their suitability for furnace treatment. These characteristics render it possible to carry on the smelting works of the Alpine lands with economy, notwithstanding the fact that the fuel requisite for the blast-furnaces has to be brought from the north of the monarchy or even from Westphalia.

The Geological Relation of the Erzberg.—The Erzberg, whose summit rises to 5043 feet above the sea level, is made up of a succession of stratified rocks whose exact geological age can only be determined with difficulty owing to the deficiency in paleontological evidence. The lowest member of the series, the "Grauwacke," the so-called footwall of the ore deposit, is a well-stratified greyish-green rock made up of fine grains of felspar and quartz on a compact base of mica scales with a little quartz, which very generally forms the limit between the Central Alpine crystalline region and the northern limestone Alps. By some geologists the Grauwacke is considered to be a gneiss, but from the evidence of the fossils which are occasionally but very rarely found in the neighbouring valleys it may be classed as Silurian, Devonian, or Lower Carboniferous.

In intimate connection with the Grauwacke a highly siliceous clay slate occurs below the ore bed with numerous pyritic inclusions and fossils of Upper Silurian species. This is followed by a heavy succession of alternating bands of spathic ore, ankerite, and a light-coloured partially variegated red and yellow limestone, the Sauberger Kalk or ore-bearing limestone of the older authorities. This contains crinoid remains and, together with the adjacent ore-bearing rocks, is of Lower Devonian age. The ore deposit attains a thickness of several hundred metres.

In the ore bed a belt of seriacitic schist occurs interbedded and closely following the undulations of the lower part, from which, however, it is so sharply differentiated by its mineral constitution that it has been held by some geologists to mark a discontinuity in age, the lower part being referred to the Devonian period, while that above the schist represents a second bed deposited in Permian times. It is possible, however, that it may merely represent a contemporaneous barren clay parting, and this is the more likely, as no perceptible difference in mineral composition can be found between the upper and lower parts of the deposit.

The newest formations forming the hanging wall or roof are the Werfen schists, which are red, finely-stratified sandy rocks of Lower Triassic age. Between these and the ore bed brecciated masses are often found, made up of fragments of the older limestones cemented by Triassic material. These overlying beds are only found on the east side of the ore deposit, having been completely denuded from the opposite side, giving unequalled facilities for working in open cast. As regards the origin of the ore bed, it may most probably be regarded as a transformed condition of an Upper Silurian limestone, by ferrous salts brought in solution from deep-seated sources. The occurrence of iron and copper sulphides in the lower strata is in favour of such an origin. The dip of the strata is tolerably uniform at about 45° to the north-east.

The numerous slips, faults, compressions, and other disturbances exposed by the working of the mass afford interesting evidence of the changes that the rocks have undergone since their original deposition. At the summit of the Erzberg the strata are vertical, or in some places slightly overturned, while at the base the underlying Grauwacke dips into the hill at a lower angle. The spathic ores found on the slopes of the adjacent mountains, including the Rabenkogel, the Donnersalpe, the Grassenberg, and the Glauzberg are outlying portions of the main ore deposit, the intermediate ground having been removed by denudation. The ore is found under similar conditions in the Radmer and Johnsbach valleys, and in the vicinity of

Admont and Aigner to the westward. The most prominent mineral of the Erzberg is siderite or spathic iron ore, which occurs in rhombohedral crystals, but most commonly in finely granular compact masses, together with the weathered products known as blauerz kernflinz and limonite, as well as wad (earthy manganese ore) in brown or bluish iridescent incrustations. Less common are quartz in the form of rock crystal, cinnabar, specular iron ore, and pyrites. Among the associated carbonates, ankerite or rohwand, lime, magnesia, and iron carbonate are most abundant. Carbonate of lime occurs both as calcite and aragonite in columnar crystalline forms, while the latter is specially represented in the beautiful coral-like form known as *flos ferri*, perhaps the most characteristic and best known of the Erzberg minerals. Another form is the so-called Erzbergite, made up of alternating bands of calcite and aragonite.

The Erzberg Excursion.—From the Prebichel station on the Vordernberg-Eisenerz Railway, the Prebichel summit on the high-road is reached in a few minutes on foot. This lies in a narrow pass 4062 feet above the sea level, commanded on the right by the rounded and well-wooded mass of the Polster, rising to 6269 feet, and on the left by the equally well-wooded Edelkogel. Here the train is taken on the narrow gauge mineral railway which is used to some extent for passenger traffic over part of its length.

This line of 3-foot gauge, having an average slope of 1 to 125, was opened for traffic in 1835, the trains being drawn by horses, which method of traction continued in use until 1878, when steam locomotives were substituted, so that it is one of the oldest railways in the Austrian dominions. Shortly after leaving the station the train passes under the Fridau Road Bridge, and, leaving the deep valley of the Gsollgraben on the right, enters the woods covering the slopes of the Edelkogel, where clearings at intervals afford glimpses of the mighty cliff of the Pfaffenstein, 6318 feet, towering above the woods of the Gsollgraben and Gerichtsgraben, the two principal tributaries of the Eisenerz brook on the eastern side, and the waste heaps of the mine. After making many bends the line turns to the left, and after passing through the Feistæck tunnel (164 yards long) the eastern side of the Erzberg is seen, with the votive cross on its summit, erected by the Archduke John in 1823. At this point miners' houses and waste heaps come in sight, below which the eastern mouth of the Platten tunnel, on the rack and pinion railway, 1522 yards long and 3609 feet above the sea level, is seen, and still lower the Trofeng valley with the workmen's houses. The Pfaffenstein closes the view on the right, while on the western side the higher points of the Triassic limestones, the Kaltemauer (6319 feet), the Hochblaser (5280 feet), the Seemauer rising steeply from the Leopoldstein Lake, and the Folz Group with the Kaiserschild (6839 feet), a marvellous prospect which is suddenly cut off by the train entering the upper Platten tunnel, 514 yards long, which is passed through in five minutes. We then emerge on the Wismath level of the Erzberg, and, continuing the journey for a short distance, passing the engine-house of the Wismath lift, reach the Kaisersteig, where the railway journey ends. During this latter part of the journey ample opportunity is afforded for enjoying the change of scenery. At a great depth below, the Erzbach is seen winding through great mountain masses, including the Reichenstein, 7107 feet, separated by the Gorge of the Grosscharte from the Linz (6785 feet), the Stadelstein (6789 feet), and the Schwarzenstein (6424 feet). In front of these on the left hand are seen the thickly wooded slopes of the Grassenberg, and the line of the rack and pinion railway, with the Ramsau Viaduct of eight arches, 328 feet long and 102 feet high, above the river, with the Radmer Hals and the Zeiritz Kampel in the distance. On the right side of the valley the

Carl Weighart, Leoben, photo.

Visit to the Erzberg.

PLATE III

prominent summits of the Donnersalpe (4760 feet), the Tulleck (4069 feet), and the Kaiserschild (6839 feet) are seen.

At the end station a self-acting inclined plane connects with the higher workings for bringing the ores down to the main loading level on the railway.

From this point the journey is downwards, following the zig-zag route known as the Kaisersteig along the northern edge of the workings by which the level known as the Maschinen étage is reached, where the workings are entered after crossing a water balance incline lifting from the lower workings. Here in many places traces of the mining activity of days long gone by are apparent in the form of chamber workings with crushed and broken timbering and small levels of trapeziform section going back to times preceding the invention of blasting, when masses of soft ore were got by the slow and laborious method of pick and gad alone.

From this point a good view is obtained of the town of Eisenerz and the blast-furnaces and Leopoldstein-Schloss in the valley beyond, while nearer by the Vordernberger, Berghaus (4058 feet), backed by the Pfaffenstein is seen. At this place a good collection of the ores, the stalactitic aragonite (*flos ferri*) and other minerals has been formed.

A few terraces further down the Ebenhöhe (3891 feet), forming the boundary between Vordernberg and Innerberg is reached, and, continuing the descent, passing the higher Innerberg workings and several workmen's barracks, we arrive at the Barbara House (3136 feet), with the adjoining votive chapel of St. Barbara, erected in 1703 on the site of an older wooden structure dating from about a century earlier.

Historical Notes on the Erzberg.—The earliest traces of mining activity on the Erzberg date back to times in the dim legendary past preceding authentic history, but from the evidence afforded by slag heaps, clay nozzles and the like it may be safely said that in pre-Roman times as well as during the Roman domination the rich ore deposits were actively worked.

The far-famed Noric iron, although the greater part of it was derived from the Hüttenberg Erzberg in Carinthia, now included in the property of the Alpine-Montangesellschaft, was to some extent produced from the Eisenerz ores. Sufficient evidence in support of this is afforded by the Roman coins and stone monuments found at different times in the workings.

After the close of the Roman occupation the mine was abandoned for a long period. Traditionally mining was resumed in the eighth century, but the first authentic records do not go back beyond the twelfth century. From this period, however, the record is continuous, forming one of the most important chapters in the economic history of the country, and the numerous documents concerning it are among the most valued of the historical archives of Styria. From early times the working was divided into two parts, the upper or Vordernberg (Fore the mountain) and the lower or Innerberg (Inner Mountain) parts, the level between these, the so-called Ebenhöhe, having been fixed in the thirteenth century which, with some modifications at subsequent intervals, has continued to the present time. The smelting furnaces and forges and the trade centres were similarly divided, those working with the Innerberger ores being confined to the Enns Valley with a trade centre and depôt at Steyr, while those on the Vordernberg side were restricted to the Mur valley with a staple place at Leoben. The whole trade was very closely regulated, the supplies of charcoal for furnaces and forges and provisions for miners and smelters, the course of trade and the relations between individual producers having, in accordance with the economic ideas prevailing in earlier times, been subjected to minute and strict official supervision.

The irregularity in the conditions of the holding and the multiplicity of small holdings in the lower part of the Erzberg gave rise at an early period to a consolidation of interests, in which nineteen forge-masters in the Enns Valley and the iron merchants of Steyr took part, in the formation of the Innerberger Hauptgewerkschaft in the year 1625 ; a combination which, owing to the essential diversity of interests in the different parties, was incapable of any very extended development. In the year 1798 the Canal and Mining Company of Vienna purchased the interest of the municipality of Steyr, thus obtaining a preponderating position in the concern. In 1801 the Erzberg passed into the possession of the Imperial family, and in 1807 was transferred to the State mining department, in whose possession it remained to 1868, when it was purchased by a newly formed Joint Stock Company, bearing the old name of the Innerberger Hauptgewerkschaft which, together with other Styrian works, was consolidated into the present Oesterreichisch Alpine-Montangesellschaft in 1881.

In the Vordernberger Erzberg the course of events was similar. Minute regulations laid down by the supreme authority concerning the relations of the individual proprietors of furnaces and forges, and the town of Leoben which owned several works besides enjoying special privileges in connection with the trade, as well as the working of forests for charcoal, the amount of output, methods of sale and provision of funds have been in force for centuries. Here, however, the irregular working of the mines, although there were only fourteen proprietors interested, gave rise to considerable trouble, and in 1829, under the intervention of the Archduke John, the proprietor of one of the works, the mineral interests of all but one of them were consolidated into the Radmeister Comunitat, the remaining works, No. 7, only joining the combination in 1871. Since 1890 the working of the mines has been entirely in the hands of the Alpine-Montangesellschaft, who also own $\frac{54}{84}$ of the shares of the older company.

Technical Details of the Erzberg Working.—Up to the middle of the eighteenth century only the weathered portions of the spathic ore, the so-called blauerz and braunerz, were utilised by the smelters, and these alone formed the object of the working. The favourable position of the ore for working, the surface covering being very light, rendered it possible to carry on irregular open-cast workings for a long time, but with the exhaustion of the surface limonite at the beginning of the sixteenth century the period of deep working commenced.

Small narrow levels, most of which scarcely attained to a man's height, were driven into the hill by pick and gad work, the sides being carefully dressed smooth to facilitate ventilation. Levels of this kind, often of considerable length, are frequently encountered in the present workings. When a body of soft ore was met with in the level, it was, as far as possible, worked so as to leave a large open chamber, and as each of the numerous proprietors worked in his own way, irrespective of his neighbour, the ground became honeycombed with irregular cavities, often leading to heavy falls of ground.

Up to the year 1564 the ore was removed by horse and cart, when the sack-carrying system was introduced in the Innerberg workings. This consisted in filling the ore broken during the shift, averaging about 140 kg. (308 lbs.) into a sack, which was drawn down the hill by the miners, upon a specially constructed carriage, at the end of the day's work, the empty bag and carriage being taken up by workmen at the beginning of the shift. For a long time very little change was made in the system of working. Regular open working was carried on during the summer, large faces of ore being left exposed to facilitate weathering, whereby the ore could be

more readily broken. During the winter working was exclusively carried on underground. In 1810 the sack carriage system was given up and the system of levels driven from the face to drop shafts communicating with main drawing roads below was substituted.

The greatly increased production since the Erzberg passed into private ownership in 1869, and more particularly since the foundation of the Alpine-Montangesellschaft, has been accompanied by a complete alteration in the methods of working and removal of the ore, the system of underground pillar working in the Vordernberg section having been entirely abandoned and the whole mountain arranged into a regular step-shaped open working with 58 working levels or terraces each of an average vertical height of about 43 feet. The ground is broken with high explosives, the waste and ore being separated by hand picking at the face.

For the removal of the ore on the level fifteen steam and ten electric locomotives, a steam crane, and an electric capstan are in use, while in the lifting or lowering between different levels seven water balance lifts, five self-acting inclines, and ten cage drops in shafts are employed.

The total length of level roads is :—

On the Innerberger Erzberg	57¼ miles.
„ Vordernberger	22 „
	79¼ miles.

And of these there are actually in use at present :—

On the Innerberger Erzberg	12½ miles.
„ Vordernberger	5 „
	17½ miles.

In the year 1890 the terminal points of the then existing branch railways at Eisenerz and Vordernberg were brought into connection by a railway on the Abt rack and pinion system, leading from Eisenerz (2269 feet) over the Prebichel (3957 feet) to Vordernberg (2565 feet). The maximum gradient is 1 in 14 on the rack rail sections, which make up 9 miles out of the total length of 12⅝ miles. The five tunnels have a total length of about 1½ mile, the longest being about three-quarters of a mile and driven on the level. On the new line loading depôts have been established at the stations of Prebichel (3937 feet), Erzberg (3511 feet), and Eisenerz (2267 feet), which are served by railway connections from the three principal distributing planes at corresponding levels in the workings. The ores from the Vordernberg section are partly lowered by self-acting and partly lifted by water balance inclined planes to the main horizon or Wismath stage (4167 feet) and travel thence to Prebichel by the narrow-gauge railway already noticed.

The ores from the highest Innerberg terraces above the Dreikönig stage (3539 feet) are lowered to that level by drop shafts, while those from lower workings are lifted by an electric winding-engine in No. VII. shaft, whence an electric railway leads to the loading pile at Erzberg station, 3511 feet above the sea level (60 feet lower than the top of Snowdon).

The collecting place for the lower Innerberg works is the Liedemann plane and adit level, which is connected with the workings by numerous drop shafts. The ore is either discharged into a storage bunker of 200,000 tons capacity at that level or is lowered by three inclined planes to the calcining kilns in the Krumpental Valley. From the kilns an electric railway, 2406 yards long, leads to a second calcining plant, the Eisenerz loading

station and the blast-furnace at the north end of the town of Eisenerz. The calcining plant includes 119 kilns, of which 99 are worked with coal and 20 with producer gas.

The smelting processes have in the course of time undergone manifold changes, and the long-continued period of uninterrupted working enables their development to be traced very completely in the Erzberg. In the earliest times small open fires were used with a production of 6 to 8 cwt. of malleable blooms daily. In the eleventh century the stückofen or high bloomery furnace was introduced, giving, at first, about 10 cwt., which, by increase in the size and power of the furnace, was gradually brought up to 2 tons per day.

Smelting for cast iron, which was begun in Carinthia in 1580, was not adopted in the Erzberg region until 1769, when the direct bloom-making was abandoned. The earliest charcoal blast-furnaces gave a maximum production of 3 tons per day, which, by progressive improvements continued for centuries, was brought up to 60 tons, the latest examples being, in regard to fuel consumption, among the most economical furnaces in the world.

Iron-Ore Production of the Erzberg.

Period.	Ore in Tons Uncalcined.	Average Yearly Output.	Proprietary Conditions.
		(*a*) *Innerberger Erzberg.*	
1466	4,710	...	Numerous independent proprietors.
1588	20,000	...	
1610	13,700	...	
1625–1700 . . .	831,889	11,092	Innerberger Hauptgewerkschaft and Kanal and Mining Company.
1701–1800 . . .	1,673,214	16,732	
1801–1868 . . .	2,205,795	32,438	Imperial family and State domains.
1869–1880 . . .	1,932,862	161,072	Innerberger Hauptgewerkschaft Company.
1881–1900 . . .	10,528,095	526,405	Oesterreichisch Alpine-Montan-gesellschaft.
1901–1906 . . .	716,521	952,754	
1907	1,400,000	1,400,000	
		(*b*) *Vordernberger Erzberg.*	
1701–1800 . . .	2,009,204	20,092	...
1801–1900 . . .	7,522,550	75,226	14 works consolidated as to 13 in 1829 and entirely in 1871.
1901–1906 . . .	963,044	160,507	...
1907	200,000	200,000	Since 1890 working taken over by Oesterreichisch Alpine-Montan-gesellschaft.
		Total Production.	
1701–1800 . . .	32,682,417	36,824	...
1801–1900 . . .	22,189,301	221,993	...
1901–1906 . . .	6,679,565	1,113,261	...
1907	1,600,000	1,600,000	...

The inability of the local forests to meet the demand consequent on a large production has, however, led to the practical extinction of the charcoal blast-furnaces, only some four or five being now blowing out of the forty-five at work at the period of the former visit of the Institute, and these are mainly for high-class crucible steel makers' supply. Coke smelting in large modern furnaces was commenced in two furnaces at Klein Schwechat, near

Vienna, but these have been abandoned for some time, the bulk of the ore being smelted either at Donawitz, near Leoben, where there are four furnaces, or at Eisenerz in a single large furnace of about 400 tons daily yield. The coke used is mostly brought from Westphalia, involving a long railway lead through a mountain region liable to interruption by snow in the winter, so that the furnace is provided with a coke store, holding some weeks' supply, which rivals in dimensions the great charcoal stores of the Swedish ironworks.

The accompanying table of production illustrates in a striking manner the productive capacity of the Erzberg and the great augmentation in production since the organisation of the Alpine-Montangesellschaft. Notwithstanding that the activity of the miner continued during nearly 2000 years, the untouched resources of this mighty deposit are so great that it may be relied upon as a source of wealth and active employment for a long future period.

Donawitz Works.

The Donawitz works are described, in an account of the visit of the Iron and Steel Institute, in the *Engineer* of October 25, 1907, in the following words:—Donawitz was originally a puddling forge, making wrought iron from the charcoal pig iron of the numerous small blast-furnaces in the Vordernberg Valley, the site being determined by the facilities for obtaining fuel from the lignite mines in the hills above Leoben, and both puddled iron and steel are still produced to some extent; but since the formation of the present company, by the amalgamation of most of the smaller works, it has been developed by the addition of blast-furnaces and open-hearth steel plant into the largest iron-producing establishment in the Alpine district. At the present time there are four blast-furnaces, of which three are in blast. The two older ones, dating back to the building of the works about thirteen years ago, are of smaller size, with lifts and charging by barrows, making from 250 to 300 tons daily. The newer ones, with inclined lifts and automatic charging arrangements by skips, are larger, the latest being about 100 feet height total, or 88½ feet effective height, 22 feet wide in the boshes, and 14¾ feet in the hearth, and making 400 tons per day. The materials smelted are calcined spathic ore from Erzhey, containing iron, 50·68; manganese, 3·0; phosphorus, 0·025; sulphur, 0·169; silica, 8·19; lime, 6·19; magnesia, 4·14; and alumina, 1·61 per cent.; reheating furnace cinder and scale from the rolling-mills, and a small amount of limestone to flux the ash of the coke, which is brought partly from Moravia and partly from Westphalia, both involving long railway journeys. The furnaces are driven very rapidly, with blast at 53 cm. to 60 cm. of mercury pressure. The coke consumption is about 17 cwt. per ton, and the slag about 16·5 cwt. The furnaces stand on high pedestals of masonry, giving a fall of about 12 feet to the slag, which issues continuously in a thin stream, and falls into a rapid current of water, where it is converted into a coarse sand, which is removed by grab buckets and a ropeway to the slag heap on some level land a short distance up the valley, where it has already annexed a considerable area of the meadow land adjoining the river. The iron made is classified, according to the local custom, into ten numbers, No. 1 being the whitest and No. 10 the greyest, all, however, being low in silicon. The range in composition is:—

Carbon	3·0 to 3·8
Manganese	2·2 to 2·8
Silicon	0·5 to 0·7
Sulphur	0·04 to 0·08
Phosphorus	0·05 to 0·10

A large pig bed with heavy chill moulds is provided for each pair of blast-furnaces, but these are only used for the Sunday iron and the ends of casts, the bulk of the metal going directly to the steelworks. These contain eleven furnaces arranged in a single line; ten of them are open-hearth steel furnaces working 28-ton charges on magnesite bottoms, arranged in two series of five, with a central tilting mixer of 150 tons capacity. This is gas fired, and serves strongly to superheat the blast-furnace metal, which in order to save coke is kept as low in silicon as possible—down to 0·2 per cent.—before charging it into the steel furnaces, the required heat being more cheaply supplied by the local coal than by expensive foreign coke. Scrap, lime, and oxide, the latter obtained by calcining spathic ores in a special range of gas-kilns adjoining the furnaces, are charged by a Lauchhammer low frame electric charging machine on the working side of the furnace, and the liquid cast iron on the tapping side by an overhead travelling crane, which also serves the casting ladle. There is no casting pit, the whole of the furnaces being built above the ground level. The ingot moulds stand upon heavy cast-iron bedplates, and the feeding is done from a raised platform on a side bay near the middle of the shop. The standard 3-ton ingots for the rolling-mills on the spot are cast in open moulds from above, but other sizes and those of 5 tons for plates are filled from the bottom by central or side runners. The steel furnaces are fired with gas from Leoben lignite or tertiary coal of 5000 to 6000 calories heating power made in Kerpely producers. These are of the revolving grate pattern, with central admission for air and steam, with circular stacks about 20 feet high and conical bottoms, which are water-sealed and slowly rotated by screw and worm-wheel gearing making about three revolutions an hour, which brings each part of the grate at intervals to an opening in the outer casing, where a lifter worked by a short stroke quick-moving eccentric lifts the ash and drops it into a pit, whence it is removed by grab buckets and a ropeway to the ash-tip. The fuel is supplied similarly by a mechanical feed from store bunkers at the rate of 20 tons per day for each of the twenty producers, which supply the steel furnaces, the mixer, and the calcining kilns. The coal used for the melting furnaces is 25 per cent. of the weight of the steel produced. The work is done slowly, only two charges—one in each twelve-hour shift—being worked in the day. The rolling-mills, which are mainly intended for making bars of various kinds, are arranged on the modern straight line plan, including a reversing cogging-mill driven by an early form of two-cylinder engine, a heavy rail and joist mill also reversing with a three-cylinder compound engine of about 10,000 horse-power and several smaller three-high mills, which, however, were only seen in the distance. Gas-fired soaking pits are used in the larger mills, and reheating furnaces with electric charging and drawing arrangements in those for the smaller sections. The whole of the furnaces and mills are arranged on one principal line under a roof about 820 feet long, the enclosed space being remarkably well ventilated and lighted. The plate ingots are sent away by railway to Zeltweg, one of the older works, about 35 miles distant, to the south-west, adjoining the Fohnsdorf coalfield, where large modern plate-mills have been recently completed. There are other rolling-mills at Kindberg and Neuberg, the latter being attached to an open-hearth steel plant with five furnaces of 5 to 10 tons capacity. The joint output of all four establishments in steel ingots is 312,000 tons; and that of the rolling-mills 245,000 tons annually.

The Eisenerz Blast-furnace.

The Eisenerz blast-furnace is generally similar in character to the newer ones at Donawitz, but larger, the make ranging from 400 to 450 tons daily.

The calcined ore loaded into 3-ton skip buckets at the kilns passes directly to the furnace top, and the coke in similar buckets, which are painted black, and the former red. The coke, which is mostly brought from Westphalia, is unloaded into a large covered storage bunker of 14,000 tons capacity, a precaution rendered necessary by the possibility of snow blocks on the railways in winter.

From the store the coke is carried by belt travellers to sizing screens connected with weighbridges, which separate the small and broken stuff, and deliver the screened material and weigh it into the charging buckets without further handling, one man looking after each of the travelling belts. The iron made is tapped into chill moulds and is sold to works at a distance.

Witkowitz Ironworks.*

The Witkowitz mines and ironworks comprise the ironworks in Witkowitz, two iron mines in Upper Hungary, hæmatite and magnetic iron-ore mines in Moravia, bog-ore mines in Galicia, and magnetite mines in Northern Sweden. The offices are in Vienna, and branches are to be found in most large towns of the Austro-Hungarian Empire and other countries.

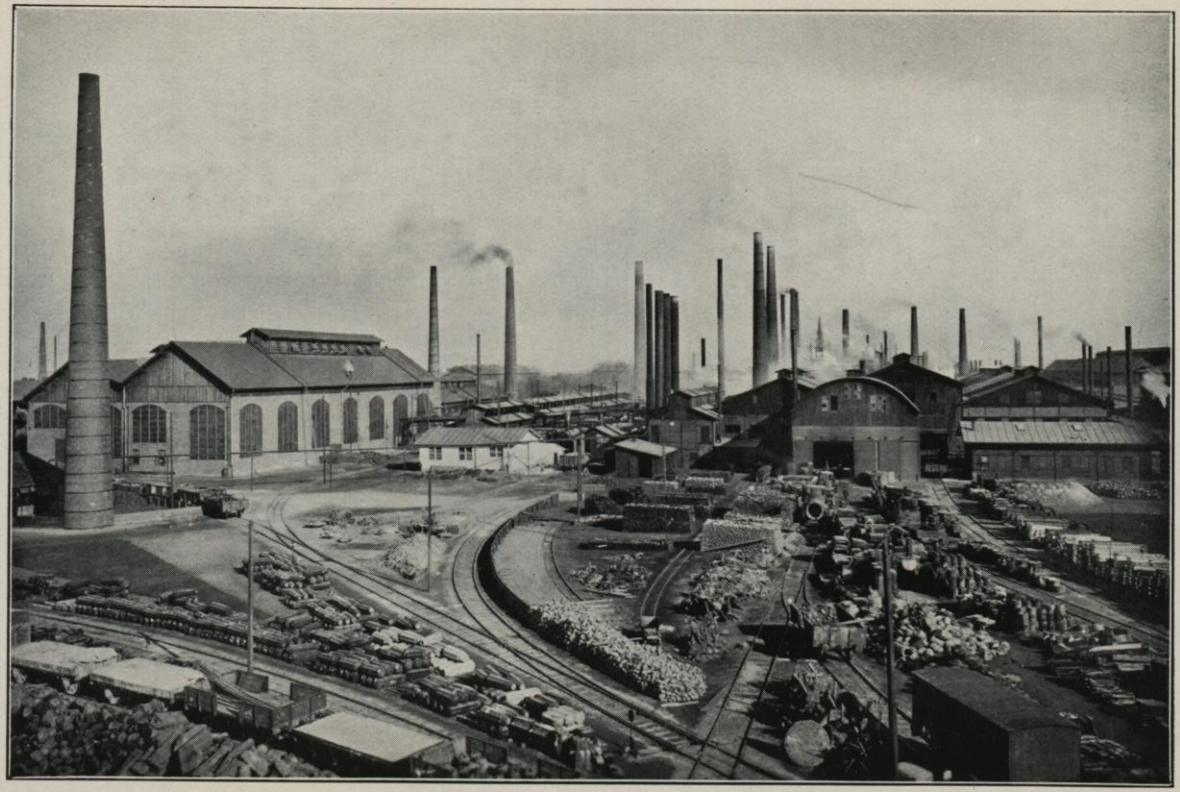
The chief events connected with the development of the works are as follows :—

1829. Foundation of the ironworks by his Imperial Highness Archduke Rudolf, Prince Archbishop of Ólmütz. The first puddling furnaces in Austria worked by English labour.
1831. Installation of the first coke blast-furnace in Austria.
1837. The first rails made in the country for the construction of the Emperor Ferdinand Northern Railway, and the first railway-car wheels with welded tires made in Witkowitz.
1843. The banking firm of S. M. von Rothschild acquire the works, the iron mines, and the coal mines.
1847. The Anselmhütte is built.
1848. The Nordbahn is completed as far as Mähr.-Ostrau.
1850. The first waggon tires are made of flat iron.
1865. The Bessemer process is introduced at Witkowitz.
1871. The first coke blast-furnace of large dimensions is built in Witkowitz.
1873. The ironworks, hitherto the sole property of Messrs. S. M. von Rothschild, pass into the possession of the Witkowitz Gewerkschaft with the firm of Guttmann Brothers.
1876. The rolling-mill is altered and extended.
1878. The first brick hot-blast ovens started in Austria.
1879. Erection of an open-hearth furnace plant.
Lixiviation plant for roasted copper pyrites put down. The first basic charge is blown on the Continent, the metal being poured from the acid converter into a basic coverter.
1880. The rod- and plate-rolling mill of the firm of Schüller, Mähr.-Ostrau, are purchased, as well as the Rudobanya-Telekes iron mines in the Borsod Komitat.
1883. Opening of works for the production of wrought-iron tubes and fittings.
New bridge-building plant put down.
1884. New Bessemer works built.

* This account is reprinted from a pamphlet presented to the members by the company on the occasion of the visit.

1885. The first Otto-Hoffmann coke-ovens for the recovery of by-products are installed.
1887-88. Steel foundry built in Neu-Witkowitz.
1888-89. New boiler works built.
1888. The blast-furnace plant at Sofienhütte in Mähr.-Ostrau, which had been let to the company since 1880, is acquired. The third blast-furnace is erected there.
Bridge-building works extended. Fire-brick works rebuilt.
1889. Five open-hearth furnaces added. The combined steel process introduced.
1890. Building of the forge-hammer and press department and of the finishing shops of the steel foundry.
1893. The manufacture of armour-plates is taken up.
1895. The iron-ore mines of Kotterbach are acquired.
The third blast-furnace is built in Witkowitz.
A three-high rolling-mill is built.
The mines of Baron von Rothschild, situated in the Ostrau, Dombrau, and Petrzkowitz districts, comprising ten shafts and two coke plants, are purchased by the Gewerkschaft.
1896. The manufacture of projectiles is taken up. Slag-brick works are started at Sofienhütte.
1897. Enlargement of the open-hearth furnace plant in the steelworks.
Benzene works built.
A central electric power-station built.
The magnetite mines in Northern Sweden are acquired.
1898. New roll-turning department fitted up.
A 20-ton hammer erected in the hammer department.
1899. Armour-plate works started at the steelworks.
1900. A new coal-washing plant provided.
Another blast-furnace erected at Sofienhütte.
1901. The armour-plate works of the steelworks are extended ; an 8000-ton press is erected. The copper lixiviation plant is rebuilt.
1902. Blast-furnace No. IV. built in Witkowitz. The rolling-mill is enlarged by the addition of an intermediate rolling-train.
The electric power-station is enlarged.
A new 1000-kilowatts generator is installed.
1903. A water-gas welding plant for plate- and sheet-metal is put down.
Projectile works built.
1904. A second central power-station driven by coke-oven gas-engines is built.
1905. Enlargement of the coke works by a battery of forty coke-ovens.
Large size gas-engines for coke and blast-furnace gas are manufactured.
Enlargement of the tube-rolling mill by the addition of an electric welding plant for the production of welded tubes of thin sheet-metal.
Pressed steel department built.
1906. The engine-works, bridge-construction works, boiler-works, and foundry are rebuilt.
Blast-furnace No. V. built in Witkowitz.
Enlargement of the coke-oven plant by forty coke-ovens.
Erection of finishing workshops in the cast-steel works.
A 4000-ton forging-press erected.

The plant at the present time comprises the following departments :—



Cast-steel Foundry at the Witkowitz Works.

PLATE IV

Blast-furnace Works, Sofienhütte and Witkowitz.—Seven blast-furnaces with thirty hot-blast stoves; eight blowing-engines driven by steam, and three blowing-engines driven by gas-motors.

Production of pig iron for puddling, steel-making, the foundry, hæmatite, Bessemer, phosphoric pig iron, iron, hard castings, ferro-manganese, ferro-silicon, and silico-spiegel. The ores and materials smelted are spathic iron ore and brown ironstone from Upper Hungary. Swedish magnetite and apatite, lixiviated copper pyrites, slags, manganese ores from Bosnia, Bukowina, and Hungary, and manganese ores from other countries.

Puddling Works in Mähr.-Ostrau.—Four single puddling furnaces, eight double puddling furnaces, four rotating furnaces, five rotating gas puddling furnaces, six hammers, and twenty steam-engines, with two billet rolling-trains. The material worked is the pig iron from the Sofienhütte for black bar and slab iron, most of which are afterwards turned into finished iron in the rolling-mills at Witkowitz.

Open-hearth Steelworks.—This group of works consists of a plant of five open-hearth furnaces, each of a capacity of 20 tons, in which steel is made by a combined process by means of two converters, each of a capacity of 10½ tons. There is a separate plant of two open-hearth furnaces for ordinary charges of 22 and 33 tons respectively.

Rolling-mills.—The rolling-mills consist of two separate buildings, one of which is equipped for the manufacture of plates for shipbuilding, boilers, and tanks, rails, girders, structural iron, strip for tube making, wire rod, railway sleepers, and armour-plates. This department is fitted with eight rolling-trains. The greatest power-engine develops 4000 effective horse-power. To this rolling-mill are added the finishing workshops, with cold saws, shears, straightening machines, chamfering appliances, circular saws, and a roll turning shop with twenty-three roll turning lathes.

The second rolling-mill produces, in five mills, merchant iron, strip for tube making, rails for mines, and small sections, both of weld iron and of mild steel. The refining of the material is effected in ten revolving regenerative gas-furnaces.

Steel Foundry.—These works comprise one plant of five open-hearth furnaces of a capacity of from 13 to 20 tons, steel moulding and steel foundries, six crucibles, hammer and press department, tire rolling-mills, armour-plate works, with workshops, plate pressing department, shell presses, and a shooting ground, with guns ranging from 4 to 15 centimetres calibre (1·58 to 5·9 inches). A view of the foundry is given in Plate III.

The products of these works are: section steel castings, forgings for engine construction and shipbuilding, open-hearth steel, crucible steel, and special steels of all kinds, axles, tires, locomotive wheels, waggon wheels, cast or forged, ingots for gun-barrels, gun-carriages, projectiles, air-chambers for torpedoes, armour-plates for the navy and for fortifications.

Iron Foundries.—These produce cast pipe for gas and water mains up to 1500 millimetres (59 inches) in diameter, chills, rolls, engine castings, and flywheels of the largest dimensions. The heaviest pieces so far cast have had the following weights: a roll standard, 62,000 kilogrammes; a roll, 45,000 kilogrammes; a chill, 42,000 kilogrammes. There are in operation in this foundry eight cupola furnaces, two reverberatory furnaces, ten moulding machines, and twenty-eight cranes for loads ranging from 1000 to 30,000 kilogrammes.

Engineering Works.—The engineering works turn out machinery for the use of the establishment as well as of the mines situated in the neighbourhood; together with rolling-mill plants, winding-engines, pumping plants, mine fans, blowing-engines for blast-furnaces, coke-oven installations with recovery of the by-products, cranes, forging presses, gaswork plants, railway-

waggon wheels, railway crossings and points, turntables, projectiles, various forgings, bars for escapes, sliding rails for boring operations, large size gas-engines, and compressors of various systems.

The Bridge-building Works supply iron bridges and iron construction of every type. For the execution of the work there are, in addition to the usual machinery, electrically and hydraulically driven riveting machines, electric drills, and six travellers, fitted with electrically worked drills.

The Boiler Shops manufacture boilers of all types, amongst which water-tube boilers, system Dürr, superheaters, preheaters, tanks for water, spirit, crude oils, petroleum, &c., in the very largest dimensions. Apparatus for distillation, vats for breweries, surface coolers; installations for metallurgical works, digesters for cellulose, riveted pipes, gasholders, &c.

The equipment further comprises several electrically driven travellers, pneumatic tools for boring, drilling, riveting, and calking, and other machinery.

The Tube Roll Mills make butt-welded and lap-welded tubes, seamless tubes of mild iron and weld iron for gas mains, water mains, steam pipes, recipients, coils, and fittings.

The Water-Gas Welding Plant supplies tubes and pipes of the largest diameters for high-pressure mains and turbine conduits, all sorts of plate ware, section irons, boilers for stationary and for portable engines, water chambers, &c.

The Electric Welding Department welds thin sheet-metal articles, such as barrels for the transport of petroleum and benzene.

The Central Electric Power Stations are equipped with four direct-current generators of a normal capacity of 2452 kilowatts. The second electric power station is worked by coke-oven gas-engines. There are installed, for the present, two direct-current generators of a normal capacity of 820 kilowatts. In course of building there are two more continuous-current generators, together of 2000 kilowatts. Sixty-four dynamos have been installed in the various departments, aggregating 8653 horse-power. The power and light wires have a length of 27,357 metres, and there are connected with this network 612 arc lamps, 3174 incandescent lamps, and 599 electric motors.

The telephone service comprises one exchange and forty-five secondary offices, together with ten multiple and 119 single telephone stations with communication amounting to a length of 28,560 metres.

The Coal Screening and Washing Department and Coke Plant are fitted with 281 coke-ovens, all of which are specially constructed for the recovery of the by-products (ammonia, benzene, and tar).

The Copper Lixiviation Plant extracts in the course of a year about 700,000 metric cwts. of roasted copper pyrites.

The Limekilns and Circular Brick Kilns produce annually about six million machine-made bricks for the use of the establishment.

The Fire-brick Works turn out all sorts of fireproof materials, particularly complete linings for blast-furnaces, hot-air ovens, coke-ovens, open-hearth furnaces, puddling and welding furnaces. About one-half of the output of these works is utilised in the establishment.

Gasworks.—The consumption of illuminating gas amounted in the year 1906 to 3,136,450 cubic metres, about twice as much as the neighbouring provincial capital of Troppau required.

The central copying and drawing offices are fitted with the most modern electrical appliances. There are also three testing departments equipped with five machines for conducting tensile tests for maximum loads ranging from 10 to 80 tons, two machines for bending tests, one machine for fall tests, one for loads of 90 tons, one for compression tests, one for ball-

pressure (Brinell) tests, for pressure of 50,000 kilogrammes. The number of tests completed in the year 1906 amounted to 134,000, and this number comprised 61,900 breaking tests and 52,300 bending tests. In the year 1906, 97,000 tests and analyses were made in the chemical laboratory.

Railways in the Works.—Communication between the different departments of the works, and connection with the stations of Mähr.-Ostrau and Schönbrunn on the Nordbahn are facilitated by normal gauge tracks, 88 kilometres (55 miles) in length, on which are run for the use of the works seventeen standard gauge engines, 630 goods waggons, and nineteen passenger carriages. The weights of materials carried on the standard gauge track in the year 1906 total up to 40,145,000 metric cwts.

There are in addition 60 kilometres (37 miles) of narrow gauge track, on which are run twenty-three locomotives and 1046 waggons. To these tracks there are 340 points and crossings of standard gauge and 350 of narrow gauge. The bridges of this railway system have a total length of 1880 metres (5570 feet), and of these 1360 metres are built of iron. There are nine weigh-bridges, each of a capacity of about 30 to 40 tons.

The 411 steam-engines which have been installed in the ironworks aggregate 41,000 horse-power. The four gas-engines total 4000 horse-power. The steam boilers, both stationary and portable, which are 300 in number, have a total heating surface of 28,400 square metres (nearly 306,000 square feet). Of the 505·4 hectares (1250 acres) covered by the works, 750,000 square metres (over 8,000,000 square feet) are under roofs.

The fire brigade has now 150 members on its roll, and is equipped with the most modern appliances. There are 160 hydrants in the works, and 140 in the colonies. There are also fourteen electric fire-alarms in the works, and the brigade can, moreover, at any time of the day or night, be called up from 175 telephone stations. The ironworks are further provided with a complete fire-service train, running on the narrow gauge track and consisting of a locomotive, six water tanks, and one waggon fitted with illuminating appliances.

Benevolent Institutions.—The pension institute for the staff, established 1897, has 240 members on its roll, and the funds had, by the end of 1906, accumulated to 2,995,608 kronen. The pension institute II. for the staff and employees, established in 1899, numbered 325 members. The funds amounted, at the end of 1906, to 1,444,263 kronen. The Gewerkschaft contributes towards both these funds to the same extent as the members do, and the Gewerkschaft has, moreover, made donations amounting to 1,060,000 kronen to both these funds. There are stipends for the sons of members of the staff, foremen, and men. Scholarships are granted to the staff and supervisors located on the mines.

The Provident Institute provides workmen with aid from the sick fund after a service period of even one year and a half, in case of total disablement or in case of death. In the latter instance the children can claim contributions towards their education, and the money paid in by the parents is repaid to the children. This fund amounted, at the end of 1906, to 10,800,500 kronen.

There is a fund of 300,000 kronen, the interest from which serves for the assistance of workmen who have done long and good service, and who have become incapable for further work, and a second fund of 300,000 kronen, the interest from which goes towards the support of the families of those married or widowed men who are summoned for military service, and who have been in the employment of the company for at least three years. A third fund of 300,000 kronen is likewise available for the support of men who have become disabled after long and faithful service. In addition to these aids, the directors make a monthly allowance to men who have served

for forty years. There is also a sick fund, and all the men belong to the Government Accident Insurance Association. The Gewerkschaft alone bears the expense of these two institutions, and had in the year 1906 to pay the sum of 922,254 kronen.

Orphanage.—In commemoration of the fiftieth anniversary of the reign of his Imperial Majesty, the Gewerkschaft built an orphanage for fifty boys and fifty girls, at an expenditure of 140,000 kronen, and the costs of the maintenance of this orphanage, which amount to about 42,000 kronen, are met by the interest from two donations made by the Gewerkschaft, amounting to 920,000 kronen. The buildings were extended in the year 1905, so that at the present time seventy-five girls can be accommodated in the orphanage.

Hospital with three pavilions, fifteen wards, and altogether 130 beds. There are, further, separate waiting-rooms and consultation-rooms for out-door patients, adapted to the different nature of the cases.

There is a hospital for infectious diseases with four wards and twenty-six beds, and a home for convalescents with twenty-six beds. These institutions are under the care of the following medical and administrative staff: One physician in chief, five physicians in ordinary, two specialists, and seven district physicians. The staff comprises, further, four clerks, twenty sisters, seven attendants, six nurses, three porters, and one housemaster.

Schools.—There is one German boys' school, and one German girls' middle-class school; and three German boys' primary schools, and two German girls' primary schools, with a staff of thirty-three masters, thirty-three mistresses, for 1680 boys and 1548 girls. One Bohemian boys' school and one Bohemian girls' school, both primary schools, with eleven teachers and 550 children; and ten kindergarten, with twenty-five mistresses for 950 children. There is also a German industrial training school for the education of supervisors, with five teachers for sixty-five pupils, and a general industrial training school for apprentices, with thirteen masters and 559 pupils.

The members of the staff, the foremen, and men employed in the works are domiciled in 176 buildings with 301 flats, for members of the staff and masters; 951 family dwellings for married men; 4773 cubicles in twenty-one barracks for single men and for those married men who do not live on the works; eighty-eight cubicles in forty-four rooms for men who wish to live singly or two together. The Gewerkschaft also keeps a home for little children, a supply association, several baths, steam laundry (electrically driven), stores, five soup-kitchens, and an hotel for the works. The consumption in the soup-kitchens for the year 1906 was the following: 252,168 kilogrammes of meat; 23,583 kilogrammes of sausage; 642,213 pairs of small sausages; 50,991 liver sausages; 6716 hectolitres (14,800 gallons) of beer; 19,313 litres (4230 gallons) of wine; 213,591 bottles of soda-water and lemonade; 480,442 litres (106,000 gallons) of coffee (black and white); 7985 litres (1760 gallons) of tea extract; 190,935 loaves of brown bread, and 404,986 loaves of white bread (rolls).

Of the estates owned by the Gewerkschaft, ninety-eight hectares (242 acres) are let to men at a low rent. The works employed in the year 1906 a staff of 750 members and 15,182 men. The wages drawn by the men in that year summed up to 17,000,000 kronen.

The Iron-Ore Mines.—1. The iron mines at Rudobanya produced in the year 1906, with a complement of 1056 men, an output of ores amounting to 3,760,000 metric cwts.

2. The 650 men of the iron mines at Kotterbach produced, in 1906, of spathic ores 1,390,000 metric cwts.; and, further, of mercury, 454 metric cwts.

3. The Koskuskulle iron mines near Gellivare, in Northern Sweden, produced, in 1906, of magnetite, 1,650,000 metric cwts.

Number of men employed at the ironworks, 15,182; wages, 17,000,000 kronen.

Number of men employed in the mines at Rudobanya, 1056; wages, 970,000 kronen.

Number of men employed in the mines at Kotterbach, 650; wages, 600,000 kronen.

Number of men employed in the mines at Koskuskulle, 135; wages, 140,000 kronen.

Total number of men employed by the Gewerkschaft, 17,023; total paid in wages, 18,700,000 kronen.

The Witkowitz Collieries and Coke Plants in the Ostrau-Karwin District.—These departments are under a separate administration, which has its seat in Mähr.-Ostrau. The employés are—staff, 93; supervisors, 383; men, 9475.

	1903.	1904.	1905.	1906.
Coal output	15,933,024	16,735,095	18,158,444	20,063,000
Coke production—				
Mines	2,967,087	3,765,403	3,852,756	5,078,000
Ironworks	1,755,668	1,767,642	1,912,744	2,080,000
Total coke production . .	4,722,755	5,533,045	5,765,500	7,158,000
Ammonium sulphate—				
Mines	36,776	42,202	43,409	53,544
Ironworks	20,568	19,010	20,201	20,820
	2,182	2,770	2,980	3,944
Total	59,526	63,982	66,590	78,308
Tar and pitch—				
Mines	111,807	125,985	134,368	174,470
Ironworks	66,445	64,990	67,636	69,660
Total	178,252	190,975	202,004	44,130

Note.—The totals represent metric hundredweights of 100 kilogrammes (0·1 ton).

Chief Products: (1) *Pig Iron* (for foundries).—Pig iron Nos. I., II., III., hard cast iron, white and grey, cylinder cast iron, and hæmatite chill iron, and pig iron, for puddling and open-hearth processes, for puddling and steel-making, and iron alloys, spiegel, ferro-silicon, ferro-chromium, ferro-manganese, and silico-spiegel.

(2) *Iron Castings.*—Sand castings, loam castings of all sizes up to the very heaviest pieces in most careful, neat finish (ornamental castings excluded). Castings of highly refractory iron. Pipes for gas mains, water mains, and steam mains, up to 1500 millimetres (59 inches) internal diameter. Stills, spherical and conical vessels for distillation, retorts, smelting-pans for

Outputs of the Witkowitz Ironworks—Metric Hundredweights of 100 *Kilogrammes.*

Products.	Year.											
	1848.	1855.	1865.	1875.	1885.	1895.	1900.	1902.	1903.	1904.	1905.	1906.
Pig iron for the foundry, puddling, and steel-works, and iron alloys	48,418	57,869	66,786	198,330	1,371,328	2,100,000	2,554,645	2,569,400	2,443,632	2,805,974	3,180,885	3,269,064
Steel ingots	...	...	...	71,995	342,297	1,260,000	1,578,000	1,547,377	1,473,432	1,791,103	2,072,849	2,099,378
Puddle bar (black bar) .	75,429	123,976	108,385	49,293	444,795	403,000	403,711	422,647	323,724	321,521	374,565	401,098
Rolled iron and steel .	50,997	132,904	105,845	102,567	589,196	1,012,000	1,360,118	1,348,072	1,269,519	1,477,247	1,796,353	1,841,633
Steel products: section castings (axles, tires, forgings, armour-plates), including those used at works	...	...	...	...	35,193	98,559	194,261	164,681	125,182	175,896	175,410	258,171
Rolled and drawn forged wrought-iron tubes and fittings	...	...	...	...	44,824	88,000	135,012	116,095	129,834	154,502	161,507	189,590
Iron castings, including own use	6,667	10,265	10,943	23,316	107,756	197,000	233,260	159,139	204,164	233,258	222,837	274,432
Output of the engine-works	...	...	....	19,220	77,939	107,000	145,098	149,785	106,360	122,758	205,941	215,161
Bridge and boiler works and forges	6,873	29,750	42,099	11,075	40,485	57,000	70,741	76,573	79,076	103,599	124,567	128,676
Fire-bricks, including own use	9,731	11,053	13,195	19,030	82,699	240,000	366,521	270,422	190,100	335,810	405,055	428,478
Coke in Witkowitz coke-ovens	...	...	...	...	783,459	1,084,000	1,588,270	1,678,174	1,755,668	1,767,642	1,912,744	2,079,637
Ammonia	...	...	...	...	...	3,267	4,545	5,663	5,741	5,543	5,850	6,198
Copper	...	...	...	...	1,514	2,994	3,275	2,770	2,926	3,383	5,552	5,621
Tar and pitch — coke and gasworks	...	...	...	...	...	44,583	55,026	62,370	66,445	64,990	67,636	69,656
Benzene	...	...	...	...	...	...	12,695	18,074	16,580	17,215	18,796	17,212
Mercury	...	...	...	...	...	...	333·5	445·4	452	474	404	455

chemical works, pans, quenching-tanks. Parts of machinery and other castings, such as require either highly close-grained or very tough materials, or both qualities combined. Cylinders, plungers, cross-heads, slides, brake-blocks, rolls for rolling-mills of all types.

(3) *Chilled Castings.*—Rolls of the most diverse kinds and sizes, smooth and grooved, rough-finished and polished, plates for pug mills, pits for presses, &c.

(4) *Steel Castings* of open-hearth and crucible steel, castings of any construction and size, of any required hardness and toughness, clean and homogeneous.

(5) *Machinery.*—Engine frames, parts of valve gear, cross-heads, eccentrics, cranks, links, bearings, and pedestals, dynamo casings, pole shoes, &c. Propellers, helms, anchors, stems, and stern-posts. Locomotive and tender wheels of mild iron, section castings, rolls, &c. Casts and forged nickel steel in all shapes.

(6) *Sections* of all qualities of open-hearth iron and steel as well as of weld iron. Slabs in all degrees of hardness. Wire rod, black bar, billets in all degrees of hardness. Strips for tube making in all widths. Materials for seamless tubes and hollow projectiles. Rods, sections, flats and universal iron and steel. Girders up to 500 millimetres (20 inches), web maximum, U iron, and all descriptions of structural iron. Rails for railways and mines, grooved and channelled, together with fish-plates. Sleepers for standard and narrow gauge tracks. Sheet-metal, thickness from 2 millimetres (0·08 inch) upward, in all qualities. Corrugated sheets. Ball-proof shields of nickel steel. Nickel steel boiler-plates for locomotive fire-boxes. Nickel steel for drills and for engine shafting.

(7) *Forgings* in open-hearth steel, nickel steel, and special steels, such as engine and propeller shafts of the largest dimensions.

(8) *Materials for the Army and Navy* for coastal defence, fortifications, and warships, armour-plates, armoured turrets, armour-sheets, gun-barrels, projectiles, gun-carriages, torpedo air-chambers, torpedo tubes, &c.

(9) *Crucible and Open-Hearth Steel Ingots* in all shapes, qualities, and dimensions.

(10) *Steam Boilers.*—Large-capacity boilers of all kinds, combined styles, such as Tischbein-Fairbairn, Meunier boilers, and water-tube boilers of the Dürr type.

Tanks for water, petroleum, spirit.

Stills, brewery pans, surface coolers, metallurgical installations, cellulose digesters, riveted conduits for turbines, air and steam pipes; plate ware of all types, gasholders in all sizes.

(11) *Bridge Construction* of all types—factories and other buildings. Elevators—railway halls; railway and tramway bridges; caissons for bridge pillars, &c.

(12) *Railway Plant.*—Cast-steel wheels of the most varied descriptions, finished wheel couples, winding cages, transport cars, steel frogs and crossings for points and switches, frogs and other parts for the points and crossings of all systems of tramways, turntables, traversers, axles of special steels and nickel steel, tires for locomotives and waggons, forged and cast waggon wheels, complete plant for electric railways, tip cars, trucks, &c., for mine railways, water-supply plants.

(13) *Pipes* of mild steel, wrought iron, weld iron (butt- and lap-welded), as well as seamless tubes. Steel sleeves with jute jackets, cylinders for liquefied gases, radiators for waggons, coils for all purposes, pipes for boring operations, heaters for steam boilers; pipes for steam, water, and gas conduits; fittings, and forged tube-masts for electric lighting and power plants, &c.

(14) *Sheet-metal Ware* welded by means of water-gas evaporating pans, galvanising tanks, steam domes with welded-in bottoms, boilers for fire-engines, welded locomotive boilers, retorts, air-chambers, frames of any size and thickness, &c., and sheet-metal ware electrically welded, such as casks and barrels for petroleum, spirit, benzene, &c.

(15) *Pressed Steel.*—Parts of locomotive boilers, as door plates, back plates, tube plates, throat plates, parts of marine boilers, front plates, smoke-boxes, deflectors, &c. Flanged branches, dome jackets, &c.

(16) Pressed steel of all types, such as gun-carriages, parts for ammunition-cars, parts for waggons, frames, &c., pressed by machinery, flat and egg-ended boiler bottoms, special bottoms.

(17) *Installations for Mines.*—Winding-engines, pit-head gears, cages, pumping-engines, compressors, fans, trucks, &c.

(18) *Metallurgical Installations.*—Blowing-engines for blast-furnaces, large size gas-engines, rolling trains and machinery for the same.

(19) *Coke Works Installations*, with or without recovery of by-products, crushers, coke ejectors, entire coke-oven plants, and (20) *Installations for Gasworks.*

(21) *Refractory Materials.*—Fire-bricks for boiler settings ; hot-blast ovens ; coke, gas, weld, and annealing furnaces ; bricks for the shafts and hearths of blast-furnaces ; Dinas bricks for cupolas ; Bessemer converters ; open-hearth furnaces ; acid-proof bricks, &c.

On the occasion of the visit of the Iron and Steel Institute to the Witkowitz works, the visitors were first taken to the hammer shop, where they witnessed the forging of steel wheel blanks for rail waggons. Subsequently they saw the forging of a shaft of an Austrian war-ship in the 2000-ton press situated at the extremity of the shop. An interesting feature was the two cooling pits for armour-plates in close proximity to the presses. The party subsequently proceeded to the open-hearth steel furnace department, which contains six basic open-hearth furnaces of a capacity of 20 tons each. These furnaces have hitherto been worked on the duplex process associated with the name of the works, but this has not proved economically satisfactory, and as it is somewhat cumbersome, it is understood that it will shortly be abandoned to be superseded by the plan, now in general favour, of putting down a large mixer and using it in order to regularise the position of the molten metal obtained from the blast-furnaces. The management have concluded arrangements for the adoption of the Talbot Continuous Steel Process, and are about to build a 200-ton furnace and a new steel plant. Some of the open-hearth furnaces at present in operation are charged by means of an electric charger, the heats averaging eight hours from the time of charging to the time of tapping. In the remaining furnaces metal which has been previously decarburised and desiliconised in the Bessemer converters adjoining is charged and worked in the ordinary way. In addition to the foregoing plant there is a second building containing two larger furnaces of 22 tons and 33 tons respectively. The furnaces are all employing the basic process. In close proximity to the range of furnaces is a pot furnace of special design containing sixty holes for the manufacture of ordinary grades of crucible steel. The shops where the manufacture of pressed steel is carried out are exceedingly extensive. After having seen several shapes pressed under the large presses at work in this department, the members visited the steel foundry, which is situated at the rear of the six basic open-hearth furnaces previously described, and it is extensively furnished with electric cranes and travellers for the purpose of handling the materials and the castings. A machine rammer on the principle of an electric riveter is employed for chipping down moulds and ramming casings. The machine

shop in which the heavy lathes are situated was the next department shown, after which the armour-plate and armour annealing departments were visited. A halt having been made for refreshments, the party proceeded to view the rolling-mills. These are housed in two large buildings, one equipped for the rolling of plates for boilers, tanks, and shipbuilding purposes, and the other for merchant mills and strip for tube making. Adjoining the strip mill is an installation of elliptical winding reels for strip on the Witkowitz patent. The plate mill consists of eight trains of rolls, the merchant and bar mill having but five trains. For reheating blooms, billets, and slabs employed in these two mills, gas-fired rotating regenerative furnaces are employed. The travelling and lifting tables, by means of which the front pair of rolls are fed, present some ingenious modifications. In the armour-plate mill the visitors witnessed the rolling of an armour-plate. The mill is of the reversing type. After rolling a plate the table rises bodily together with its full complement of live rails and roller gear, and in doing so tilts the plate over to the next section of the live roller gear, which rises simultaneously at an angle to receive it. The plate is thus turned completely over, and the distribution of the heat can be better regulated. After inspecting the adjoining departments, the members proceeded to the blast-furnaces.

The two largest furnaces are 80 feet high, the diameter at the throat and at the hearth being 14 feet, and at the boshes 20 feet; fourteen tuyeres are provided. The production of each of the furnaces amounts roughly to 400 tons in twenty-four hours, but, should occasion arise, the output can be increased to 450 tons. There are five smaller furnaces, thirty hot-blast stoves, eight steam blowing-engines, together with three gas blowing-engines. Much of the coal used is coked at the works, where there are two batteries aggregating 550 Otto coke-ovens with by-product recovery plant. These ovens are charged and discharged by electrical machines. There are two powerful Deutz gas-engines of 1500 horse-power each, two of 1300 horse-power, and two of 600 horse-power, with two dynamos, while the electrical equipment consists of two central power-stations.

The Trzynietz Ironworks.*

The Trzynietz Ironworks comprises the following departments:—One coal-washing, coke, and ammonium recovery plant; three blast-furnaces, one agglomerating plant, two grey cast-iron foundries, one steelworks with steel foundry, one forge, one puddling works, five rolling-mills, one fitting shop, one electric central station with boilers, one fire-brick works, one brickworks, two limekilns, one chemical laboratory with testing apparatus.

Output of the Works in 1906.

	Metric Cwts.		Metric Cwts.
Coke	434,058	Girders	92,519
Tar	17,840	Sleepers	1,939
Ammonium sulphate	6,141	Plates	103,848
Foundry pig iron	105,036	Small section iron	18,923
Open-hearth pig iron	359,165	Merchant bars, sections, light rails, and wire	195,171
Forge pig iron	376,413	Heavy rails	46,170
Open-hearth steel ingots	712,000	Points and crossings	14,800
Open-hearth steel castings	7,950	Fire-bricks	48,302
Forgings	8,850	Burnt lime	17,241
Slabs and bars	146,384	Building bricks	895,170
Standard rails	98,240		

* This account is reprinted from a pamphlet presented to the members by the company on the occasion of the visit.

The staff at the end of 1906 consisted of 2932 persons, made up as follows: Engineering staff, 17; chemists, 4; counting-house, 58; foremen, 36; overseers, 45; workmen, 2772.

Coal-washing, Coke, and Ammonium Plant.—The coke required for the blast-furnaces is produced in three batteries, each of thirty coke-ovens, on the Otto-Hoffmann regenerating system, the coal being coked after being washed. Each coke-oven contains 58 metric cwts. of stamped washed coal; the average duration of burning is thirty-eight hours. From the by-products of the gases of the coke-ovens ammonium sulphate and tar are recovered in the recovery works. In addition to the Trzynietz coke-ovens, the company own three batteries of thirty Otto ovens, with under-firing, at the Hohenegger shaft.

Blast-furnaces.—The plant consists of three blast-furnaces, one of which is out of blast. Forge, open-hearth, and foundry pig iron are produced. The average daily production is 1500 cwts. white iron per blast-furnace. The ore employed is principally roasted spathic ore from the company's mines in Hungary. In addition, South-Russian red hæmatite, Bosnian hæmatite, burnt pyrites, Galician brown iron ore, and slag are used. The blast is heated by Cowper stoves. The blast is furnished by two horizontal steam piston blowing-engines of 21,895 cubic feet capacity per minute; a turbo blowing-engine by the Brünner Maschinenfabrik, which delivers 18,364 cubic feet of air at a pressure of 0·63 atmosphere, is used as a reserve. The turbo blowing-engine develops 780 effective horse-power at 3000 revolutions per minute. A Bleichert suspended electric mono-rail will be shortly started for conveying the ore to the furnace top. The surplus blast-furnace gases are utilised for generating the necessary steam for the central electrical generating station.

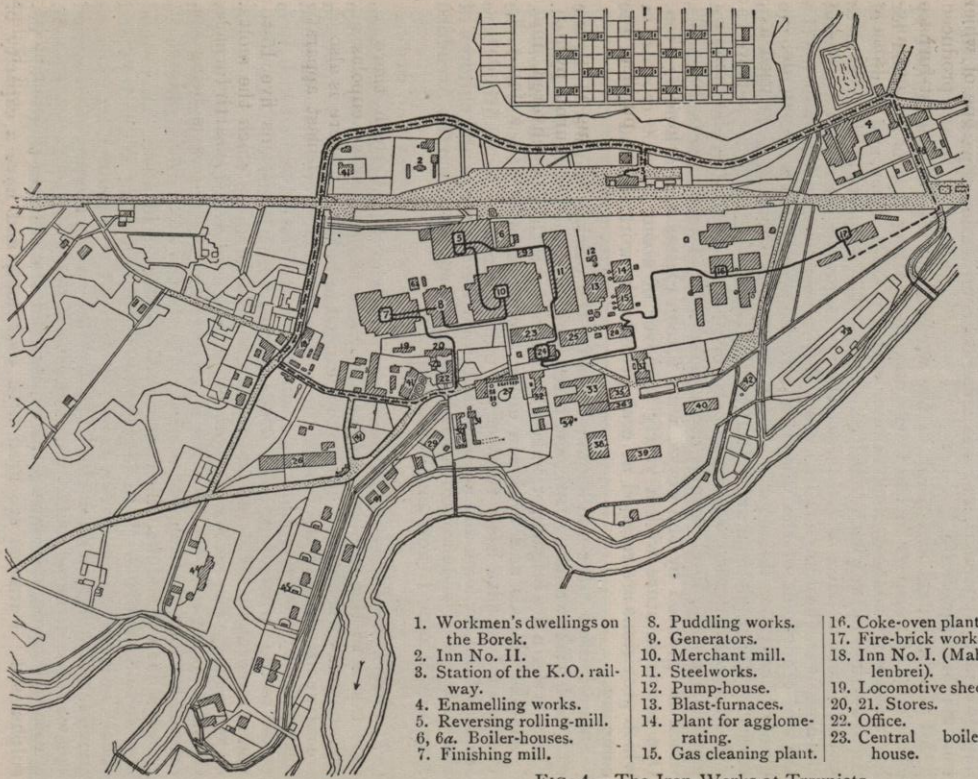
All the furnace gases, including those for the boilers, are purified in a Zschocke gas purifying plant.

Agglomerating Plant.—A rotary furnace with coal-dust firing is utilised for the agglomeration and desulphurisation of ore-dust (burnt pyrites). The dried coal is finely ground in a ball-mill, and is delivered under pressure into the furnace through a nozzle by means of a fan. The furnace has an output of 80 to 100 tons of agglomerates per twenty-four hours.

Iron Foundries.—The iron foundries produce general commercial, structural, and machine castings, chilled castings, rolls, &c. There is a heavy foundry for large castings and a light foundry for light and thin castings, which are mostly moulded on moulding machines, of which there are twenty hydraulic and five hand moulding machines. Five cupolas and eight cranes from 3 to 15 tons capacity are employed; there is also the necessary plant for the preparation of sand, and a sand-blast apparatus for cleaning castings.

Steelworks and Steel Foundry.—The old steelworks contains five 15-ton basic open-hearth furnaces and two 7-ton converters, in which the molten iron direct from the blast-furnace is prepared for the open-hearth furnaces. A new steelworks with four 30-ton open-hearth furnaces is being constructed. A 4-ton acid open-hearth furnace is also employed for the production of steel castings.

The small motors are driven by three-phase current of 320 volts. A phase regulator of 1500 kilowatts-volts-amperes, 500 revolutions per minute, 3100 volts is placed in the circuit. The necessary steam for the central station, steam-hammers, steelworks, blast-furnaces, &c., is generated by the surplus blast-furnace gases in two adjoining boiler-houses, containing seventeen two-flued Lancashire boilers, four Tischbein boilers,



1. Workmen's dwellings on the Borek.
2. Inn No. II.
3. Station of the K.O. railway.
4. Enamelling works.
5. Reversing rolling-mill.
6, 6*a*. Boiler-houses.
7. Finishing mill.
8. Puddling works.
9. Generators.
10. Merchant mill.
11. Steelworks.
12. Pump-house.
13. Blast-furnaces.
14. Plant for agglomerating.
15. Gas cleaning plant.
16. Coke-oven plant.
17. Fire-brick works.
18. Inn No. I. (Mahlenbrei).
19. Locomotive shed.
20, 21. Stores.
22. Office.
23. Central boiler-house.
24. Turbo-dynamos.
25. Blast-furnace boilers.
26. New blowing-engine house.
27. Generator plant.
28. Mechanical workshop.
29. Laboratory.
30. Hot and cold bath.
31. Lime stamp mill.
32. Dwelling-house.
33. Small foundry.
34. Coke shed.
35. Locksmith's workshop.
36. Store.
37. Office No. II.
38. Chilled roll foundry.
39. Store.
40. Pattern-shop.
41. Dwelling-house for officers.
42. Pump-house.
43. Blank's carbonisation.
44. Hospital.
45. Dwelling-houses for officers.
46. School.

FIG. 4.—The Iron Works at Trzynietz.

one Willmann boiler, and two economisers ; the Lancashire and Tischbein boilers being provided with superheaters to 300° C.

The Fire-brick Works manufacture the fire-bricks used in the works. They contain a continuous gas kiln, various crushing and mixing machines, presses and lifts. The brickworks and limekilns produce hand-made and machine-made bricks and burnt lime for the requirements of the works, with one Hoffmann continuous kiln and two shaft limekilns.

Chemical and Testing Laboratory.—The chemical laboratory deals with the chemical and physical testing of all raw materials employed, and of the finished products, and analyses the gases, &c. The testing laboratory for tensile, bending, compression, and impact testing, &c., contains a 70-ton tensile testing machine, one bending machine for 50 tons maximum, one impact testing apparatus, and one spherical compression apparatus with 50 tons maximum pressure.

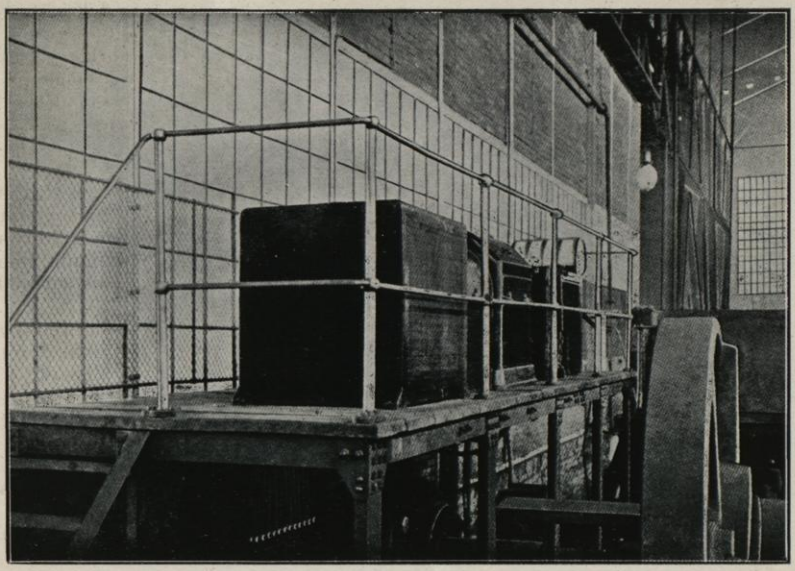
All the buildings and plant in the works (see Fig. 4) are lighted by electricity. Transport in the works and on the slag tips is provided for by 14 miles of standard-gauge railway with five locomotives, and 3½ miles of narrow-gauge railway with four locomotives. The property of the Trzynietz works covers an area of 870 acres; the works proper occupy 89 acres, and the area of the buildings is 19 acres. Fields, meadows, and gardens for the use and enjoyment of the workmen cover an area of 765 acres. There are ninety houses for officials, 455 houses for workmen and their families ; in addition, 475 single men are lodged in thirteen houses.

Benevolent Institutions.—There are also one hospital with forty-nine beds, a home for nurses, kitchen, and other buildings. Two elementary schools, which are granted by the works, with fifteen classes and a kindergarten. One provision store with a yearly turnover of about 200,000 crowns, in which provisions are retailed at cost price to the workmen and staff of the company.

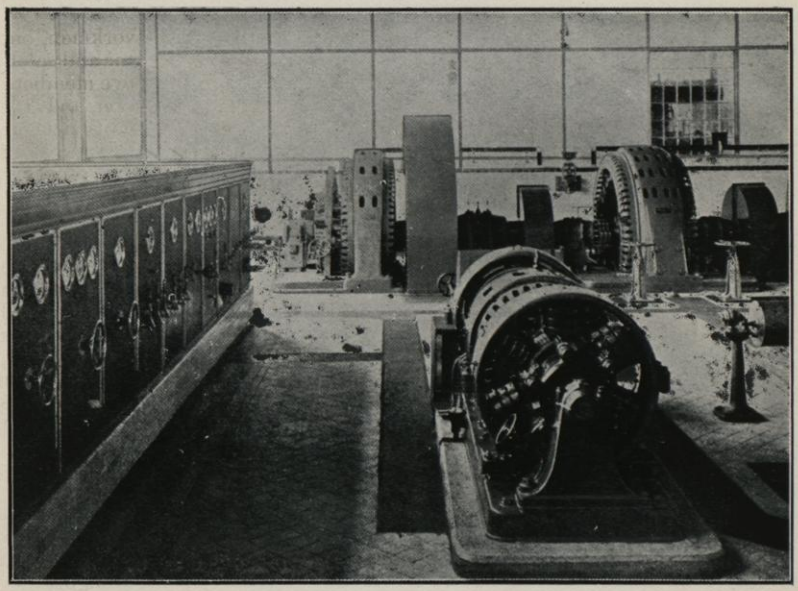
Steam-heated baths and shower-baths for the officials and workmen, one cold bath with swimming bath, and three inns with nine bedrooms and salon. There is also a fire brigade, organised by the works, with ninety-five members.

All the officials and workmen enjoy the right of a pension, and the Provident Institute has a fund of 5·3 million crowns. In addition there is a sick fund for men, and a family sick fund for the wives and children of the workmen. Needy workmen receive help and support from the Archduke Friedrich Mining Benevolent Fund.

The members of the Iron and Steel Institute who visited these works were first taken to the coke-ovens, where they saw the ingenious rope-haulage installation by means of which coke is carried in buckets from the ovens in a continuous series to the foot of the inclined hoists. Here it is detached automatically from the main rope, and passes to the cable, by which it is raised to the furnace top. The whole of this plant is driven electrically, and is remarkably compact and effective, besides requiring very little labour or attention. The coke-oven plant of the Trzynietz works consists of three Otto-Hoffmann coke-ovens of the regenerative type. The capacity of each oven is 5·8 tons of steam and washed coal. In the ore-yards visitors were shown a heap of nodules which attracted considerable interest. They would appear to be similar to those described at the July meeting of the Iron and Steel Institute in 1906 by Mr. A. Ladd Colby, but are produced by a process peculiar to the Trzynietz works. The details by which the process is carried out were not divulged, but it was understood that the nodules are made in a rotary furnace, and during the process the ore becomes thoroughly de-sulphurised. Furnaces are fired with coal dust, and have a capacity of



Rolling-mill Motor at Trzynietz.



Operating Platform at Trzynietz.

80 to 100 metric tons per twenty-four hours. At the time of the visit of the Institute only two of the three blast-furnaces at these works were in blast. The daily make of pig iron is 150 tons per furnace. The ore used is a roasted, spathic ore from the company's mines in Hungary, mixed with South Russian hæmatite and brown ore from Galicia. The blast-furnace engine-house contains two steam blowing-engines and a turbo-engine, the capacities of which are given in the foregoing description. The older portions of the steelworks contains five 15-ton basic open-hearth furnaces and two 7-ton converters; but the new steelworks, which is in course of erection, when completed will contain four 30-ton basic open-hearth furnaces. The externally complete and ingenious installation of overhead travellers and cranes which have been installed in the new steelworks attracted much attention. It was, however, in the new mill, which made the subject of the paper by Mr. D. Selby-Bigge at the May meeting, that the chief attraction lay, inasmuch as the mill in question is the first electric reversing rolling-mill ever built. It consists of four stands of rolls, 29½ inches diameter. Standard rails, girders up to 17¾ inches high, sleepers, bars, and slabs are produced. The electric drive consists of a flywheel converter (Ilgner system) which transforms the high-tension alternating current of 3100 volts from the central station to 1000 volts continuous current. There are also three continuous-current motors, directly coupled to the reversing rolling-mill, which take current from the transformer and conduct it to the rolling-mill. The converter consists of an alternate-current motor of 3100 volts and 2500 horse-power, 50 cycles per second and a maximum speed of 375 revolutions per minute. Each end of the shaft of the converter is coupled to the continuous-current dynamos. On the shafts of the continuous-current dynamos there are two cast-steel flywheels, 13 feet in diameter, and weighing 26 tons each. The continuous-current dynamos have a maximum output of 1000 volts at 8000 amperes, which is directly taken up by the three driving motors. These three motors have a maximum speed of 130 revolutions per minute.

The maximum output of the three driving motors is theoretically about 11,000 horse-power. For the speed control and constant current of the 2500 horse-power motor a regulator operated by two three-phase motors excited by the 2500 horse-power motor is employed. The running of these motors is remarkably steady and free from vibration.

The reversing mill is equipped with the necessary live rolls, pulley-blocks, and travelling crane for changing the rolls; the output is about 180 tons of rolled material in twelve hours, direct from ingots 16½ inches by 17¾ inches square. The ingots are heated in two rotary reheating furnaces, and are drawn by a hydraulic discharger. The usual weight of the ingots is 1·8 tons. The mill is also equipped with the necessary straightening, milling, and drilling machines, and hot and cold saws.

The roughing-mill consists of a three-high mill with four sets of housings, with rolls 22 inches diameter, and produces principally flat bars, light rails, and girders. In the light rail mill the drive is effected by two three-phase motors, each of 750 horse-power, at a tension of 3100 volts. Rolling is always done with only one motor, according to the speed required. One motor has a standard speed of 210, the other of 167 revolutions per minute. Intermediate speeds can be obtained by means of the regulator. The ingots, 7¾ inches by 10 inches square, and weighing from 4 cwts. to 10 cwts., are heated in three rotary furnaces, and are presented to the rolls large end first. The power is transmitted from the shaft of the motor to the rolling-mill by hemp ropes. Straightening, milling, drilling, and shearing machines are employed.

The finishing-mill contains two electric rolling-mills for producing merchant bar, wire rods, &c., an intermediate mill and a finishing-mill. Driving is effected by two three-phase motors on one shaft with each rolling-train; each motor has a capacity of 750 horse-power, 3100 volts, and 50 cycles per second. One motor only is at work at a time, and the other runs light. Power is transmitted from the shaft of the motor in the finishing-mill by square hemp ropes, and in the intermediate mill by hair belts. Four reheating furnaces are employed for heating the material.

Acknowledgments.

In the preparation of this report free use has been made of the information kindly supplied by the Reception Committee, as well as of the detailed accounts published in the *Ironmonger*, vol. cxxi., October 5, special number; in the *Iron and Coal Trades Review*, vol. lxxv., September 27, special number; and in *Page's Weekly*, vol. ii. pp. 575–578, 629–630, 676–680, 736–738. These three journals published portraits and biographies of the members of the executive Reception Committee and of the authors of the papers read at the meeting. Full reports were also published in the *Engineer*, vol. civ. Nos. 2701, 2702, 2703, 2704; *Engineering*, vol. lxxxiv. Nos. 2178, 2179; the *Contract Journal*, vol. lvii. Nos. 1478, 1479, 1480, 1481; the *Times Engineering Supplement*, Nos. 135, 136; the *Iron and Steel Trades Journal*, vol. lxxxi. Nos. 2520–2522; the *Zeitschrift des Oesterreichischen Ingenieur- und Architecten-Vereines*, vol. lix. No. 40; the *Oesterreichische Zeitschrift für Berg- und Hüttenwesen*, vol. lv. No. 44; in *Stahl und Eisen*, vol. xxvii. Nos. 40, 42, 43; and in other technical journals.